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Review of evidence for identified seabird aggregations

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Summary

As part of the process of identifying potential Marine Protected Areas, Kober *et al* (2010, 2012) undertook a detailed analysis of seabird data collected during surveys within the British Fishery Limit and stored within the European Seabirds At Sea (ESAS) database. These analyses identified 42 key seabird aggregations around the coast of the UK. The aim of this report is to review some of the important areas identified in light of other independent information, in order to give the most robust and complete evidence-base possible (given current knowledge) on which to base any future decisions about these areas.

We consider a subset of 25 of the 42 aggregations identified by Kober *et al* (2010, 2012), which cover both breeding and wintering aggregations as well as two multi-species assemblages. The 25 areas are a shortlist of areas considered by the Statutory Nature Conservation Bodies for designation as marine SPAs for seabirds (note: this list might not contain all areas under consideration, nor will all of these areas necessarily become SPAs in the future). We carry out a detailed review of both peer-reviewed and grey literature in order to obtain independent data that may support, or otherwise question, the aggregations identified in Kober *et al* (2010, 2012). The information obtained was put through a scoring system to aid the assessment of the strength of the independent evidence available for each of the aggregations, though these scores should be interpreted with caution and never without reference to the written review for each area, which provides a more complete assessment of the evidence.

To provide additional information, we explore raw data provided by RSPB from the “FAME” project, which has tracked seabirds during the breeding season from various colonies around the UK, in order to assess the use of the aggregations by birds from nearby breeding colonies and explore anecdotal information such as seawatching counts presented in local bird reports (for coastal sites). We investigate a range of environmental datasets to determine whether there are ecological explanations for the aggregation (such as suitable habitat, proximity to known breeding colonies, or high abundance of prey species in the area). We also consulted a wide variety of experts through a questionnaire survey, with the aim of obtaining any unpublished data regarding the areas and species under consideration, though ultimately this consultation did not provide any relevant information that was not already published or otherwise available to us.

The quantity and quality of information available for each of the aggregations was highly variable. For some of the areas there was strong independent evidence for the presence of an aggregation of the size estimated by Kober *et al* (2010, 2012), while for others there were no additional data for the site and species in question, though most were between these two extremes, with weak or moderate evidence to suggest the area was important for the species, but not necessarily confirming the size of the aggregation. Some studies had surveyed the relevant areas but did not support the presence of an aggregation. Even in cases with limited data availability, there were often strong ecological reasons to suggest the areas identified by Kober *et al* (2010, 2012) were likely to be of importance to seabirds. Where limited information was available, this reflected areas or regions in which the species in question is currently under-researched. In the future, further marine bird surveys, broad scale tracking projects such as the RSPB FAME project (once data have been fully analysed and published), or more detailed local tracking studies may fill many of these gaps in knowledge.

Contents

1 Introduction

The UK hosts internationally important populations of seabirds (Mitchell *et al* 2004) with more than seven million breeding individuals thought to use the UK's coastline (JNCC 2012). As a member of the EU, the UK is bound by international law to identify important sites for seabirds and designate them for protection. In 2009, the European Parliament and the Council adopted Directive 2009/147/EC on the conservation of wild birds (a codified version of the 'Birds Directive' 79/409/EEC as amended). Member States of the EU are required to identify and classify the most suitable territories for the conservation of rare and vulnerable species (listed in Annex I) and migratory bird species. These areas, Special Protection Areas (SPAs), aim to be the most suitable territory for these species in each Member State regardless of whether they occur on land or sea.

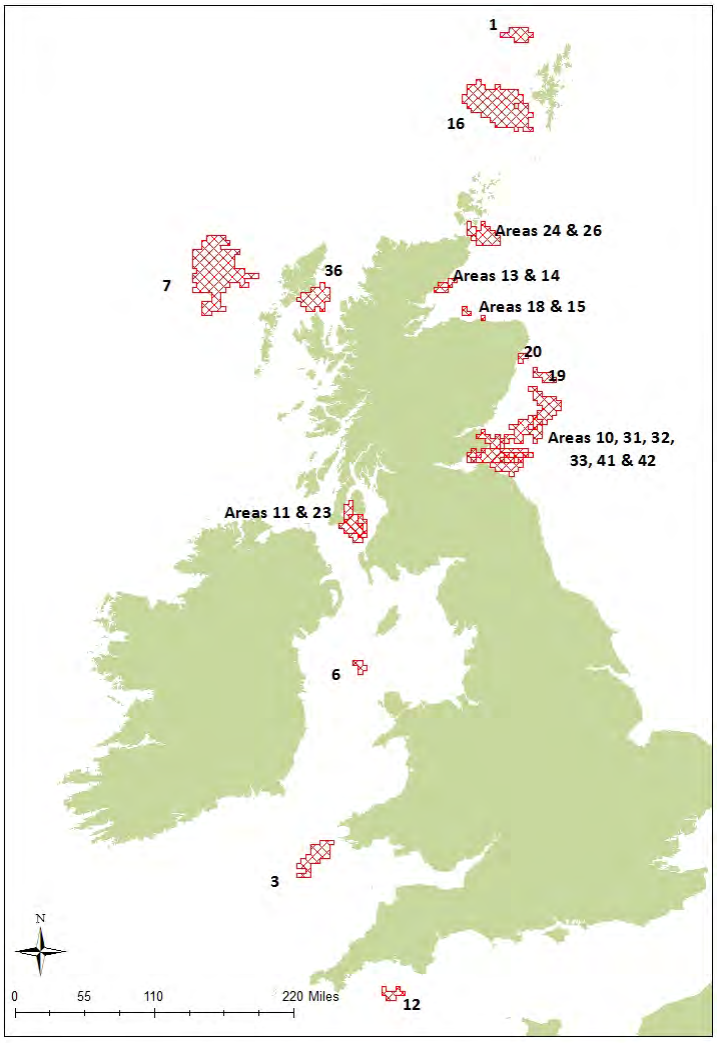
Through programmes like the Seabird Monitoring Programme (SMP) (JNCC 2012) there is already a good understanding of the requirements on land and many of the breeding colony sites are already protected as SPAs (Stroud *et al* 2001). However, important seabird areas away from colonies are also a key part of the conservation of these species. Despite recent advances in tracking technologies (Wilson & Vandenabeele 2012) and aerial survey techniques (Thaxter *et al* 2009), relatively little is known about the inshore and offshore areas used by true seabirds, for feeding and other activities, throughout the year. To identify marine SPAs, further evidence is required in order to advise the government on continued SPA selection.

Recently, data collated in the European Seabirds at Sea (ESAS) database were analysed to identify and delineate seabird aggregations within the British Fishery Limit that might qualify as SPAs (Figure 1, Kober *et al* 2012). From this, 42 areas have been identified as areas of importance for eleven seabird species (northern fulmar, Manx shearwater, northern gannet, European shag, great skua, black-legged kittiwake, common gull, herring gull, Arctic tern, common guillemot, and Atlantic puffin) in both the breeding and the non-breeding seasons.

The ESAS database is the most comprehensive and longest running data-set for the distribution of seabirds at sea in north-west European waters (Pollock & Barton 2006). However, data were collected from vessels of opportunity, and therefore survey effort varied over time (between years and seasonally) and between regions, such that there are some gaps in coverage (Kober *et al* 2012). Through the continued development of the offshore renewables industry (requiring offshore bird surveys), and the large number of seabird tracking studies that have been conducted in recent years, there is now a wealth of additional information available to assess the identification of important seabird areas. However none of this information is available at a UK-wide scale, rendering it inappropriate for identifying the most suitable territories across UK waters. Reviewing this information and combining it with evidence from analysis of the ESAS database (Kober *et al* 2012) will however allow us to ensure that any area identified as important across UK waters from the analysis of ESAS data takes account of all available evidence and is used by the appropriate species beyond the period of ESAS data collection analysed by Kober *et al* (2010, 2012). This not only provides a recent usage argument, but in conjunction with the ESAS analysis will strengthen the regularity of use argument and allow marine SPA selection to be based on the best evidence currently available. We focus on 25 of the areas identified in Kober *et al* (2010 & 2012) (Figure 1) selected following ongoing consultations between JNCC and statutory nature conservation bodies.

The specific aim of this project is to a carry out a detailed review of the additional evidence available regarding the aggregations identified by Kober *et al* (2010, 2012). The resulting information will be collated for each aggregation and the quality and consistency of the evidence presented will be assessed. We will also consider whether there is a sound

ecological rationale behind the identification of each aggregation by evaluating the available data regarding habitat suitability and food availability in the area. It is important to note that the aim of this work was not to provide an assessment of whether the 25 identified areas constitute the most suitable areas for the species in question, but simply to assess whether other studies provide evidence for or against the use of each of the 25 areas by the species and numbers of birds suggested by Kober *et al* (2010, 2012). We therefore focussed only on studies that covered the areas in question.



Area ID	Target Species
1	northern fulmar, breeding
3	Manx shearwater, breeding
6	Manx shearwater, breeding
7	northern gannet, breeding
10	northern gannet, breeding
11	northern gannet, breeding
12	northern gannet, winter
13	European shag, breeding
14	European shag, winter
15	European shag, winter
16	great skua, breeding
18	black-legged kittiwake, breeding
19	black-legged kittiwake, breeding
20	black-legged kittiwake, breeding
21	black-legged kittiwake, breeding
23	herring gull, breeding
24	Arctic tern, breeding
26	common guillemot, breeding
31	common guillemot, winter
32	common guillemot, winter
33	Atlantic puffin, breeding
36	Atlantic puffin, breeding
40	Atlantic puffin, winter
41	seabird assemblage, breeding
42	seabird assemblage, summer

Figure 1. Seabird aggregations identified in Kober *et al* (2010, 2012) for which additional, corroborative evidence was sought as part of this study.

2 Methodology

The BTO reviewed the evidence available regarding 25 of the 42 seabird aggregations (Figure 1) that have been identified by Kober *et al* (2010, 2012) – these 25 areas being a shortlist of areas considered by the Statutory Nature Conservation Bodies for designation as marine SPAs for seabirds (note: this list might not contain all areas under consideration, nor will all of these areas necessarily become SPAs in the future). The 25 shortlisted aggregations cover 10 seabird species and 2 areas selected for their "seabird assemblage" as well as both winter and breeding season populations. The review process included a comprehensive search of peer-reviewed and grey literature as well as engagement with known experts through a questionnaire. Several environmental datasets provided further supplementary evidence to the review process by offering possible ecological explanations for seabird distributions. Investigating potential ecological explanations for seabird distribution may strengthen confidence in our assessment of whether or not the hotspots identified by Kober *et al* (2010, 2012) accurately reflect areas of importance to seabirds.

An assessment of strength of the evidence collated and also whether or not the evidence consistently supports the identification of each aggregation as a seabird "hotspot" was carried out. We detail how different data sources were obtained below, before describing how a two-step process was used to assess and summarise the evidence presented for each aggregation.

For each of the sources identified, an initial screening process was used to judge whether the data presented reflected the season and area covered by the aggregation. Only data collected during the relevant period of the year (i.e. overlapping with the relevant period identified for each aggregation in Kober *et al* (2010, 2012)) were taken forward. In order to determine whether the source covered the spatial area of the aggregation identified in Kober *et al* (2010, 2012) a variety of approaches were used, as follows:

- Where a source contains geographic coordinates or a shapefile was available, this was overlaid with the area of the aggregation using GIS to determine whether there is overlap, for example between key foraging areas or areas of high densities and the aggregation in question.
- Where maps were presented in reports or papers but shapefiles/coordinates were not available, the map was overlaid as an image (jpeg) in GIS, using geographical features to match to key points in the GIS. However this must be interpreted with caution as maps may have different projections which will not be apparent when comparing an image in this way. In some cases, where maps clearly had odd projections, it was not possible to overlay and match a jpeg in GIS and therefore judgement had to be made by eye as to whether the areas overlapped.
- In other circumstances, there was sufficient spatial reference information provided in the text to determine whether there is any evidence for the aggregation (for example information about the foraging range of individuals, or distance/direction of key foraging areas, from a particular colony).

For sources that reflect the season and area covered by the aggregation, the strength of the evidence presented was assessed using a detailed process to score each study against a range of criteria, and then combine the scores for all studies contributing to the evidence base for each seabird aggregation. This process also investigated the consistency of the evidence by taking account of studies that had covered the season and area in question but had not found evidence for the aggregation (section 2.5).

Where a source did not contain spatially referenced information (for example, a notable count obtained from a summary of sea-watching within a county bird report), this is reported

within Appendix 1, and may be used to provide additional background to inform conclusions, but it is not taken through the assessment process.

2.1 Peer-reviewed literature

Google Scholar, Scopus and Web of Science were used to identify studies which have either; (1) reported the distribution of birds at sea or; (2) have used tracking devices to look at ranging behaviour or migration of individual birds.

An extensive number of terms were used in combination with both the common and scientific name of the bird species of interest (for example see Table 1). These were as follows: fulmar OR *Fulmarus glacialis*; Manx shearwater OR *Puffinus puffinus*; gannet OR *Morus bassanus* OR *Sula bassana*; shag OR *Phalacrocorax aristotelis*; great skua OR *Stercorarius skua* OR *Catharacta skua*; kittiwake OR *Rissa tridactyla*; herring gull OR *Larus argentatus*; Arctic tern OR *Sterna paradisaea*; guillemot OR *Uria aalge;* and puffin OR *Fratercula arctica*.

Table 1. Example search terms used for identifying peer-reviewed literature for northern fulmar.

Species name		"Distribution at sea" search terms (one at a time)		"Tracking studies" search terms(one at time)
e.g. fulmar OR Fulmarus glacialis	+	Distrib* Location* Spatial Area Patterns Hotspots Survey Boat Ship Aerial Transect	OR	Forag* Rang* Distance Feeding Tracking Geolocat* Satellite GPS Tag

* Is used to indicate that the search term used can be used to pick up all words which start with the phrase.

2.2 Grey literature

The majority of relevant grey literature came from sources such as county bird reports, Environmental Impact Assessments (EIAs) for Offshore Wind Farms and other industry reports. For this reason a structured search, as described above was not considered to be appropriate. Instead, we focused on EIAs for developments, such as wind farms, neighbouring, or overlapping, with each of the 25 aggregations (Figure 2) and county bird reports from areas neighbouring each of the aggregations. We also considered individual species monographs (i.e. Brooke 1990; Nelson 2002) and the recently published Birds of Scotland (Forrester *et al* 2007). For a list of potential grey literature sources identified, see Table 2.

Figure 2. Spatial relationships between proposed offshore wind farms (purple) and seabird aggregations of interest (red).

Table 2. Grey literature sources for each of the 25 seabird aggregations under consideration. Note that for proposed offshore wind farms where the Environmental Statement has not yet been published, there was, in some cases, still useful survey data in preliminary reports, such as Zone Appraisal and Planning (ZAP) reports. In addition to the sources listed here, Birds of Scotland (Forrester & Andrews 2007) was referred to for all Scottish sites.

Area ID	Possible OWF EIAs	Possible County Bird Reports	Other
1			SOTEAG Monitoring Report Fisher, J. (1984) The Fulmar, Collins, London.
3		Pembrokeshire Bird Report	Brooke, M. (1990) The Manx Shearwater, T & AD Poyser, London.
6	Irish Sea	MarineLife Survey Reports	Brooke, M. (1990) The Manx Shearwater, T & AD Poyser, London.
7		Outer Hebrides Bird Report	Nelson, B. (2002) The Atlantic Gannet, Fenix, Great Yarmouth.
10	Firth of Forth Inch Cape Neart na Gaoithe	Lothian Bird Report Fife Bird Report Angus and Dundee Bird Report Isle of May Observatory Bird Report	Nelson, B. (2002) The Atlantic Gannet, Fenix, Great Yarmouth.
11		Argyll Bird Report Arran Bird Report	Nelson, B. (2002) The Atlantic Gannet, Fenix, Great Yarmouth.
12			Nelson, B. (2002) The Atlantic Gannet, Fenix, Great Yarmouth.
13	Beatrice Moray Firth	North East Scotland Bird Club Highland Bird Report MarineLife Survey Report	Nelson, B. (2006) Pelicans, Cormorants and their relatives. OUP, Oxford.

Area ID	Possible OWF EIAs	Possible County Bird Reports	Other
14	Beatrice Moray Firth	North East Scotland Bird Club Highland Bird Report	Nelson, B. (2006) Pelicans, Cormorants and their relatives. OUP, Oxford.
15	Beatrice Moray Firth	North Sea Bird Club North East Scotland Bird Club	Nelson, B. (2006) Pelicans, Cormorants and their relatives. OUP, Oxford.
16			SOTEAG Monitoring Report Furness, R. (1987) Skuas, T & AD Poyser, Calton.
18	Beatrice Moray Firth	North Sea Bird Club North East Scotland Bird Club	Coulson, J. (2011). The Kittiwake, T & AD Poyser, London.
19		North Sea Bird Club North East Scotland Bird Club	Coulson, J. (2011). The Kittiwake, T & AD Poyser, London.
20		North Sea Bird Club North East Scotland Bird Club	Coulson, J. (2011). The Kittiwake, T & AD Poyser, London.
21	Firth of Forth Inch Cape Neart na Gaoithe	Lothian Bird Report Fife Bird Report Angus and Dundee Bird Report Isle of May Observatory Bird Report	Coulson, J. (2011). The Kittiwake, T & AD Poyser, London.
23		Argyll Bird Report Ayrshire Bird Report Ayrshire Bird Report	
24		Highland Bird Report Orkney Bird Report	Cabot, D. & Nisbet, I. (2013) Terns, New Naturalist, 123, Collins, London.
26		Highland Bird Report Orkney Bird Report	Gaston, A. J. & Jones, I. L. (1998) The Auks, OUP, Oxford. Nettleship, D. N. & Birkhead, T. (1985) The Atlantic *Alcidae*, Academic Press, London.
31	Firth of Forth Inch Cape Neart na Gaoithe	Lothian Bird Report Fife Bird Report Angus and Dundee Bird Report Isle of May Observatory Bird Report	Gaston, A. J. & Jones, I. L. (1998) The Auks, OUP, Oxford. Nettleship, D. N. & Birkhead, T. (1985) The Atlantic *Alcidae*, Academic Press, London.
32	Firth of Forth Inch Cape Neart na Gaoithe	Lothian Bird Report Fife Bird Report Angus and Dundee Bird Report Isle of May Observatory Bird Report	Gaston, A. J. & Jones, I. L. (1998) The Auks, OUP, Oxford. Nettleship, D. N. & Birkhead, T. (1985) The Atlantic *Alcidae*, Academic Press, London.

Area ID	Possible OWF EIAs	Possible County Bird Reports	Other
33		Lothian Bird Report Fife Bird Report Angus and Dundee Bird Report	Gaston, A. J. & Jones, I. L. (1998) The Auks, OUP, Oxford. Nettleship, D. N. & Birkhead, T. (1985) The Atlantic *Alcidae*, Academic Press, London. Harris, M. P., Wanless, S., Brockie, K. (2011) The Puffin, T & AD Poyser, London.
36		Outer Hebrides Bird Report	Gaston, A. J. & Jones, I. L. (1998) The Auks, OUP, Oxford. Nettleship, D. N. & Birkhead, T. (1985) The Atlantic *Alcidae*, Academic Press, London. Harris, M. P., Wanless, S., Brockie, K. (2011) The Puffin, T & AD Poyser, London.
40		North Sea Bird Club	Gaston, A. J. & Jones, I. L. (1998) The Auks, OUP, Oxford. Nettleship, D. N. & Birkhead, T. (1985) The Atlantic *Alcidae*, Academic Press, London. Harris, M. P., Wanless, S., Brockie, K. (2011) The Puffin, T & AD Poyser, London.
41	Firth of Forth Inch Cape Neart na Gaoithe	Lothian Bird Report Fife Bird Report Angus and Dundee Bird Report Isle of May Observatory Bird Report	Cabot, D. & Nisbet, I. (2013) Terns, New Naturalist, 123, Collins, London. Coulson, J. (2011). The Kittiwake, TA&D Poyser, London. Fisher, J. (1984) The Fulmar, Collins, London. Furness, R. (1987) Skuas, T & AD Poyser, Calton. Gaston, A. J. & Jones, I. L. (1998) The Auks, OUP, Oxford. Harris, M. P., Wanless, S., Brockie, K. (2011) The Puffin, T & AD Poyser, London. Nelson, B. (2002) The Atlantic Gannet, Fenix, Great Yarmouth. Nettleship, D. N. & Birkhead, T. (1985) The Atlantic *Alcidae*, Academic Press, London.

Area ID	Possible OWF EIAs	Possible County Bird Reports	Other
42	Firth of Forth Inch Cape Neart na Gaoithe	Lothian Bird Report Fife Bird Report Angus and Dundee Bird Report Isle of May Observatory Bird Report	Cabot, D. & Nisbet, I. (2013) Terns, New Naturalist, 123, Collins, London. Coulson, J. (2011). The Kittiwake, T & AD Poyser, London. Fisher, J. (1984) The Fulmar, Collins, London. Furness, R. (1987) Skuas, T & AD Poyser, Calton. Gaston, A. J. & Jones, I. L. (1998) The Auks, OUP, Oxford. Harris, M. P., Wanless, S., Brockie, K. (2011) The Puffin, T & AD Poyser, London. Nelson, B. (2002) The Atlantic Gannet, Fenix, Great Yarmouth. Nettleship, D. N. & Birkhead, T. (1985) The Atlantic *Alcidae*, Academic Press, London.

2.3 Tracking data from the RSPB FAME project

The RSPB supplied tracking data from their FAME project for use in this work, as GIS shapefiles of raw track data. As these data had not yet been subject to the same degree of analysis or scrutiny as published tracking information, it was not possible to put them through the same scoring system as peer-reviewed and grey literature. However they can add to our understanding of the importance of the hotspots identified by Kober *et al* (2010, 2012), for example by providing links between hotspots and specific breeding colonies. These data, like all tracking data, were treated with caution with respect to how representative they are of the population (e.g. when only limited numbers of individuals from only a subset of colonies in the area were tracked).

2.4 Expert knowledge

The BTO, in consultation with JNCC, identified experts, from a broad range of backgrounds, including researchers, wardens, country agency ornithologists and ecotourism operators, who were approached about their knowledge of areas of importance for seabirds (Appendix 2). These experts may have detailed (though in some cases anecdotal) knowledge of the areas concerned, which may be more up to date than that presented in either the peer-reviewed or grey literature. Each expert was sent a questionnaire (Appendix 3), the content of which was agreed with JNCC. The questionnaire included a map of the region concerned but did not display the aggregations that have been identified. As well as maintaining the confidentiality associated with the aggregations, this had the additional benefit of being less likely to bias responses towards areas which were identified as being of importance to seabirds in Kober *et al* (2010, 2012).

Respondents were asked to identify which areas they collect data from in order to determine whether their data will be able to contribute evidence regarding the aggregations identified.

Respondents were also asked to determine which areas on the supplied maps are of importance to which seabird species and during which seasons, as well as describing the basis for their assessment (i.e. survey methods). The aim of this process was to access

information, which may not have been published elsewhere, from experts who have detailed knowledge of the areas concerned.
Completed questionnaires are shown in Appendix 4. The resulting data were interpreted with caution, given the potential for biases, such as ecotourism operators overestimating the importance of areas they visit regularly or presenting a biased opinion due to a vested interest in sites. However, the inclusion of experts from such a broad range of industries was thought to be important given gaps in coverage by surveys and scientific research, though in the end, the information supplied in the questionnaires did not add any useful additional evidence (other than highlighting published information) for the areas in question and therefore was not used in the assessments. Of the 68 individuals or organisations we contacted (appendix 2), we received eight completed questionnaires and responses from an additional seven indicating that they were unable to offer any useful information. Of the eight completed questionnaires we received, only two indicated significant overlap between the survey area and seabird aggregations and the data from these surveys were considered elsewhere, either through review of published literature or the tracking data from the RSPB FAME project.

2.5 Ecological Explanations

In order to strengthen confidence in the identification of each aggregation, it is useful to understand why it is important to the birds. Data presented in Kober *et al* (2010, 2012) refer to boat surveys and the analyses did not differentiate between foraging, other behaviours, and commuting birds (i.e. birds that are simply passing through the area). For this reason, it is unclear whether the identified aggregations relate to foraging hotspots, important roosting or loafing aggregations, areas with large numbers of commuting birds, or reflect a different aspect of seabirds' behaviour. To understand why an aggregation might be of importance for the birds, a number of environmental datasets were investigated for their potential relevance. For each dataset, where possible we provide a map showing the overlap between the 25 aggregations of interest and the key environmental variables (Appendix 5). It was not possible to provide a map in this report for some of the datasets due to copyright issues, but these were still used to investigate potential ecological reasons for the aggregations. Assessment of how seabird aggregation locations potentially relate to environmental datasets was based on our interpretation of these maps and knowledge of seabird ecology gained both from the literature review and from our existing knowledge.

2.5.1 Bathymetry

(https://www.bodc.ac.uk/data/online_delivery/gebco/, and additional data supplied by JNCC)
Bathymetry may affect seabird foraging behaviour as it may determine how accessible prey species are to different seabirds. This is likely to be determined by the foraging behaviour of the species concerned, for example, species like European shag, which feed on the sea-floor, may be more constrained than those that feed on the surface like black-legged kittiwake, or those that feed in the water column, like northern gannet. (Wanless *et al* 1991, 1993; Brierley & Fernandes 2001; Scott *et al* 2010). Changes in bathymetry may also have an important effect on bird distributions, for example the continental shelf edge often supports high densities of prey species, and so may be an important foraging area.

2.5.2 Seabird Breeding Colony Location

(http://jncc.defra.gov.uk/smp/)

Several of the aggregations are located around seabird breeding colonies. Seabirds are central place foragers during the breeding season, and are therefore constrained to marine areas that are within a reasonable foraging range of the colony. We focus on seabird

breeding colony data collected as part of Seabird 2000, as this represents the most consistent data available describing colony location and size, and for each breeding season aggregation we consider the number of breeding colonies within foraging range for the species in question, with foraging ranges taken from Thaxter *et al* (2012). This allows us to estimate the number of breeding birds that are potentially able to make use of each area, giving a good indication of whether the numbers of birds determined as using the areas by Kober *et al* (2010, 2012) are probable.

2.5.3 Probability of Thermal Fronts

(http://portal.oceannet.org/search/full/catalogue/dassh.ac.uk__MEDIN_2.3__MB010200002F000002.xml)
Areas with a high probability of thermal fronts occurring provide areas of predictable resources for seabirds and are therefore likely to be used consistently from year to year. In the Irish Sea, several species, including the Manx shearwater have been shown to congregate around thermal fronts (Begg & Reid 1997). Fronts are zones of high productivity which therefore provide a predictable source of prey for birds at relatively high abundance (Hunt 1991; Weimerskirch 2007; Pettex *et al* 2010).

2.5.4 Location of reefs and submarine structures

Reefs and other submarine structures may provide valuable habitat for the prey species of many seabirds, for example cold-water reefs have been shown to have much higher abundance of most fish species than the surrounding seabed (Costello *et al* 2005), which will be important for piscivorous birds. This may be particularly important for pursuit divers, like the European shag and auks that often feed close to the seabed (Burger & Simpson 1986; Wanless *et al* 1993).

2.5.5 Location of sandbanks

Sandbanks at an appropriate depth and with appropriate sediment and grain size are a key habitat for sandeel populations (Holland *et al* 2005), an important prey species for many seabirds such as kittiwakes, terns and auks (Furness & Tasker 2000).Where an aggregation coincides with a sandbank, it may indicate a key foraging area for the birds concerned (Wanless *et al* 1998).

2.5.6 Tracking data from the RSPB FAME project

The data used in the identification of the hotspots are useful for highlighting areas of high seabird density, but they provide no information about the origins of birds recorded by ESAS. Tracking data may help to make links between the hotspots identified by Kober *et al* (2010, 2012) and seabird breeding colonies, providing an additional ecological explanation for the presence of aggregations. The main dataset used for this purpose was the FAME data supplied by RSPB as GIS shapefiles of raw track data. As these data had not been subject to the same degree of analysis or scrutiny as tracking information published in peer-reviewed journals, it was not possible (within the time constraints of this work) to use them to make detailed conclusions about the relative importance of particular areas, but they could be used to provide links between the hotspots identified by Kober *et al* (2010, 2012) and specific breeding colonies. These data, like all tracking data, were treated with caution with respect to how representative they are of the population (e.g. when only limited numbers of individuals from only a subset of colonies in the area were tracked).

2.6 Assessing and summarising the evidence for each seabird aggregation

A two-step scoring system was used to guide our assessment of the strength of the evidence available around each seabird aggregation, based on a range of criteria. The scores were tabulated in excel spreadsheets that are presented as an electronic appendix to the final report (Appendix 6). This was done to ensure that the decision making process underpinning our conclusions was fully transparent.

Step 1 of the process scored each individual evidence source (i.e. peer-reviewed paper, grey literature report or expert opinion), to assess the strength of the evidence it presents, taking into account the suitability of the study for assessing the distribution of the species in question in the area in question, and a range of other factors. In step 2, the evidence from all sources relevant to the seabird aggregation area in question was combined, to provide an overall score for the strength of the evidence regarding the identification of that particular area as a potential marine SPA.

2.6.1 Step 1

Each evidence source was represented in one row of the spreadsheet and scored against a range of criteria in various columns (Table 3). The first column of the spreadsheet provided a reference to the paper or report in question (Table 3; column 1), and details of the hotspot for which it provides evidence (Table 3; columns 2-4). We also describe the type of data presented by the source (i.e. density/population estimates or count data) and the platform used to collect these data (i.e. aerial survey, tagging) (Table 3; Column 5).We scored each source from one to five against four different criteria to assess the strength of the evidence it provides, as detailed below:

(1) *How recent are the data presented?* (Table 3; Columns 6–7). Aggregations identified based on recent data increase the confidence in their current presence.
To assess this, we determined the age of the most recent data contributing to the evidence source (i.e., where two years of data have been collected, we considered the second year of data collection). We scored this on a five point scale as follows:

Most recent data collected during 2013 (</=1 year old)	= 5
Most recent data collected between 2011 and 2012 (<3 years old)	= 4
Most recent data collected between 2009 and 2010 (<5 years old)	= 3
Most recent data collected between 2004 and 2008 (<10 years old)	= 2
Most recent data collected in 2003 or earlier (>10 years old)	= 1

(2) *How many years of data contribute to the evidence?* (Table 3; columns 8-9). It is important to ensure that the evidence is not overly influenced by single surveys in which seabirds could be responding to unusual conditions, or rare events.

To assess this we considered how many years' data contribute to the evidence. In scoring this category, we took account of the fact that the majority of studies will incorporate only a limited range of years. However, in order to ensure comparability with other categories we scored this on the same five point scale as follows:

Data collected over a single year/season	= 1
Data collected over two years/seasons	= 3
Data collected over three, or more, years/seasons	= 5

(3) *Has an appropriate methodology been followed?* (Table 3; columns 10-11). It was important to ensure that the methodologies used to collect the data were appropriate for assessing at-sea bird distributions, and that the conclusions drawn are supported by the evidence presented. Survey methodology was used as an initial filter so that a study cannot gain a high score through advanced analysis of data that have been collected in an inappropriate fashion for assessing at-sea bird distributions. It is also important to note that the assessment of whether an appropriate methodology has been used was not intended to pass judgement on the methodology used by the study concerned, merely whether it is appropriate for the purposes of this project (i.e. assessing at-sea bird distributions for comparison with the hotspots identified in Kober *et al* 2010, 2012).We assessed the appropriateness of the methodology for our purposes in the same way that we would make such an assessment when conducting a peer-review.

In assessing this, we referred to the methodology presented in the document concerned. We scored this on a five point scale as follows:

No methodology reported = 1

Where study reports the results of a survey:

Opportunistic observations or inappropriate methodology for assessing at-sea bird distributions (e.g. data collected in a non-standardised fashion as part of a survey of other taxa) = 2
Robust survey methodology with no analysis (e.g. follows Camphuysen *et al* 2004, or similar) = 3
Robust survey methodology and basic analysis (e.g. observations corrected for detectability) = 4
Robust survey methodology and advanced analysis (e.g. spatial modelling of distributions) = 5

Where study reports the outputs of tracking work:

Small sample size (n<10), with no analysis = 2
Small sample size (n<10), with analysis = 3
Large sample size (n>10), with no analysis = 4
Large sample size (n>10), with analysis = 5

(4) *Are the data representative?* (Table 3; columns 12-19) It is important to ensure that the data concerned accurately reflect the populations of interest. If this is not the case, there is a danger that the evidence for each aggregation has been over- or understated. This category has been broken down into sub-categories that assess whether the data were collected within the different seasons of interest; if the data were collected during one or multiple surveys; and for tagging studies, if tagged individuals were subject to sex, age or colony bias.

In our initial assessment of how representative the data are, we scored the study on the basis of whether data have been collected throughout the season of interest (i.e. covers the whole season, as defined in Kober *et al* 2012) (Table 3; column 14).

Partial coverage of aggregation area during season of interest, or complete coverage of the aggregation area but not covering all months within the season of interest	= 1
Complete coverage of survey area during all months of interest	= 2

We then considered whether data have been collected through tagging projects, or as part of a survey. Where data have been collected as part of a tagging project (Table 3; columns 15-17), we scored as follows:

Is there a sex bias in the birds that were tagged? (e.g. were only males selected or a biased proportion males?) (Table 3; column 15).

Yes	= 0
No	= 1

Were birds of age classes other than adults included?? (Table 3; column 16).

Yes	= 1
No	= 0

Were birds tagged at single or multiple colonies? (Table 3; column 17).

Single	= 0
Multiple	= 1

Where data have been collected as part of surveys, there are likely to be fewer inherent biases related to the age, sex or origin of the birds concerned. However, where data are based on only a single survey, there is a danger that the importance of an area may be over- or under-stated as it may be biased by the conditions during that survey. For this reason, we scored survey data on the basis of the total number of surveys contributing data to the study in a single season (Table 3; column 18) as follows:

Single survey	= 1
Two surveys	= 2
More than two surveys	= 3

The final score (Table 3; column 19) for how representative the data presented in the study are will then be obtained by summing columns 14-18.

We then scored the source (columns 20-21) based on whether the information was derived from the peer-reviewed literature, grey literature or expert knowledge, as follows:

Peer-reviewed literature	= 3
Grey literature	= 2
Expert knowledge	= 1

These scores reflect the level of scrutiny each data source has been subjected to. With this in mind, we assigned the same scores to the EIAs for offshore wind farms as peer-reviewed literature (rather than scoring them as grey literature). We recognise that the peer-review process for these two types of publications is not the same (for example EIAs do not need to meet the criteria of producing novel science, but can still produce good estimates of bird

densities or populations sizes in offshore areas).However, the degree of scrutiny to which EIAs have been subjected is comparable to, and may even exceed, that given to peer-reviewed literature.

The final score awarded to each study was the mean of the scores for age of data (Table 3; column 7), number of years data (Table 3; column 9), methodology (Table 3; column 11) and how representative the data are of the wider population (Table 3; column 19), multiplied by the score based on whether the source is based on peer-reviewed literature, grey literature or expert knowledge (Table 3; column 21) [eq. 1]. By using the mean, rather than sum, of the scores for each category, the final score for the source was within the range 1-15, making it easier to compare between sources.

$$\left(\frac{Data\ Age+N\ Years\ Data+Methods+Representative}{4}\right) \times Source \text{ [eq. 1]}$$

This score provided a balance between the strength of the evidence presented and the quality of the source material. Finally, we determined whether the data presented in the source supported the identification of the aggregation as being of importance (Table 3; Column 23) by comparing spatially referenced data within the source (for example from a map or co-ordinates) to the location of the seabird aggregation using GIS. For example, where a study presents a map, this can be achieved by saving the map as a .jpeg and overlaying on a map of the aggregation within ArcGIS.

Table 3. Scoring system step 1. A method to assess the strength of the evidence presented by each of the data/information sources identified during our review process. This will be compiled as an excel spreadsheet with a row for each data/information source, and will be supplied as one of the project outputs along with the written report. Initially we will relate each study to relevant aggregation(s) based on the species concerned, geographic location and months over which data were collected. We will then score each study against each of four criteria reflecting the age of the data, the number of years contributing to the study, and whether data are collected in an appropriate fashion and are representative of the wider population. A final score for each study will be obtained by weighting the mean of these scores by a score based on whether the data originate from the peer-reviewed literature, the grey literature or expert knowledge.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Reference	Aggregation			Type of Data	Age of Data		N Years Data		Appropriate Methodology		Representative								Type of Source		Total Score	Overlap with hotspot	Comments
														Tagging			Survey						
	Area	Species	Months		Comment	Score	Comment	Score	Comment	Score	Comment	Data Type	Collected in season of interest	Sex	Age	Colonies	Multiple/ Single	Score	Comment	Score			
Source for data	Which aggregation do data relate to?	Which species do data relate to?	Which months does hotspot relate to? As defined in Kober *et al* 2010, 2012	How were data collected?	How recent are the data?	How old is the most recent data contributing to the source? Score as follows:1 yr = 5, <3 yrs = 4, <5 yrs = 3, <10 yrs = 2, > 10 yrs = 1	List years data collected This reflects the fact that the majority of data collection will occur over just one or two years, but there may be	Have data been collected over a number of years? Score as follows: 1 yr = 1, 2yrs = 3, >2yrs = 5.	Brief description of data collection methodology	Does the survey follow a widely accepted methodology (e.g. Camphuysen *et al* 2004), Where distributional data are presented, have appropriate analytical approaches been used (i.e. kernel smoothing). Score on the basis of information presented – no information or inappropriate survey methodology = 1, opportunistic observations = 2, robust survey methodology with no analysis = 3, robust survey with basic analysis (i.e. Distance) = 4, robust survey with advanced analysis (i.e. spatial modelling) = 5	Brief description of data	Were data collected from aerial surveys, boat surveys, tagging etc.	Were data collected in the season of interest? No (0), data collected during part of season of interest (1) or data collected throughout season of interest (2)	Any sex-bias in tagged birds? Yes (0) or No (1)	Any age-bias in tagged birds? Yes (0) or No (1)	Do birds come from multiple colonies? No (0) or Yes (1)	Were data collected from one (1), two (2) or more than two (3) surveys?	Sum of columns 14-18	Peer-reviewed, grey literature or expert knowledge	Peer-reviewed = 3, grey literature = 2, Expert knowledge = 1, for purposes of this assessment, EIA's are assessed as peer-reviewed	Average of columns 7,9, 11, 19 multiplied by column 21	Do key areas identified by study overlap with aggregation? Yes or No	Any additional information to provide

2.6.2 Step 2

The second step of the scoring process was to combine all the evidence for each seabird aggregation identified by JNCC into a single score for that area. We did this by combining the scores derived from stage 1 for all the different data sources that provide evidence in relation to the area in question. This allowed us to assess whether or not the identification of the aggregation is supported by the evidence provided by the review process, and how strong the evidence contributing to this conclusion is. Scores were tabulated in a spreadsheet (Table 4). In this spreadsheet, each seabird aggregation area identified by JNCC was represented in one row and scored against a range of criteria in various columns of the spreadsheet (Table 4). The first three columns of the spreadsheet provide details of the aggregation ("hotspot") in question (Table 4; columns 1-3). We then gave each aggregation a score from one to five against four different criteria.

We carried out this analysis separately for studies which provided evidence to support the presence of the aggregation and for those studies that did not provide evidence to support the presence of the aggregation, to give final scores for each. The final assessment compared the number and quality of studies that support the presence of the aggregation with those that have surveyed the area but do not provide support.

This process is described in detail below:

(1) *How many studies contribute to the evidence?* (Table 4; column 4-5 & 17-18). Each aggregation was given two scores in this category with separate scores derived for those studies which provide evidence to support the presence of the aggregation (Table 4; columns 4-5) and for those studies that have surveyed the area in question during the season in question but do not provide evidence to support the presence of the aggregation (Table 4; columns 17-18). We scored each aggregation on the basis of the number of different sources contributing evidence in each of these two groups on a five point scale, such that aggregations with the greatest quantity of relevant evidence receive the highest scores.

1-2 studies	= 1
3-4 studies	= 2
5-6 studies	= 3
7-8 studies	= 4
>9 studies	= 5

(2) *Total years contributing evidence.* (Table 4; columns 6-7 & 19-20). The total number of separate years during which data have been collected will be indicative of whether the aggregation is likely to persist through time, or whether an area has been identified as a result of one-off factors, for example a temporary re-distribution of prey. If the aggregation has been identified as a result of occasional factors, this will give an indication of how common an occurrence these factors are. As above, separate scores were derived for studies which provide evidence to support the presence of the aggregation(Table 4; columns 6-7) and for those studies that do not provide evidence to support the presence of the aggregation (Table 4; columns 19-20).

1-2 years	= 1
3-4 years	= 2
5-6 years	= 3
7-8 years	= 4
>9 years	= 5

(3) *What is the mean score assigned to the data sources contributing evidence?* (Table 4; columns 8-9 & 21-22). We assessed the strength and quality of evidence associated with each aggregation by calculating mean values for the score given in column 22 of Table 3 derived for studies which provide evidence to support the presence of the aggregation (Table 4; columns 8-9) and for those studies that do not provide evidence to support the presence of the aggregation (Table 4; columns 21-22). The final score for each category (those which provide support for the aggregation and those which do not provide support for the aggregation) were derived by dividing the mean scores for all sources by 3 so that it is within a range of 1-5.

(4) *Does the evidence come from multiple, independent sources?* (Table 4; 10-16 & 23-29). The reliance on a single data collection methodology as evidence for an aggregation may indicate a bias in the available data. For example, where data are obtained from aerial surveys, it may not be possible to determine whether an aggregation reflects commuting birds, or whether it reflects a key foraging area. Similarly, a reliance on only tagging data or only casual observations may indicate that the data regarding an aggregation has relatively little power. In order to increase confidence in identified aggregations, it is important to combine the power of data obtained using surveys with the behavioural data obtained from other methodologies, such as tagging. We therefore scored multiple data sources as follows:

One or two different data collection methodologies	= 1
Three different data collection methodologies	= 2
Four different data collection methodologies	= 3
Five different data collection methodologies	= 4

We also considered whether the data collected come from independent sources, for example if all data come from tagging studies, do all tagged birds originate from a single colony? (Table 4; columns 15 & 28).

No	= 1
Yes	= 0

In deriving a final score for whether studies reflect multiple, independent data sources (Table 4; column 16 & 29) we added the score for the total number of data collection methodologies contributing data to the score for whether the data come from independent sources. Again, we completed this assessment separately for studies which provide evidence to support the presence of the aggregation and for those studies that do not provide evidence to support the presence of the aggregation.

Finally, we summed the scores across these four categories to give an overall score indicating our confidence in the evidence presented for each aggregation (Table 4, columns 30 & 31). We considered the studies which identify the aggregation as important (Table 4, column 30) and those that do not identify the aggregation as important (Table 4, column 31) separately, deriving final scores for both. This allowed us to assess whether the strength of the evidence confirming the aggregation as important exceeds that identifying it as unimportant. The proportion of studies that suggest the aggregation is important (i.e. where the key areas for birds identified in the study overlap with the aggregation) is also given (Table 4, column 33).

Table 4. Scoring system step 2. A method to combine the different data sources in order to assess both whether the identification of the aggregation is supported by the evidence, and how strong the evidence contributing to this conclusion is. This will be compiled as an excel spreadsheet with a row for each data/information source, and will be supplied as one of the project outputs along with the written report. Each aggregation will be assessed based on the number of studies contributing evidence, the temporal coverage of data obtained from these studies, the mean score from Table 3 for the strength of evidence in each of these studies and whether data obtained from these studies reflect multiple, independent data sources. A final score for each will be obtained by summing the four categories. For each aggregation assessments will be carried out separately for studies identifying the area as important and for those identifying the area as unimportant, and the strength of evidence in each category assessed. This will allow us to assess whether the strength of the evidence confirming the aggregation as important exceeds that identifying it as unimportant.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
			Studies Identifying Area as Important													Studies Identifying Area as Not Important															
Seabird Aggregation			N Studies		Total Years		Mean Score		Multiple Independent data sources							N Studies		Total Years		Mean Score		Multiple Independent data sources							Strength of Evidence		Proportion Important
Area	Species	Months	Count	Score	N Years	Score	Value	Score	Tagging	Boat surveys	Aerial Surveys	Seawatching	Casual obs.	Independent	Score	Count	Score	N Years	Score	Value	Score	Tagging	Boat surveys	Aerial Surveys	Seawatching	Casual obs.	Independent	Score	Studies suggesting area is Important	Studies suggesting area is Unimportant	
Area 1	northern fulmar	Mar - Jul	How many studies contribute to the evidence?		How many years contribute to the evidence?		What is the mean score from the table above of studies contributing evidence	The final score will be derived by dividing the mean score from the previous column by 3 so that it is within a range of 1-5	Number of tagging studies	Number of boat survey studies	Number of Aerial Survey studies	Number of Sea-watching studies	Number of seawatching studies	Are studies independent? i.e. do all tagging studies come from a single colony? Yes (1) or No (0)	Number of different types of data obtained (i.e. where columns 10–14 >0) plus whether studies are independent or not (column 15)	How many studies contribute to the evidence?		How many years contribute to the evidence?		What is the mean score from the table above of studies contributing evidence	The final score will be derived by dividing the mean score from the previous column by 3 so that it is within a range of 1-5	Number of tagging studies	Number of boat survey studies	Number of Aerial Survey studies	Number of Sea-watching studies	Number of seawatching studies	Are studies independent? i.e. do all tagging studies come from a single colony? Yes (1) or No (0)	Number of different types of data obtained (i.e. where columns 23–27 >0) plus whether studies are independent or not (column 28)	Sum of columns 5, 7, 9 and 16 based on studies where aggregation is identified as overlapping with key areas	Sum of columns 5, 7, 9 and 16 based on studies where aggregation is identified as not overlapping with key areas	Proportion of studies where key areas are identified as overlapping with the aggregation
Area 3	Manx shearwater	May - Sep																													
Area 6	Manx shearwater	May - Sep																													
Area 7	northern gannet	May - Sep																													
Area 10	northern gannet	May - Sep																													
Area 11	northern gannet	May - Sep																													
Area 12	northern gannet	Oct - Apr																													
Area 13	European shag	Mar - Sep																													
Area 14	European shag	Oct - Feb																													
Area 15	European shag	Oct - Feb																													
Area 16	great skua	May - Aug																													
Area 18	black-legged kittiwake	May - Sep																													
Area 19	black-legged kittiwake	May - Sep																													
Area 20	black-legged kittiwake	May - Sep																													
Area 21	black-legged kittiwake	May - Sep																													
Area 23	herring gull	Apr - Aug																													
Area 24	Arctic tern	May - Aug																													
Area 26	common guillemot	May - Jun																													
Area 31	common guillemot	Oct - Apr																													
Area 32	common guillemot	Oct - Apr																													
Area 33	Atlantic puffin	Apr - Jul																													
Area 36	Atlantic puffin	Apr - Jul																													
Area 40	Atlantic puffin	Aug - Mar																													
Area 41	seabird assemblage	All breeding combined																													
Area 42	seabird assemblage	Jul - Aug																													

Our final conclusions are presented as follows: "*Overall, beyond that presented by Kober* et al *(2010, 2012), the evidence that supports the identification of the aggregation as being important to species X in season Y is stronger/weaker than the evidence that does not. The quality of this evidence is weak/moderate/strong"*. However this summary is also accompanied by a wider and more detailed written discussion of the assessment in the text for each aggregation.

We assess the strength of the evidence, as reported in the above statement, by combining the site score for the evidence as a whole, with the total number of studies contributing to that evidence in the matrix presented below (Table 5). This enables us to present a combined assessment of both the quantity and quality of evidence available.

Table 5. Matrix combining the quantity and quality of available sources to give an assessment of the overall evidence available regarding the identification of an aggregation.

		Site Scores (Columns 30/31 of table 4)		
		0-5	>5-10	>10
Available Studies	0-3	Weak	Weak	Moderate
	4-6	Weak	Moderate	Strong
	>7	Moderate	Strong	Strong

3 Results and Discussion

In total, we identified 33 studies which were of relevance to the 25 seabird aggregations considered in this report. Of these, 12 were from the grey literature, including Environmental Impact Assessments or Zonal Appraisal and Planning reports for the Beatrice, Firth of Forth, Irish Sea and Neart na Gaoithe offshore wind farm zones. The remaining 21 studies came from the peer-reviewed literature and covered both tracking studies and boat-based surveys. In addition to these published studies, we also use data from the RSPB FAME tracking project, where appropriate, to provide additional information about the potential importance of each aggregation.

The quantity of evidence available varied strongly by area. This reflected the intensity of research carried out in the surrounding regions, with some, such as the areas surrounding the Firth of Forth having a much larger evidence base than others, such as those in Orkney and Shetland.

3.1 Seabird Aggregation – Area 1

Northern fulmar *Fulmarus glacialis* - breeding season (March to July)

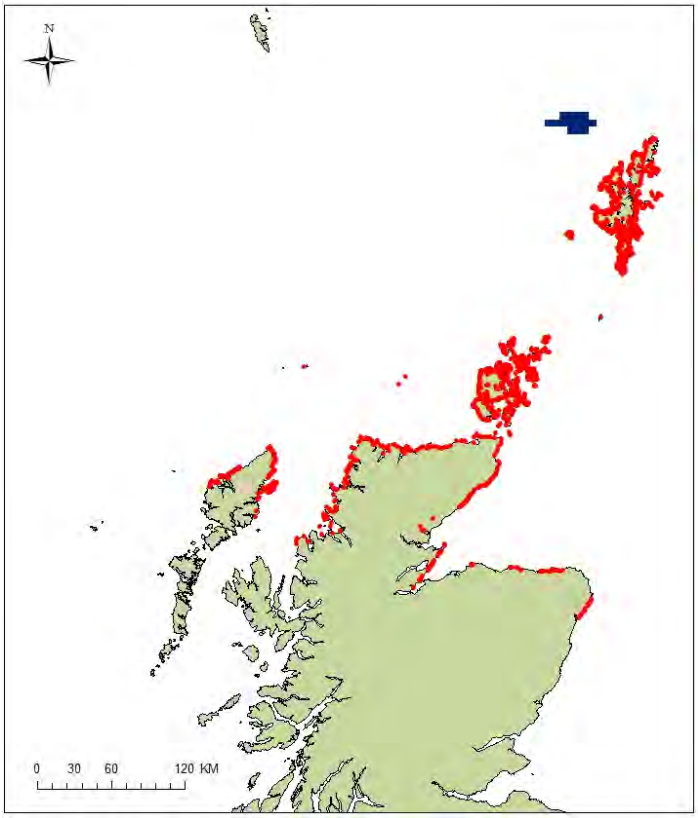


Figure 3. Area 1 (blue polygon), identified as an aggregation for northern fulmar *Fulmarus glacialis* during the breeding season (March to July). Breeding colonies of northern fulmar potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points). A number of additional colonies on the Faroe Islands are also likely to be within foraging range.

3.1.1 Identification of Area 1 as an important aggregation of northern fulmar

Area 1 was identified by Kober *et al* (2010) as an important aggregation of northern fulmar *Fulmarus glacialis* during the breeding season. Based on analysis of ESAS data, the area supports a population of 40,755 birds, 0.40% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 5 of the 8 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.1.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was based on a single boat survey. No evidence was located from tracking, aerial survey data, seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: A single study was found relating to Area 1, Camphuysen and Garthe (1997) which covered the full extent of the North Sea and was carried out in conjunction with the international bottom trawl survey (including the ICES regions IIIa, IVa, IVb and IVc). This study collected data by a range of methods including; (i) standardised ship-based surveys during the periods of January-February 1993, April–May 1994, August-September 1994 and October-November 1994 (these data were not assessed as they have been included in the ESAS database); (ii) opportunistic observations of northern fulmar in association with fishing vessels (n=272); (iii) counts of all seabirds around the ship during hauling activity and experimental discarding of fish and offal (n=841 events). We reviewed evidence from (iii) and concluded that between April and September there was no evidence to suggest that northern fulmars were present scavenging at the stern of research vessels in Area 1.It is important to note that the location of these discarding events was not planned in a systematic way and therefore sampling effort cannot be considered to evenly spread across the study area. This study has very limited value therefore.

Grey literature: No studies found.

Expert opinion: No relevant information received.

Table 6. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 1 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source											
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.	Type of source	Total adjusted score (max 15)	Supports Area as Important
Camphuysen & Garthe 1997	1	1	2	1	NA	NA	NA	1	2	3	**4.5**	**N**

Stage 2 of Assessment

Beyond the data presented in Kober *et al* (2010, 2012), there is no evidence supporting the identification of Area 1 as being of importance to breeding northern fulmar and one study that does not support the identification of the area (Appendix 6, Stage 2 - Site Scores). However, the strength of this evidence is weak.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*0*	*0*
Have surveyed Area 1 but do not provide supporting evidence	*1*	*4.5*

3.1.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of northern fulmar in Area 1 are likely to be linked to the species foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 40,755 birds are present within Area 1 during the breeding season. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher. Based on the mean maximum foraging range of 400km for northern fulmar identified in Thaxter *et al* (2012), there are 1,584 colonies potentially within foraging range of Area 1, with a total population of 363,649 breeding pairs from the British Isles (Mitchell *et al* 2004). It is also, potentially within the foraging range of another 600,000 breeding pairs on the Faroe Islands (Mitchell *et al* 2004). The abundance of breeding birds within foraging range of Area 1 suggests that it is feasible for Area 1 to support a population of the size suggested by Kober *et al* (2010, 2012).

Area 1 shows significant overlap with areas of high intensity fishing activity (Coull *et al* 1998) and the spawning or nursery grounds of cod, whiting and sandeel (Ellis *et al* 2012). Northern fulmar have been shown to exploit fisheries discards as a food source, particularly in the southern part of their range (Hudson & Furness 1989; Camphuysen & Garthe 1997; Phillips *et al* 1999; Ojowski *et al* 2001). Fish offal from discards was found in 32% of samples from one Shetland colony (Ojowski *et al* 2001), whilst juvenile gadoids, like cod, and sandeel also make an important contribution to the species' diet (Phillips *et al* 1999). Area 1 shows significant overlap with several high intensity fisheries and the spawning grounds for several fish species. Whilst the fisheries and spawning or nursery grounds occur over a much wider spatial scale than Area 1, they are likely to offer a highly predictable food supply to northern fulmar foraging within Area 1.

Area 1 is largely characterised by deep water (mean depth 229m ±98m SD) with a sandy and muddy sand substrate (Appendix 5). As a surface feeder (Cramp & Simmons 1977), there is no obvious ecological reason for the deep water to attract northern fulmar to Area 1, (though the area could still potentially provide suitable food sources near the surface). The probability of thermal fronts within the area was low.

The proximity of the area to a large number of breeding colonies and the presence of predictable food sources provide ecological explanations for the presence of an important aggregation of northern fulmar within Area 1 during the breeding season.

3.1.4 Conclusions

We did not find any evidence beyond that presented by Kober *et al* (2010, 2012) that directly supports the identification of Area 1 as being of importance to northern fulmar during the breeding season. The only relevant study of the area is limited to a single boat-based survey and did not provide supporting evidence of the importance of Area 1 to northern fulmars during the breeding season. The overlap with high intensity fishing grounds, and proximity to

a large number of breeding colonies, does provide circumstantial evidence to suggest that the area may be of importance to birds foraging on discards from fishing vessels.

Overall, beyond that presented by Kober *et al* (2010, 2012), no evidence was found that supports the identification of the aggregation as being important to northern fulmar in the breeding season.

3.2 Seabird Aggregation – Area 3

Manx shearwater *Puffinus puffinus* - breeding season (May to September)

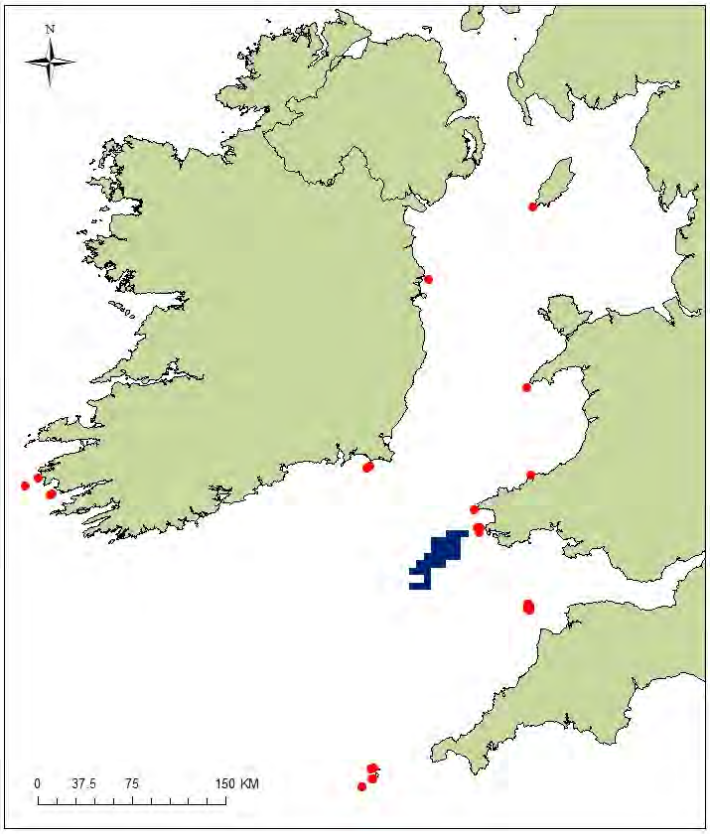


Figure 4. Area 3 (blue polygon), identified as an aggregation for Manx shearwater *Puffinus puffinus* during the breeding season (May to September). Breeding colonies of Manx shearwater potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.2.1 Identification of Area 3 as an important aggregation of Manx shearwater

Area 3 was identified by Kober *et al* (2010) as an important aggregation of Manx shearwater *Puffinus puffinus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 51,792 birds, 4.60% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 4 of the 5 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.2.2 Literature review of additional evidence

Stage 1 of Assessment

The available supporting evidence base for Area 3 covered six tracking studies and an aerial survey. No evidence was located from seawatching records, other casual observations, or expert knowledge of the area.

Peer reviewed: Three relevant tracking studies were identified during a review of peer-reviewed literature. The first two studies (Guildford *et al* 2008; Dean *et al* 2013) used GPS

tags to track birds from the Skomer and Copeland Island breeding colonies during the chick rearing period in three consecutive years. Whilst Guildford *et al* (2008) did not attempt to analyse any of the distributional data collected, Dean *et al* (2013) used Markov models in order to infer at-sea behaviour, and identify foraging areas. This analysis revealed overlap between the foraging areas for birds from Skomer, but not Copeland Island, and Area 3. The third tracking study (Guildford *et al* 2009) used geo-locator data to reveal that birds from Skomer may use Area 3 when they first return to the breeding colony, prior to egg-laying, but did not model the distributions of these birds.

Grey literature: Two tracking studies (Dean *et al* 2010; Freeman *et al* 2011) and one aerial survey (WWT Consulting 2009) were identified during our review of the grey literature. During 2009 and 2010, birds fitted with GPS tags at the colony on Lundy were shown to forage within Area 3 during the chick-rearing period (Dean *et al* 2010). However, 2011 data from the same colony did not show any link with Area 3, although this may reflect the shorter time period in which these data were collected (4 days vs 2 weeks) (Freeman *et al* 2011). Aerial survey data collected between October 2007 and August 2008 revealed that Manx shearwater were found within Area 3 throughout the breeding season in high densities relative to other survey areas (WWT Consulting 2009).

Expert opinion: No relevant information received.

Table 7. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 3 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source											
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.	Type of source	Total adjusted score (max 15)	Supports Area as Important
Dean *et al* 2010	3	3	4	1	1	0	0	NA	2	2	**6**	**Y**
Dean *et al* 2013	4	5	5	2	1	0	1	NA	4	3	**13.5**	**Y**
Freeman *et al* 2011	4	1	4	1	1	0	0	NA	2	2	**5**	**N**
Guildford *et al* 2008	2	5	4	1	1	0	0	NA	2	3	**9.75**	**Y**
Guildford *et al* 2009	2	1	4	1	1	0	0	NA	2	3	**6.75**	**Y**
WWT Consulting 2009	3	1	3	1	NA	NA	NA	1	1	2	**4.5**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 3 as being of importance to breeding Manx shearwater, beyond the analyses undertaken by Kober *et al* (2010, 2012) is strong with an overall score of 11.7/20 (Appendix 6, Stage 2 – Site Scores). Whilst the data collected rarely covered the whole of the breeding season (May-September), studies were carried out in six separate years and consistently highlighted Area 3 as being of important (e.g. WWT Consulting 2009) and revealed direct links to four different breeding colonies (Guildford *et al* 2008, 2009; Dean *et al* 2010, 2013; Freeman *et al* 2011). Whilst one tracking study did not reveal an overlap between Area 3 and breeding birds from Skomer, it should be noted that the focus of this study was rafting birds, and technological limitations meant there was only partial overlap between the study area and Area 3.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*5*	*11.7*
Have surveyed Area 3 but do not provide supporting evidence	*1*	*5.7*

3.2.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of Manx shearwater in Area 3 are likely to be linked to the species' foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 51,792 birds are present within Area 3. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher. Guildford *et al* (2008, 2009) and Dean *et al* (2010, 2013) demonstrated that birds from the breeding colonies on Lundy and Skomer make extensive use of Area 3. Based on the mean maximum foraging range for Manx shearwater of 330km identified in Thaxter *et al* (2012), there are an additional 19 colonies potentially within the foraging range of Area 3 – Lambay, Deenish, Great Skellig, Puffin Island, Scariff, Great Saltee, Little Saltee, Calf of Man, Annet, Shipman Head, Gugh Island, Round Island, St Agnes Island, St Helen's Island, Cardigan, Ramsey, Skokholm, Middleholm and Bardsey – reflecting a total population of 178,187 breeding pairs potentially within foraging range of Area 3 (Mitchell *et al* 2004). This suggests that it is entirely feasible for Area 3 to support a population of the size suggested by Kober *et al* (2010).

The area is also characterised as having a high probability of thermal fronts (mean 66% ± 21%) (DEFRA 2013), with the Celtic Sea front lying to the west of Skomer having been previously shown to attract large numbers of Manx shearwaters (Stone *et al* 1994; Pollock *et al* 1997). Thermal fronts are likely to attract birds as they offer a highly predictable food source (Begg & Reid 1997; Durazo *et al* 1998). Although the area is not intensively fished (Coull *et al* 1998), it does overlap with the spawning areas of several fish species, including sprat, which are likely to be a key part of the species' diet (Cramp & Simmons 1977; Coull *et al* 1998; Ellis *et al* 2012).

Area 3 is largely characterised by deep water (mean depth 80m ±13m SD) over a sand and muddy sand substrate (BODC 2010; JNCC 2011). However, the foraging ecology of Manx shearwater suggests that neither of these factors is likely to influence the distribution of this species.

The proximity of the area to a large number of breeding colonies and the presence of predictable food sources provide ecological explanations for the presence of an important aggregation of Manx shearwater within Area 3 during the breeding season.

3.2.4 Conclusions

Evidence that directly supports the identification of Area 3 as being of importance to Manx shearwater during the breeding season, in addition to that identified by Kober *et al* (2010, 2012) is available from both the grey and peer-reviewed literature. Four tracking studies revealed a direct link between the area and two breeding colonies. Whilst only a relatively minor proportion of the population may be tagged, these studies show that tagged birds spend a significant amount of time within Area 3, a pattern which is repeated over a number of years. Recent aerial surveys have also confirmed high concentrations of Manx shearwaters in the area. In addition, seawatching from sites on the Pembrokeshire coast close to Area 3 frequently record significant counts of the species (Berry *et al* 2010), confirming that Manx shearwater are present in large numbers in the region surrounding Area 3. Furthermore, the overlap with areas with a high probability of thermal fronts and nursery grounds for potential prey species suggests that Area 3 may represent an important foraging ground for the species.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to Manx shearwater in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 11.7/20 for supporting studies compared to 5.7/20 for non-supporting studies. The strength of the additional evidence is strong and consistent (81% studies with additional information support the identification of the area as important, Appendix 6).

3.3 Seabird Aggregation – Area 6

Manx shearwater *Puffinus puffinus* - breeding season (May to September)

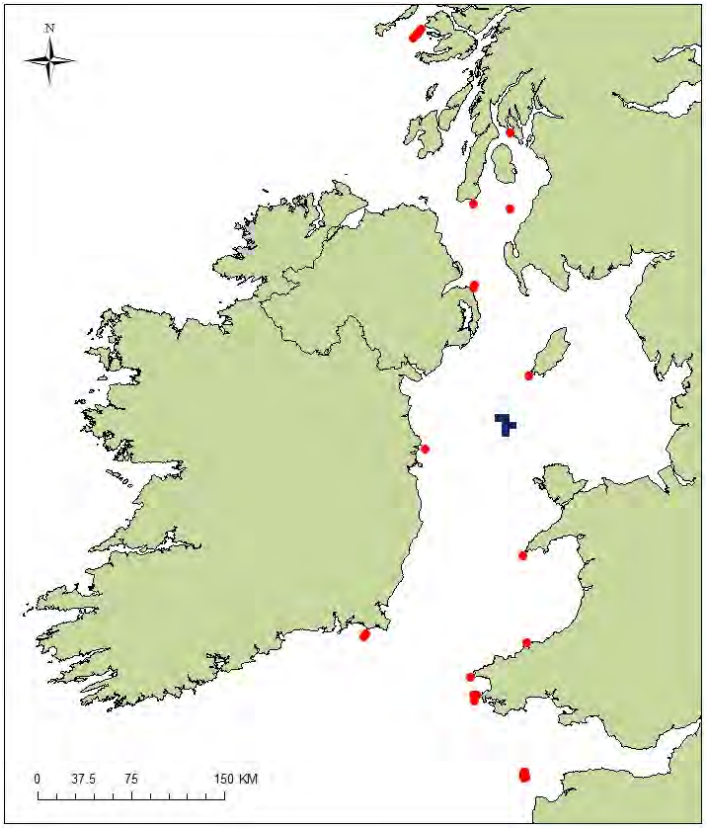


Figure 5. Area 6 (blue polygon), identified as an aggregation for Manx shearwater *Puffinus puffinus* during the breeding season (May to September). Breeding colonies of Manx shearwater potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.3.1 Identification of Area 6 as an important aggregation of Manx shearwater

Area 6 was identified by Kober *et al* (2010) as an important aggregation of Manx shearwater *Puffinus puffinus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 12,039 birds, 1.07% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 3 of the 5 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.3.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base for Area 6 (other than ESAS data already analysed by JNCC) covered five tracking studies, one boat survey and an aerial survey. No evidence was located from seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: Three tracking studies were identified during a review of peer-reviewed literature. Two studies (Guildford *et al* 2008; Dean *et al* 2013) used GPS tags to track birds from the Skomer and Copeland Island breeding colonies during the chick rearing period in three consecutive years. Bird from both colonies showed overlap with Area 6, suggesting it may constitute a foraging area for birds from these colonies. Whilst Guildford *et al* (2008) did not attempt to analyse any of the distributional data collected, Dean *et al* (2013) used Markov models in order to infer at-sea behaviour, and identify foraging areas. This analysis revealed overlap between the foraging areas for birds from Skomer and Copeland and Area 6. The third tracking study (Guildford *et al* 2009) used geo-locator data to reveal that birds from Skomer may use Area 6 when they first return to the breeding colony, prior to egg-laying, but did not model the distributions of these birds.

Grey literature: Two tracking studies (Dean *et al* 2010; Freeman *et al* 2011), one boat survey (Centrica 2012) and one aerial survey (WWT Consulting 2009) were identified during our review of the grey literature. Between 2009 and 2011, birds fitted with GPS tags at the colony on Lundy were shown to forage within Area 6 during the chick-rearing period (Dean *et al* 2010; Freeman *et al* 2011). Aerial survey data collected between October 2007 and August 2008 revealed that Manx shearwater were found within Area 6 throughout the breeding season (WWT Consulting 2009), as did boat survey data covering the 2010 and 2011 breeding seasons (Centrica 2012).

Expert opinion: No relevant information received.

Table 8. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 6 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source											
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.	Type of source	Total adjusted score (max 15)	Supports Area as Important
Dean *et al* 2013	4	5	5	2	1	0	1	NA	4	3	**13.5**	**Y**
Freeman *et al* 2011	4	1	3	1	1	0	0	NA	2	2	**5**	**Y**
Dean *et al* 2010	3	3	4	1	1	0	0	NA	2	3	**6**	**Y**
Guildford *et al* 2009	2	1	4	1	1	0	0	NA	2	3	**6.75**	**Y**
WWT Consulting 2009	3	1	3	1	NA	NA	NA	1	2	2	**4.5**	**Y**
Guildford *et al* 2008	2	5	4	1	1	0	0	NA	2	3	**9.75**	**Y**
Centrica Energy 2012	4	3	5	2	NA	NA	NA	3	5	3	**12.75**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 6 as being of importance to breeding Manx shearwater, beyond the analyses undertaken by Kober *et al* (2010, 2012) is strong with an overall score of 12.77/20 (Appendix 6, Stage 2 – Site Scores). Whilst the data collected rarely covered the whole of the breeding season (May–September), studies were carried out in seven separate years and consistently highlighted Area 6 as being of importance (e.g. WWT Consulting 2009, Centrica Energy 2012) also revealing direct links to three different breeding colonies (Guildford *et al* 2008, 2009; Dean *et al* 2010, 2013; Freeman *et al* 2011).

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*7*	*12.77*
Have surveyed Area 6 but do not provide supporting evidence	*0*	*0*

3.3.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of Manx shearwater in Area 6 are likely to be linked to the species foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 12,039 birds are present within Area 6 during the breeding season. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher. Guildford *et al* (2008, 2009) and Dean *et al* (2010, 2013) demonstrated that birds from the breeding colonies on Copeland Island, Lundy and Skomer make extensive use of Area 6. Based on the mean maximum foraging range for Manx shearwater of 330km identified in Thaxter *et al* (2012), there are an additional 13 colonies potentially within the foraging range of Area 6 – Lambay, Great Saltee, Little Saltee, Calf of Man, Inchmarnock Island, Sanda Island, Treshnish Isles, Ailsa Craig, Cardigan, Ramsey, Skokholm, Middleholm and Bardsey – reflecting a total population of 174,278 breeding pairs potentially within foraging range of Area 6 (Mitchell *et al* 2004). It is, however, entirely feasible for Area 6 to support a population of the size suggested by Kober *et al* (2010).

The area is also characterised as having a high probability of thermal fronts (mean 61% ± 16%) (DEFRA 2013), with the Irish Sea front lying to the south of the Isle of Man having been previously shown to attract large numbers of Manx shearwaters (Stone *et al* 1994; Pollock *et al* 1997). Thermal fronts are likely to attract birds as they offer a highly predictable food source (Begg & Reid 1997; Durazo *et al* 1998). Although the area is not intensively fished (Coull *et al* 1998), it does overlap with the spawning areas of several fish species, including sprat and herring, which are likely to be a key part of the species' diet (Cramp & Simmons 1977; Coull *et al* 1998; Ellis *et al* 2012).

Area 6 is largely characterised by deep water (mean depth 80m ±13m SD) over a sand and muddy sand substrate (BODC 2010; JNCC 2011). However, the foraging ecology of Manx shearwater suggests that neither of these factors is likely to influence the distribution of this species.

The proximity of the area to a large number of breeding colonies and the presence of predictable food sources provide ecological explanations for the presence of an important aggregation of Manx shearwater within Area 6 during the breeding season.

3.3.4 Conclusions

Evidence that directly supports the identification of Area 6 as being of importance to Manx shearwater during the breeding season, in addition to that identified by Kober *et al* (2010, 2012) is available from both the grey and peer-reviewed literature. Four tracking studies revealed a direct link between the area and three breeding colonies whilst recent aerial and boat surveys also confirmed high concentrations of Manx shearwaters in the area. In addition, regular Marine Life surveys on board the Heysham to Warrenpoint Ferry route, which passes close to Area 6, regularly report the species (Marine Life 2014), confirming that Manx shearwater are present in large numbers in the region surrounding Area 6. Furthermore, the overlap with areas with a high probability of thermal fronts, notably the Irish Sea Front, and nursery grounds for potential prey species suggests that Area 6 may represent an important foraging ground for the species.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to Manx shearwater in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 12.77/20 for supporting studies with no non-supporting studies. The strength of the additional evidence is strong and consistent (all

studies with additional information support the identification of the area as important, Appendix 6).

3.4 Seabird Aggregation – Area 7

Northern gannet *Morus bassanus* - breeding season (May to September)

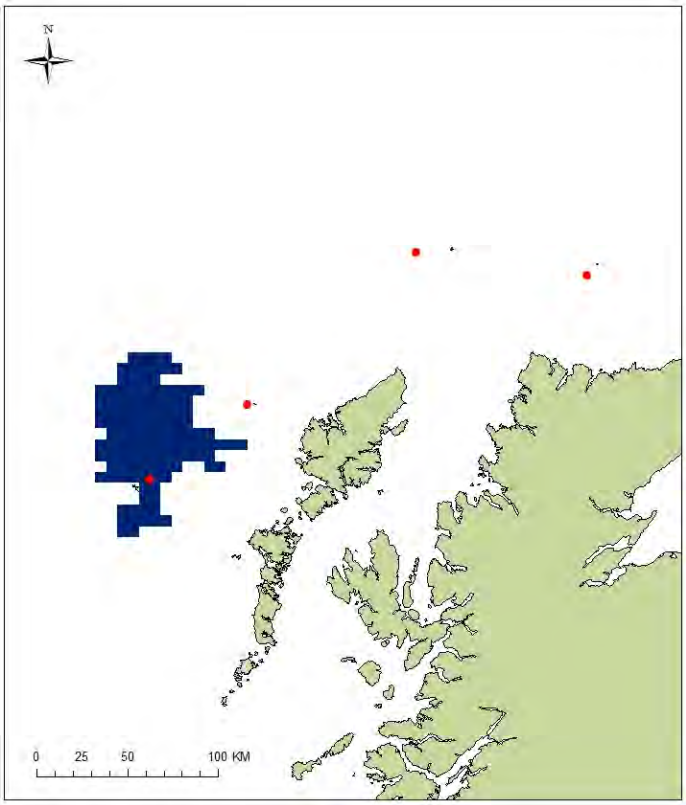


Figure 6. Area 7 (blue polygon), identified as an aggregation for northern gannet *Morus bassanus* during the breeding season (May to September). Breeding colonies of northern gannet potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.4.1 Identification of Area 7 as an important aggregation of northern gannet

Area 7 was identified by Kober *et al* (2010) as an important aggregation of northern gannet *Morus bassanus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 51,784 birds, 4.47% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 8 of the 12 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.4.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to one tracking study (see below). Some evidence was located from seawatching records and other casual observations (Appendix 1). No evidence was based on expert knowledge of the area from our questionnaire survey or located from boat-based or aerial surveys.

Peer reviewed: Wakefield *et al* (2013) fitted 21 adult northern gannets from the St Kilda breeding colony with PPT tags during the 2010 chick-rearing period (June to August). As well as presenting foraging tracks of individual birds, this study used kernel density analysis

to identify areas of importance to the birds. Area 7 falls completely within the 75% utilization distribution which indicates that it may be a key foraging area for birds breeding on St Kilda.

Grey literature: No studies found.

Expert opinion: No relevant information received.

Table 9. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 7 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source											
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.	Type of source	Total adjusted score (max 15)	Supports Area as Important
Wakefield *et al* 2013	4	1	5	1	1	1	0	NA	3	3	**9.75**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 7 as being of importance to breeding northern gannet, beyond the analyses undertaken by Kober *et al* (2010, 2012) is weak with an overall score of 6.25/20 (Appendix 6, Stage 2 – Site Scores). Although Wakefield *et al* (2013) showed adult birds from St Kilda to forage within Area 7; the data represents a portion of only one breeding season.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*1*	*6.25*
Have surveyed Area 7 but do not provide supporting evidence	*0*	*0*

3.4.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of northern gannet in Area 7 are likely to be linked to the species' foraging behaviour and the proximity to breeding colonies (Robinson *et al* 2002; Davoren 2013). Kober *et al* (2010) estimate that 51,784 birds are present within Area 7 during the breeding season. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher.

Area 7 surrounds the three main gannetries of Boreray, Stac Lee and Stac Arnin which make up the St Kilda breeding population, where the most recent population estimates are

61,340 occupied nests (Mitchell *et al* 2004). Wakefield *et al* (2013) carried out a tracking study on a total of 12 northern gannet colonies around the UK and northern France which demonstrated that despite having relatively large foraging ranges, northern gannets utilise almost mutually exclusive colony-specific foraging areas, a pattern which is likely to be driven by density dependent competition. It is, however, entirely feasible for Area 7 to support a population of the size suggested by Kober *et al* (2010), based on the size of St. Kilda population alone.

Although the foraging distributions of northern gannet from different colonies may not overlap (Wakefield *et al* 2013), based on the mean maximum foraging range for northern gannet of 229km identified in Thaxter *et al* (2012), there are (in theory) a further three other colonies potentially within foraging range: Sule Stack, Flannan Isles and Sula Sgeir Island – reflecting an additional 78,424 breeding pairs potentially within foraging range of Area 7 (Mitchell *et al* 2004).

Northern gannets are capable of utilizing a wide range of fishing techniques such as deep plunging, shallow plunging, scooping prey, surface seizing and scavenging at fishing vessels (Camphuysen 2011). Consequently they typically have a highly varied fish diet (Nelson *et al* 2002) and common species consumed in UK waters include mackerel *Scomber scombrus*, sandeel *Ammodytes marinus*, sprat *Sprattus sprattus* and herring *Clupea harengus* (Hamer *et al* 2000). The northern gannet also frequently will make use of fisheries discard as a food resource where available (Votier *et al* 2010, 2013). Area 7 is not intensively fished (Coull *et al* 1998) and contains low intensity sandeel and herring spawning and nursery grounds (Ellis *et al* 2012). However, Area 7 overlaps with high intensity mackerel nursery grounds, which peaks in May and June (Ellis *et al* 2012). Other datasets indicative of northern gannet food distribution also show high levels of overlap. Although, typically, northern gannets do not feed on copepods directly, copepod abundance has previously been mapped to predict northern gannet food availability as a proxy environmental variable (Grecian *et al* 2012). On comparison, Area 7 shows overlap with a high average June abundance of calanoid copepods, which may suggest further that this area supports high concentrations of food during the northern gannet breeding season.

Northern gannets have a strong foraging preference for oceanic fronts (Grémillet *et al* 2006; Skov *et al* 2008; Hamer *et al* 2009). However, Area 7 is characterised as having a low probability of thermal fronts (mean 22% ±9%) during the summer (Defra 2013), therefore this is unlikely to be an explanation for their presence in this area.

Despite a low probability of the presence of an oceanic front within Area 7, the proximity of the area to a large number of breeding colonies and the presence of some predictable food sources provide supporting ecological explanations for the presence of an important aggregation of northern gannet within Area 7 during the breeding season.

3.4.4 Conclusions

Available evidence, additional to the ESAS analysis carried out by Kober *et al* (2010, 2012), that directly supports the identification of Area 7 as being of importance to northern gannet during the breeding season is limited to one tracking study from the peer-reviewed literature. However, the combination of a large breeding colony in close proximity, food availability in the area, and direct evidence of northern gannets foraging in the area, suggests that Area 7 is likely to be an important feeding area for northern gannet.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012) the evidence that supports the identification of the aggregation as being important to northern gannet in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 6.25/20 for supporting studies with no non-

supporting studies. The strength of the additional evidence is weak, but it is consistent with Kober *et al* (2010) (Appendix 6).

3.5 Seabird Aggregation – Area 10

Northern gannet *Morus bassanus* - breeding season (May to September)

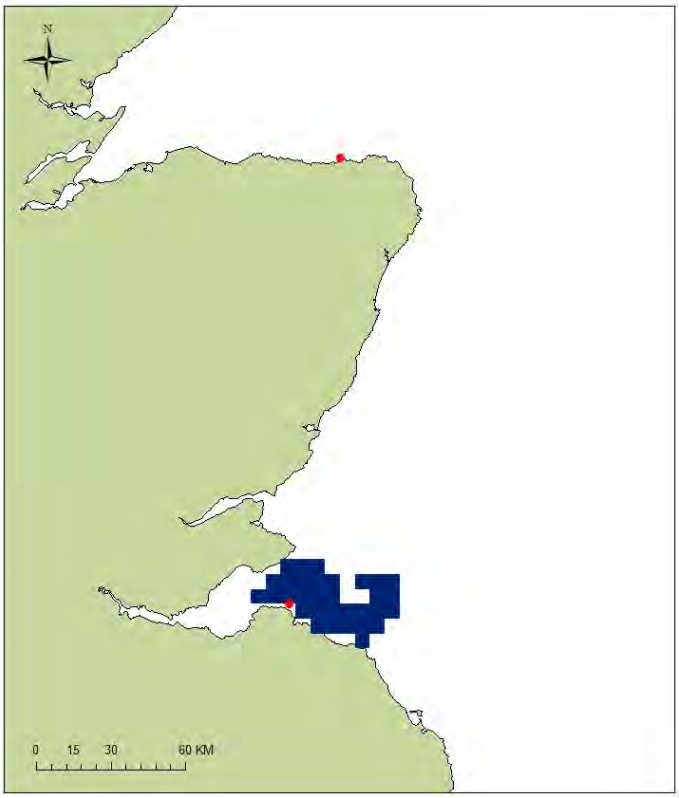


Figure 7. Area 10 (blue polygon), identified as an aggregation for northern gannet *Morus bassanus* during the breeding season (May to September). Breeding colonies of northern gannet potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.5.1 Identification of Area 10 as an important aggregation of northern gannet

Area 10 was identified by Kober *et al* (2010) as an important aggregation of northern gannet *Morus bassanus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 7,915 birds, 0.68% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 11 of the 15 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.5.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to two tracking studies, one boat-based study and one aerial study. Some supporting evidence was located from seawatching records and other casual observations (Appendix 1). No evidence was based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: Wakefield *et al* (2013) fitted 69 adult northern gannets from the Bass Rock breeding colony with GPS tags during the 2010 and 2011 chick-rearing period (June to

August). As well as presenting foraging tracks of individual birds, this study used kernel density analysis to identify areas of importance to the birds. Area 10 falls completely within the 75% utilization distributions, which indicates that it may be a key foraging area for birds breeding on Bass Rock.

Hamer *et al* (2007) fitted 43 adult northern gannets from Bass Rock breeding colony with PPT and GPS tags during the 1998, 2002 and 2003 chick-rearing period (July to August). The study was carried out to assess the annual variation in diets, feeding locations and foraging behaviour of northern gannets over three breeding seasons. In addition to presenting locations of individual northern gannets at sea, this study used kernel density analysis to identify areas of importance to the birds. In all years Area 10 was almost completely within the 75% fixed kernel density estimates providing further evidence indicating that it may be a key foraging area for northern gannets breeding on Bass Rock.

Two additional tracking studies were identified, Hamer *et al* (2009) and Skov *et al* (2008), but were based on the same data as presented in Hamer *et al* (2007) and were consequently excluded from our assessment. These studies however did present the actual dive locations of northern gannets in relation to oceanographic data and are discussed later under ecological explanations. Another study was based on ship based seabird surveys carried out on 8-9 June in 2003 in the North Sea (in adjacent waters of the Firth of Forth and Tay) using standard transect methodology (Scott *et al* 2010). Additional information differentiating between non-feeding and feeding birds (with up to 20 types of behaviour identified was also collected. Numbers of foraging birds (rather than all birds seen) were mapped, but it was hard to assess the extent of spatial overlap due to a lack of coast line in the figures. Moreover, data from black-legged kittiwake and common guillemot were also overlaid which made it difficult to differentiate between the symbols for different species. This study was therefore not considered as part of the assessment.

Grey literature: Between November 2009 and October 2011, boat-based ornithological surveys were carried out to inform an assessment of the Neart na Gaoithe wind farm development site, lying approximately 15km off Fife Ness (National Research Projects 2012). The methods used for the two years of baseline seabird surveys followed standard COWRIE approved survey methodology (Camphuysen *et al* 2004) and used distance sampling with corrections to produce density and population estimates. Whilst the survey area only partially overlapped with Area 10, northern gannet density estimates indicated that Area 10 was likely to be important for the species. The peak population estimate in the survey area (which only covered part of Area 10) of 5,632 birds in July, means that the estimate of 7,915 birds for the whole of Area 10 (Kober *et al* 2010, 2012) is entirely feasible, accounting for the areas not covered by this survey.

Between May 2009 and February 2010, digital aerial surveys were carried out to inform an assessment Round 3 Firth of Forth development sites (Seagreen Wind Energy 2012). The methods used for the two years of baseline seabird surveys followed standard COWRIE approved survey methodology (Camphuysen *et al* 2004). Although the survey area overlapped with only the north-eastern parts of Area 10, distribution maps of all birds recorded suggest high densities of northern gannet during the summer months where the survey area overlaps with Area 10. This overlap indicates that Area 10 may be a key foraging area for birds from breeding colonies within foraging range.

Expert opinion: No relevant information received.

Table 10. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 10 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.			
Wakefield *et al* 2013	4	3	5	1	1	1	0	NA	3	3	**11.25**	**Y**
Hamer *et al* 2007	1	5	5	1	1	1	0	NA	3	3	**10.5**	**Y**
National Research Project Ltd 2012	4	3	4	2	NA	NA	NA	3	5	3	**12**	**Y**
Seagreen Wind Energy 2012	3	1	4	2	NA	NA	NA	3	5	3	**9.75**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 10 as being of importance to breeding northern gannet, beyond the analyses undertaken by Kober *et al* (2010, 2012) is strong with an overall score of 11.63/20 (Appendix 6, Stage 2 – Site Scores). Whilst the data collected rarely covered the whole of the breeding season (May–September), studies were carried out in six separate years. Two tagging studies showed individuals tagged from Bass Rock to use Area 10 during the breeding season (Wakefield *et al* 2013; Hamer *et al* 2007) and two other studies – one aerial and one boat-based - indicated high densities of northern gannet within Area 10 (National Research Project Ltd 2012; Seagreen Wind Energy 2012).

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*4*	*11.63*
Have surveyed Area 10 but do not provide supporting evidence	*0*	*0*

3.5.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of northern gannet are likely to be linked to the species' foraging behaviour and the proximity to breeding colonies (Robinson *et al* 2002; Davoren 2013). Kober *et al* (2010) estimate that 7,915 birds are

present within Area 10. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher.

Area 10 surrounds the Bass Rock gannetry, estimated at 44,110 occupied nests during Seabird 2000 (Mitchell *et al* 2004). Wakefield *et al* (2013) carried out a tracking study on a total of 12 northern gannet colonies around the UK and northern France which demonstrated that despite having relatively large foraging ranges, northern gannets utilise almost mutually exclusive colony-specific foraging areas, a pattern which is likely to be driven by density dependent competition. It is, however, entirely feasible for Area 10 to support a population of the size suggested by Kober *et al* (2010) based on the Bass Rock population alone.

Although foraging distributions of northern gannet from different colonies may not overlap (Wakefield *et al* 2013), based on the mean maximum foraging range for northern gannet of 229 km identified in Thaxter *et al* (2012), there is (in theory) one other smaller gannetry potentially within foraging range: Troup Head – reflecting a total population of 45,195 breeding pairs potentially within foraging range of Area 10 (Mitchell *et al* 2004).

Northern gannets are capable of a utilizing a wide range of fishing techniques such as deep plunging, shallow plunging, scooping prey, surface seizing and scavenging at fishing vessels (Camphuysen 2011) Consequently they typically have a highly varied fish diet (Nelson *et al* 2002) and common species consumed in UK waters include mackerel *Scomber scombrus*, sandeel *Ammodytes marinus*, sprat *Sprattus sprattus* and herring *Clupea harengus* (Hamer *et al* 2000). The northern gannet also frequently will make use of fisheries discard as a food resource where available (Votier *et al* 2010, 2013). Although Area 10 contains low intensity sandeel nursery grounds, the area does contain a high level of sandeel spawning activity (Ellis *et al* 2012). Furthermore, herring nursery grounds overlapping with Area 10 are classified as high intensity (Ellis *et al* 2012) and the area is classified as having a moderate intensity of demersal fisheries and shellfisheries (Coull *et al* 1998), which could indicate an availability of discarded fish. Other datasets indicative of northern gannet food distribution also show high levels of overlap; although, typically, northern gannets do not feed on copepods directly, copepod abundance has previously been mapped to predict northern gannet food availability as a proxy environmental variable (Grecian *et al* 2012). On comparison, Area 10 shows overlap with a moderate average June abundance of calanoid copepods, providing further evidence that this area may supports concentrations of food during the northern gannet breeding season.

Area 10 is characterised as having a low probability of thermal front occurrence (mean 32% ±20%) during the summer (DEFRA 2013). However, a tidal mixing front occurs approximately 50km offshore, and within Area 10, where well mixed shallow coastal waters meet deeper water, which is highly stratified in the summer (Skov *et al* 2008). Breeding northern gannets from the Bass Rock appear to focus much of their diving, as shown by the location of dives and area-restricted searching behaviour, at this front, indicating it may be an area of good food availability (Hamer *et al* 2009; Skov *et al* 2008). Ship-based survey data have also highlighted the importance of this region to northern gannet during the breeding season (Scott *et al* 2010).

The proximity of the area to a large number of birds breeding within foraging range and the presence of some predictable food sources provide supporting ecological explanations for the presence of an important aggregation of northern gannet within Area 10 during the breeding season.

3.5.4 Conclusions

Available evidence, additional to the ESAS analysis carried out by Kober *et al* (2010, 2012), that directly supports the identification of Area 10 as being of importance to northern gannet during the breeding season is limited to two tracking studies from the peer-reviewed literature, one aerial survey and one boat-based survey, both from the grey literature. All studies indicated that Area 10 may be an important foraging area for northern gannet. Further evidence obtained from the literature supports Area 10 as an area containing high levels of food availability.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to northern gannet in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 11.63/20 for supporting studies with no non-supporting studies. The strength of the additional evidence is strong and consistent (all studies with additional information support the identification of the area as important, Appendix 6).

3.6 Seabird Aggregation – Area 11

Northern gannet *Morus bassanus* - breeding season (May to September)

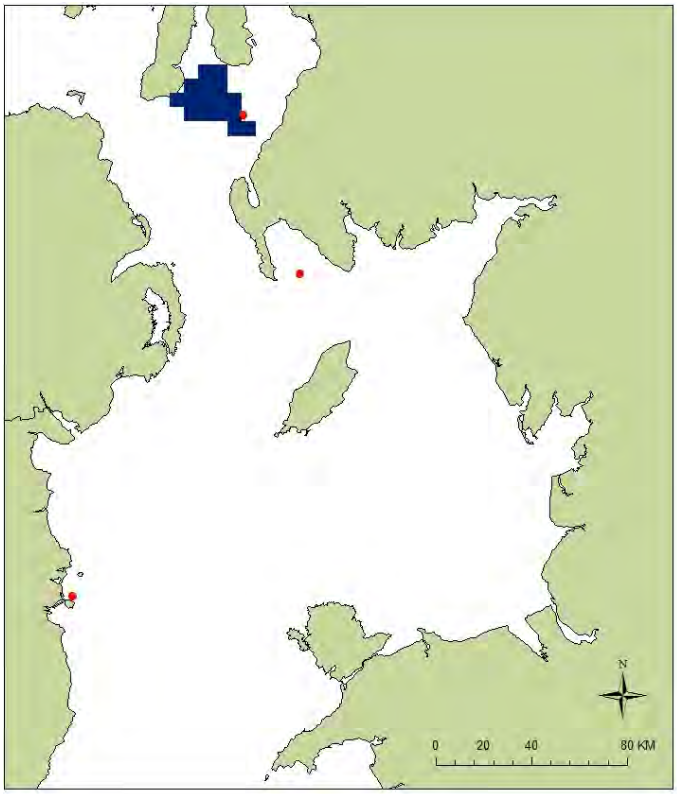


Figure 8. Area 11 (blue polygon), identified as an aggregation for northern gannet *Morus bassanus* during the breeding season (May to September). Breeding colonies of northern gannet potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.6.1 Identification of Area 11 as an important aggregation of northern gannet

Area 11 was identified by Kober *et al* (2010) as an important aggregation of northern gannet *Morus bassanus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 5,276 birds, 0.46% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 5 of the 7 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.6.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to one tracking study (see below). No evidence was located from boat or aerial survey data, seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: Wakefield *et al* (2013) fitted 12 adult northern gannets from Ailsa Craig breeding colony with GPS tags during the 2011 chick-rearing period (June to August). As

well as presenting foraging tracks of individual birds, this study used kernel density analysis to identify areas of importance to the birds. Area 11 falls completely within the 75% utilization distribution, which indicates that it may be a key foraging area for birds breeding on Ailsa Craig.

Grey literature: No studies found.

Expert opinion: No relevant information received.

Table 11. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 11 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.			
Wakefield *et al* 2013	4	1	5	1	1	1	0	NA	3	3	**9.75**	**Y**

Stage 2 of Assessment

Evidence supporting the identification of Area 11 as being of importance to breeding northern gannet, beyond the analyses undertaken by Kober *et al* (2010, 2012) is weak with an overall score of 6.25/20 (Appendix 6, Stage 2 – Site Scores). Although Wakefield *et al* (2013) showed adult birds from Ailsa Craig to forage within Area 11, the data represent a portion of only one breeding season.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*1*	*6.25*
Have surveyed Area 11 but do not provide supporting evidence	*0*	*0*

3.6.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of northern gannet are likely to be linked to the species' foraging behaviour and the proximity to breeding colonies (Robinson *et al* 2002; Davoren 2013). Kober *et al* (2010) estimate that 5,276 birds are present within Area 11. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher.

Area 11 surrounds the north and west coasts of Ailsa Craig. The island contains a large gannetry where the population estimate from Seabird 2000 is 35,825 occupied nests (Mitchell *et al* 2004). Wakefield *et al* (2013) carried out a tracking study on a total of 12 northern gannet colonies around the UK and northern France which demonstrated that despite having relatively large foraging ranges, northern gannets utilise almost mutually exclusive colony-specific foraging areas, a pattern which is likely to be driven by density dependent competition. It is entirely feasible for a population of the size described in Kober *et al* (2010) to be supported by birds from Ailsa Craig alone.

Although foraging distributions of northern gannet from different colonies may not overlap (Wakefield *et al* 2013), based on the mean maximum foraging range for northern gannet of 229 km identified in Thaxter *et al* (2012), there are (in theory) a further two other smaller gannetries potentially within foraging range: Ireland's Eye and Scar Rocks – reflecting an additional population of 37,642 breeding pairs potentially within foraging range of Area 11 (Mitchell *et al* 2004).

Northern gannets are capable of a utilizing a wide range of fishing techniques such as deep plunging, shallow plunging, scooping prey, surface seizing and scavenging at fishing vessels (see Camphuysen 2011 for further details) Consequently they typically have a highly varied fish diet (Nelson *et al* 2002) and common species consumed in UK waters include mackerel *Scomber scombrus*, sandeel *Ammodytes marinus*, sprat *Sprattus sprattus* and herring *Clupea harengus* (Hamer *et al* 2000). Although Area 11 contains low intensity sandeel and mackerel spawning and nursery grounds (Ellis *et al* 2012), herring nursery grounds overlapping with the area are classified as high intensity (Ellis *et al* 2012). In addition, Area 11 is intensively fished (Coull *et al* 1998), which could indicate a high availability of discarded fish. Other datasets indicative of northern gannet food distribution also show high levels of overlap; although, typically, northern gannets do not feed on copepods directly, copepod abundance has previously been mapped to predict northern gannet food availability as a proxy environmental variable (Grecian *et al* 2012). On comparison, Area 11 shows overlap with a high average June abundance of calanoid copepods, which may suggest further that this area supports high concentrations of food during the northern gannet breeding season.

Northern gannets have a strong foraging preference for oceanic fronts (Grémillet *et al* 2006; Skov *et al* 2008; Hamer *et al* 2009). Area 11 is characterised as having a medium probability of thermal front occurrence (mean 40% ±20%) during the summer (Defra 2013), which might give further support to Area 11 containing good foraging grounds.

The proximity of the area to a large number of breeding colonies, the presence of some predictable food sources, and the moderate probability of thermal fronts occurring within the area provide supporting ecological explanations for the presence of an important aggregation of northern gannet within Area 11 during the breeding season.

3.6.4 Conclusions

Available evidence, additional to the ESAS analysis carried out by Kober *et al* (2010, 2012), that directly supports the identification of Area 11 as being of importance to northern gannet during the breeding season is limited to one tracking study from the peer-reviewed literature. This study indicated that Area 11 may be an important foraging area for birds breeding on Ailsa Craig. Further evidence obtained from the literature supports Area 11 as an area which might offer predictable food resources including herring and fisheries discards, and moderate levels of thermal front probability. These environmental features have strong correlations with northern gannet foraging distribution providing good ecological explanations for the presence of this aggregation.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012) the evidence that supports the identification of the aggregation as being important to northern gannet in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 6.25/20 for supporting studies with no non-supporting studies. The strength of the additional evidence is weak, but it is consistent with the findings from Kober *et al* (2010) (Appendix 6).

3.7 Seabird Aggregation – Area 12

Northern gannet *Morus bassanus* - winter (October to April)

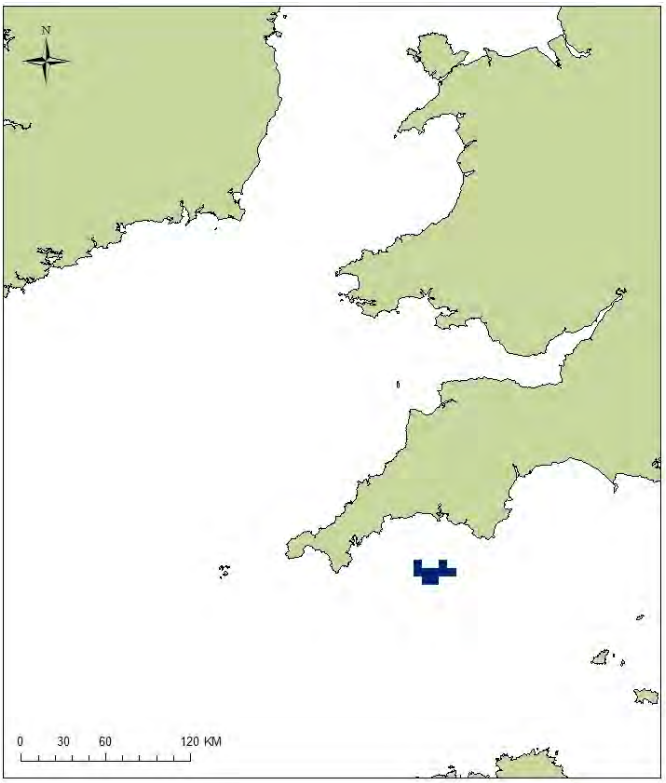


Figure 9. Area 12 (blue polygon), identified as an aggregation for northern gannet *Morus bassanus* during the winter (October to April).

3.7.1 Identification of Area 12 as an important aggregation of northern gannet

Area 12 was identified by Kober *et al* (2010) as an important aggregation of northern gannet *Morus bassanus* during the winter. Based on analysis of ESAS data, the area supports a population of 2,144 birds, 0.18% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 4 of the 4 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.7.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to one tracking study (see below) and one aerial survey. No evidence was located from boat survey data, seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: Kubetzki *et al* (2009) fitted adult northern gannets from the Bass Rock breeding colony with geolocation dataloggers. In total, 15 were deployed in August 2002 and 26 were deployed in August 2003. Of these, 13 were retrieved in April and May 2003 and 21 were retrieved in April 2004.There was no detailed analysis of area usage by the birds, but

the study presented the locations of birds at sea over the wintering period for only four individual birds as examples. Of these, two of which appear to overlap with Area 12 (but the scale of the map made it difficult to assess to what extent). Of the 18 birds for which winter home ranges were calculated, 8 remained within the wider geographic region surrounding Area 12 (described in the study as North Sea/English Channel or Celtic Sea/Bay of Biscay).The limited data available means this must be regarded as relatively weak evidence.

Grey literature: In the winter of 2007 to 2008, WWT Consulting (2009) undertook visual aerial surveys on a national scale using a methodology developed in Denmark by the National Environment Research Institute (NERI) (Kahlert *et al* 2004). The methods used followed distance sampling techniques (Buckland *et al* 2001) and data collected were analysed to produce density estimates with confidence limits. Maps of relative density produced for the south-west region of the survey indicate that densities of northern gannet observed within Area 12 during the winter months (ranging between 0 and 50 birds km^{-2}) were high, relative to the surrounding area.

Expert opinion: No relevant information received.

Table 12. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 12 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source											
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.	Type of source	Total adjusted score (max 15)	Supports Area as Important
Kubetzki *et al* 2009	1	3	2	1	1	1	0	NA	3	3	**6.75**	**Y**
WWT Consulting 2009	3	1	3	1	NA	NA	NA	1	2	2	**4.5**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 12 as being of importance to wintering northern gannet, beyond the analyses undertaken by Kober *et al* (2010, 2012) is weak with an overall score of 5.88/20 (Appendix 6, Stage 2 – Site Scores). Neither study (Kubetzki *et al* 2009; WWT Consulting 2009) represented an entire winter season and these data were collected during three separate winters.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*2*	*5.88*
Have surveyed Area 12 but do not provide supporting evidence	*0*	*0*

3.7.3 Ecological explanations

Processes underpinning the wintering distribution of northern gannet are poorly understood. Birds wintering within Area 12 may originate from a variety of different breeding colonies. Kubetzki *et al* (2009) demonstrated that birds from Bass Rock pass through Area 12 during the winter. Due to the migration patterns demonstrated through this study, it is quite possible that individuals from other large breeding colonies throughout the UK and Europe also use Area 12 during the winter period either as they pass through on migration, or could use the area as a wintering ground.

Northern gannets are capable of a utilizing a wide range of fishing techniques such as deep plunging, shallow plunging, scooping prey, surface seizing and scavenging at fishing vessels (see Camphuysen 2011 for further details) . Consequently they typically have a highly varied fish diet (Nelson *et al* 2002) and common species consumed in UK waters during the breeding season include mackerel *Scomber scombrus*, sandeel *Ammodytes marinus*, sprat *Sprattus sprattus* and herring *Clupea harengus* (Hamer *et al* 2000). There is a lack of information on the diet of the northern gannet in the winter however the northern gannet will frequently make use of fisheries discard as a food resource where available (Votier *et al* 2010, 2013). Direct evidence was found for a high presence of prey (Ellis *et al* 2012; Coull *et al* 1998), the area is known to be intensively fished for both pelagic and demersal species (Coull *et al* 1998), which could indicate a high availability of both prey and, potentially, discarded fish. However, over winter, the local herring fishery is closed to protect juvenile and spawning fish (Rogers 1997). As a consequence, there may be an increased abundance of key prey species in the area over the winter.

The proximity of the area to a large number of breeding colonies and the presence of high levels of fishing activity in summer, and potentially more abundant prey in winter due to the fishery closure, provide supporting ecological evidence for Area 12 as an important aggregation of northern gannet during the winter.

3.7.4 Conclusions

Evidence that directly supports the identification of Area 12 as being of importance to northern gannet during the winter, in addition to that identified by Kober *et al* (2010, 2012) is available from both the grey and peer-reviewed literature. One tracking study revealed a direct link between individuals using the area and the Bass Rock breeding colony, whilst a recent aerial survey also confirmed relatively high concentrations of northern gannet within Area 12. Area 12's overlap with high intensity fishing grounds, provide an indication of why the area could be important.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to northern gannet in the non-breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 5.88/20 for supporting studies, with no non-supporting studies. The strength of the additional evidence is weak but consistent (all studies with additional information support the identification of the area as important, Appendix 6).

3.8 Seabird Aggregation – Area 13

European shag *Phalacrocorax aristotelis* - breeding season (March to September)

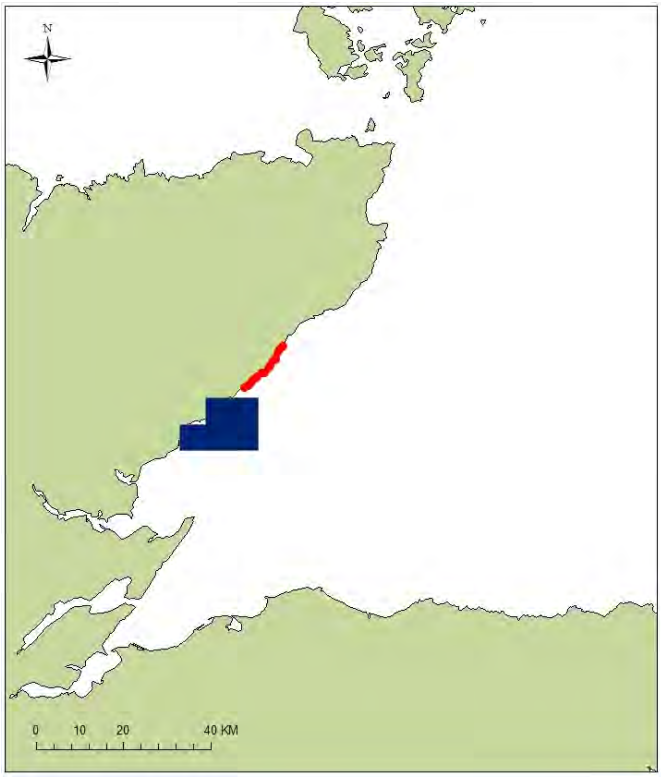


Figure 10. Area 13 (blue polygon), identified as an aggregation for European shag *Phalacrocorax aristotelis* during the breeding season (March to September). Breeding colonies of European shag potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.8.1 Identification of Area 13 as an important aggregation of European shag

Area 13 was identified by Kober *et al* (2010) as an important aggregation of European shag *Phalacrocorax aristotelis* during the breeding season. Based on analysis of ESAS data, the area supports a population of 4,606 birds, 2.28% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 3 of the 3 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.8.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to two boat-based surveys – one from the grey literature and one peer reviewed. No evidence came from tagging surveys, aerial surveys, seawatching data or casual observations. No relevant expert knowledge of the area was submitted through the questionnaire survey.

Peer reviewed: Between 9 and 16 June 1992, boat-based surveys were carried out to assess how differences in the marine environment influence feeding performance and distribution of

European shags (Wanless *et al* 1997). Standard survey methods were used (Tasker *et al* 1984; Webb & Durinck 1992) and the data were analysed to calculate average densities, but without the application of correction factors to account for environmental variables and detection issues. The mapped densities show that Area 13 overlaps with an area containing high densities of European shag.

Grey literature: Between January 1982 and December 1983, boat-based ornithological surveys were carried out covering much of the Moray Firth area (RPS 2012). Although the field methods used are not clear, during the analysis phase, distance sampling techniques with corrections were applied to produce densities and population estimates. The maps produced show European shag to be present in high densities (50-100 individuals) between May to July, and moderate densities (20–50 individuals) between August and October, in areas overlapping with Area 13. This overlap indicates that Area 13 may support high densities of European shag during the breeding season.

Expert opinion: No relevant information received.

Table 13. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 13 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
	Age of data	Number of years	Appropriate methodology	Representativeness								
				Season	Sex	Age of bird	Colony	Survey	Total represent.			
Wanless *et al* 1997	1	1	4	1	NA	NA	NA	1	2	3	**6**	**Y**
RPS 2012	1	3	0	2	NA	NA	NA	3	5	3	**6.75**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 13 as being of importance to breeding European shag, beyond the analyses undertaken by Kober *et al* (2010, 2012) is weak with an overall score of 6.13/20 (Appendix 6, Stage 2 – Site Scores). One study found in the search, collected data throughout the European shag breeding season (RPS 2012), identified by Kober *et al* (2010, 2012) as March to September. However some of the breeding season data were presented with data collected during the winter period and these data are over 30 years old and the relative value of this data should be interpreted carefully. Data from the peer reviewed study used for this assessment were collected only over a short period of the European shag breeding season (Wanless *et al* 1997). Both studies combined represented a total of 3 breeding season years (1982, 1983 and 1992).

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*2*	*6.13*
Have surveyed Area 13 but do not provide supporting evidence	*0*	*0*

3.8.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of European shag in Area 13 are likely to be linked to the species foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 4,606 birds are present within Area 13 during the breeding season. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher.

European shag have relatively short foraging distances during the breeding season. Based on the mean maximum foraging range for European shag of 14.5km identified in Thaxter *et al* (2012), there are 23 Seabird 2000 breeding colony count locations within foraging range totalling 839 occupied nests (Mitchell *et al* 2004). This suggests that it is feasible for Area 13 to support a population of the size suggested by Kober *et al* (2010), particularly after the chick fledging phase when large rafts of juveniles congregate close to the breeding colonies.

The European shag is classified as foot-propelled pursuit diver, feeding predominantly on lesser sandeels (Wanless *et al* 1998). Seabed sediment type (based on a relatively simple classification of the relative amounts of sand, gravel and mud) has been used a proxy for relative sandeel abundance and therefore used to identify potential feeding grounds for the European shag (Wanless *et al* 1997). Area 13's substrate is classified as sand and muddy sand (JNCC 2011) and the depth range within Area 13 (mean depth 28m ±12m SD) (BODC 2010) is optimum for sandeels (Wright *et al* 2000). High intensity sandeel spawning occurs in areas overlapping with Area 13 during the winter season (Ellis *et al* 2012), and this may reflect the presence of this species in summer.

Thus, the proximity of the area to a large number of breeding colonies and a possible high abundance of prey species during the summer months provides ecological explanations for the presence of an important aggregation of European shag within Area 13 during the breeding season.

3.8.4 Conclusions

Evidence that directly supports the identification of Area 13 as being of importance to European shag during the breeding season, in addition to that identified by Kober *et al* (2010, 2012) is available from both the grey and peer-reviewed literature. Two boat-based surveys confirm high densities of European shag within Area 13 during the breeding season. Furthermore, Area 13 is in foraging range of several other large breeding colonies. An overlap with areas containing possible high levels of prey species, including Smith Bank, an important sandeel spawning area, also suggests that Area 13 may represent an important foraging ground for the species.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to European shag in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 6.13/20 for supporting studies, with no non-

supporting studies. The strength of the additional evidence is weak but consistent (all studies with additional information support the identification of the area as important, Appendix 6).

3.9 Seabird Aggregation – Area 14

European shag *Phalacrocorax aristotelis* - winter (October to February)

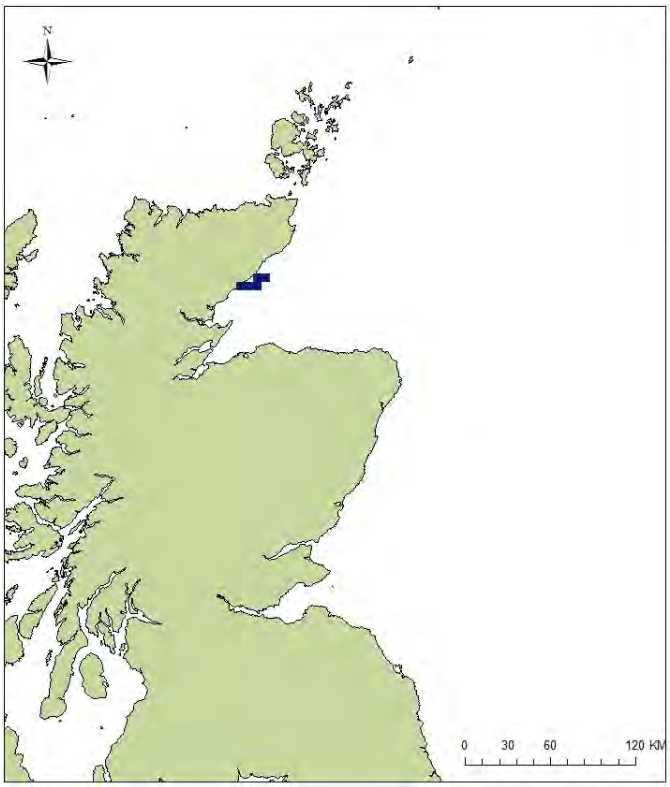


Figure 11. Area 14 (blue polygon), identified as an aggregation for European shag *Phalacrocorax aristotelis* during the winter (October to February).

3.9.1 Identification of Area 14 as an important aggregation of European shag

Area 14 was identified by Kober *et al* (2010) as an important aggregation of European shag *Phalacrocorax aristotelis* during the winter. Based on analysis of ESAS data, the area supports a population of 3,179 birds, 1.58% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 3 of the 3 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.9.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to one boat-based survey in the grey literature. No evidence came from tagging surveys, aerial surveys, seawatching data or casual observations. No relevant expert knowledge of the area was submitted through the questionnaire survey.

Peer reviewed: No studies found.

Grey literature: Between January 1982 and December 1983, boat-based ornithological surveys were carried out by RPS, covering much of the Moray Firth area (RPS 2012). Although it is not clear whether standard survey methods were used (e.g. Tasker *et al* 1984),

during the analysis phase, distance sampling techniques with corrections were applied to produce densities and population estimates. The maps produced show European shag to be present in high densities (50-100 individuals per km^2) between November and April, in areas overlapping with Area 14.

Expert opinion: No relevant information received.

Table 14. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 14 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.			
RPS 2012	1	3	0	2	NA	NA	NA	3	5	3	**6.75**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 14 as being of importance to wintering European shag, beyond the analyses undertaken by Kober *et al* (2010, 2012) is weak with an overall score of 6.25/20 (Appendix 6, Stage 2 – Site Scores). Only one relevant study was found in the literature search (RPS 2012) for which data were collected over three winter seasons (identified by Kober *et al* 2010, 2012 as October to February). These results should be treated with caution as the data are over 30 years old.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*1*	*6.25*
Have surveyed Area 14 but do not provide supporting evidence	*0*	*0*

3.9.3 Ecological explanations

Processes underpinning the wintering distribution of European shag are poorly understood. There is no evidence that European shag disperse south for the winter based on work carried out in the Firth of Forth (Daunt *et al* 2006), so birds wintering within Area 14 may originate from the colonies within the Moray Firth (Mitchell *et al* 2004).

European shag typically have a varied fish diet, of which the lesser sandeel *Ammodytes marinus* make up a very important component (Harris & Wanless 1991). The distribution of this fish species may determine feeding area preference (Wanless *et al* 1998). High intensity sandeel spawning occurs in areas overlapping with Area 14 during the winter (Ellis *et al*

2012). In addition, the depth range within Area 14 (mean depth 40m ±10m SD) (BODC, 2010) are optimum both for sandeels, and for the diving limits of European shag (Wright *et al* 2000; Daunt *et al* 2003).

Thus, the proximity of the area to a large number of breeding colonies and a possible high abundance of prey species during the winter months provides ecological explanations for the presence of an important aggregation of European shag within Area 14 during the breeding season.

3.9.4 Conclusions

Evidence that directly supports the identification of Area 14 as being of importance to European shag during the wintering season, in addition to that identified by Kober *et al* (2010, 2012) is available from one study in the grey literature. This boat-based survey confirms the presence of European shag within Area 14, but not in high density.

European shag are unlikely to disperse during the winter and Area 14 is close to several large breeding colonies. An overlap with areas containing possible high levels of prey species also suggests that Area 14 may represent an important foraging ground for the species.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to European shag in the winter is stronger than the evidence that does not, with the strength of the evidence being scored as 6.25/20 for supporting studies with no non-supporting studies. The strength of the additional evidence is weak, but consistent with that provided by Kober *et al* (2010) (Appendix 6).

3.10 Seabird Aggregation – Area 15

European shag *Phalacrocorax aristotelis* - winter (October to February)

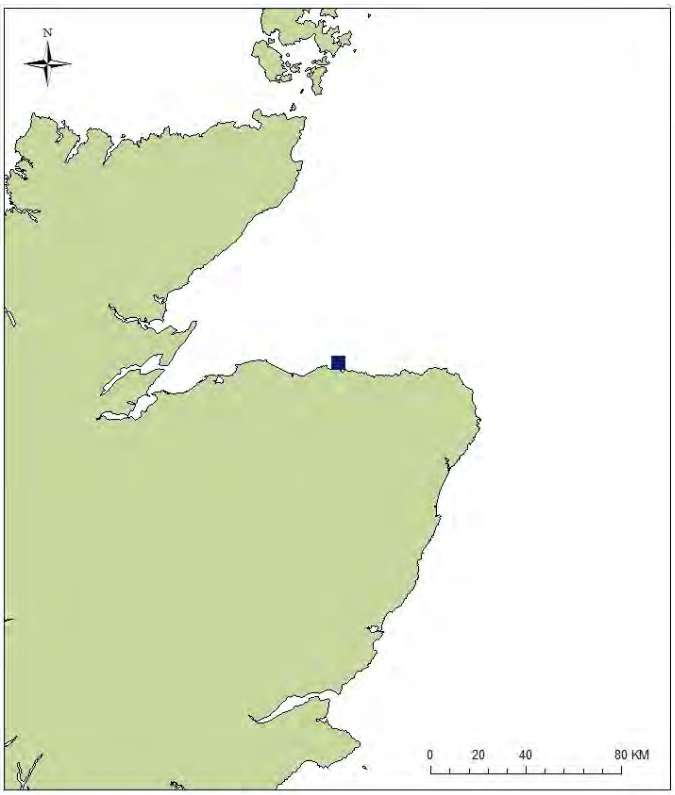


Figure 12. Area 15 (blue polygon), identified as an aggregation for European shag *Phalacrocorax aristotelis* during the winter (October to February).

3.10.1 Identification of Area 15 as an important aggregation of European shag

Area 15 was identified by Kober *et al* (2010) as an important aggregation of European shag *Phalacrocorax aristotelis* during the winter. Based on analysis of ESAS data, the area supports a population of 1,967 birds, 0.97% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 3 of the 3 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.10.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to one boat-based survey in the grey literature. No evidence came from tagging surveys, aerial surveys, seawatching data or casual observations. No relevant expert knowledge of the area was submitted through the questionnaire survey.

Peer reviewed: No studies found.

Grey literature: Between January 1982 and December 1983, boat-based ornithological surveys were carried out by RPS, covering much of the Moray Firth area (RPS 2012). Although it is not clear whether standard survey methods were used (e.g. Tasker *et al* 1984),

during the analysis phase, distance sampling techniques with corrections were applied to produce densities and population estimates. The maps produced show European shag to be present in moderate densities (1-5 individuals per km^2) between November to January and between February to April, in areas overlapping with Area 15. This overlap does not indicate high densities within Area 15, but, nevertheless, confirms European shag to use the area during the winter.

Expert opinion: No relevant information received.

Table 15. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 15 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.			
RPS 2012	1	3	0	2	NA	NA	NA	3	5	3	**6.75**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 15 as being of importance to wintering European shag, beyond the analyses undertaken by Kober *et al* (2010, 2012) is weak with an overall score of 6.25/20 (Appendix 6, Stage 2 – Site Scores). Only one relevant study was found in the literature search (RPS 2012) for which data from this study were collected over three winter seasons (identified by Kober *et al* 2010, 2012 as October to February). However, some of the winter season data was presented with data collected during the breeding season period, defined by Kober *et al* (2010, 2012) as March to September. These results should be treated with caution as the data are over 30 years old.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*1*	*6.25*
Have surveyed Area 15 but do not provide supporting evidence	*0*	*0*

3.10.3 Ecological explanations

Processes underpinning the wintering distribution of European shag are poorly understood. There is no evidence that European shag disperse for the winter based on work carried out in the Firth of Forth (Daunt *et al* 2006), so birds wintering within Area 15 may originate from the colonies within the Moray Firth (Mitchell *et al* 2004).

European shag typically have a varied fish diet, of which the lesser sandeel *Ammodytes marinus* make up a very important component (Harris & Wanless 1991). The distribution of this fish species may determine feeding area preference (Wanless *et al* 1998). High intensity sandeel spawning occurs in areas overlapping with Area 15 during the winter (Ellis *et al* 2012). In addition, (JNCC 2011) the depth range within Area 15 (mean depth 26m ± 9m SD) (BODC 2010) are optimum both for sandeels, and for the diving limits of European shag (Wright *et al* 2000; Daunt *et al* 2003).

Thus, the proximity of the area to a large number of breeding colonies and a possible high abundance of prey species during the winter months provides ecological explanations for the presence of an important aggregation of European shag within Area 15 during the winter.

3.10.4 Conclusions

Evidence that directly supports the identification of Area 15 as being of importance to European shag during the winter, in addition to that identified by Kober *et al* (2010, 2012) is available from one study in the grey literature. This boat-based survey confirms the presence of European shag within Area 15, but not in high density.

European shag are unlikely to disperse during the winter and Area 15 is close to several large breeding colonies. An overlap with areas containing possible high levels of prey species also suggests that Area 15 may represent an important foraging ground for the species.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to European shag in the winter is stronger than the evidence that does not, with the strength of the evidence being scored as 6.25/20 for supporting studies with no non-supporting studies. The strength of the additional evidence is weak, but it is consistent with Kober *et al* (2010) (Appendix 6).

3.11 Seabird Aggregation – Area 16

Great skua *Stercorarius skua* – breeding season (May to August)

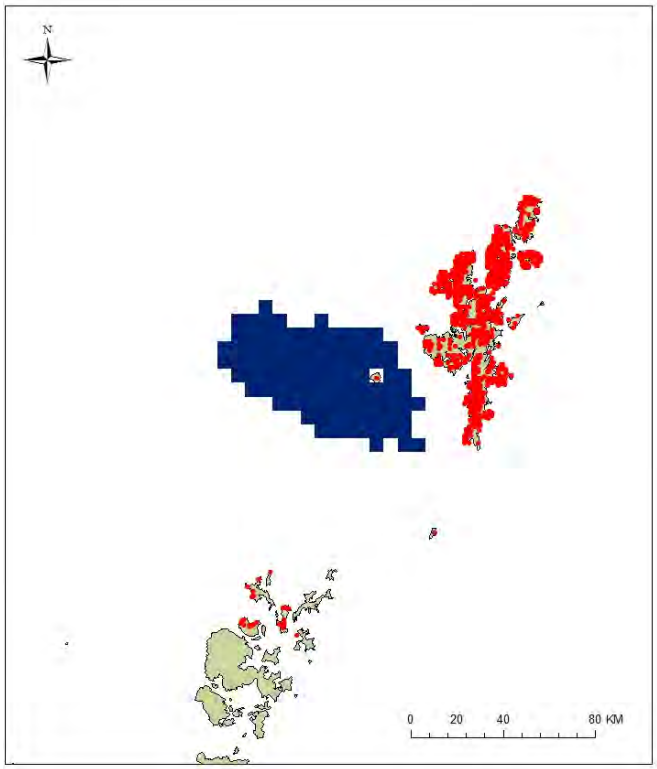


Figure 13. Area 16 (blue polygon), identified as an aggregation for great skua *Stercorarius skua* during the breeding season (May to August). Breeding colonies of great skua potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.11.1 Identification of Area 16 as an important aggregation of great skua

Area 16 was identified by Kober *et al* (2010) as an important aggregation of great skuas *Stercorarius skua* during the breeding season. Based on analysis of ESAS data, the area supports a population of 1,620 birds, 3.97% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 13 of the 14 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.11.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to two tracking studies (see below). No evidence was located from boat or aerial survey data, seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: No studies found.

Grey literature: Two tracking studies were located (Thaxter *et al* 2011), and Wade *et al* (2012). Both studies used birds fitted with GPS tags at their breeding colony on Foula. The

studies followed a methodology which provides data suitable for assessing the importance of Area 16, although their conclusions are based on limited sample sizes.

The studies use kernel density analysis to identify areas of importance to the birds, which were presented as 50% utilization areas. In both studies, Area 16 fell within the 50% utilization areas of birds from Foula, indicating it may reflect a key foraging area for birds from this colony. However, the same did not appear to be true for Hoy as none of the birds from this colony were tracked to Area 16, although this is not an unexpected finding as Area 16 was outside the mean maximum foraging range of birds from Hoy identified by Thaxter *et al* (2012). This suggests that the importance of Area 16 to great skua during the breeding season may vary by colony (see below, Ecological Explanations, for further discussion of this).

Expert opinion: No relevant information received.

Table 16. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 16 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
	Age of data	Number of years	Appropriate methodology	Representativeness								
				Season	Sex	Age of bird	Colony	Survey	Total represent.			
Wade *et al* 2012	4	1	4	2	1	0	1	NA	4	2	**6.5**	**Y**
Thaxter *et al* 2011	3	1	4	2	1	0	0	NA	3	2	**5.5**	**Y**

Stage 2 of Assessment

Whilst this evidence supports the identification of Area 16 as being of importance to breeding great skua, the strength of this evidence is weak with an overall score of 5/20 (Appendix 6, Stage 2 - Site Scores). Whilst data were obtained throughout the breeding season, data cover a total of two years only (i.e. Thaxter *et al* 2010; Wade *et al* 2011). Furthermore, the evidence supporting the identification of the area as important is limited to a small number of adult birds from a single breeding colony, and therefore, may not be representative of the population as a whole. Whilst data are relatively recent, the reliance on tracking studies, in combination with the limited number of studies and years of data collection (Appendix 6, Stage 2 - Site Scores), means there is limited additional evidence to support the identification of Area 16 as being of importance to breeding great skua, beyond the analysis of ESAS data undertaken in Kober *et al* (2010, 2012).

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*2*	*5*
Have surveyed Area 16 but do not provide supporting evidence	*0*	*0*

3.11.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of great skua in Area 16 are likely to be linked to the species foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 1,620 birds are present within Area 16. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher. Thaxter *et al* (2011) and Wade *et al* (2012) both showed birds from the breeding colony on Foula, where the most recent population estimates are of 2,293 apparently occupied territories (Mitchell *et al* 2004), making extensive use of Area 16. Based on the mean maximum foraging ranges of 86.4km presented in Thaxter *et al* (2012), there are a total of 882 great skua breeding colonies potentially within range of Area 16, with a total population of 6,924 apparently occupied nests (Mitchell *et al* 2004). The abundance of breeding birds within foraging range of Area 16 suggests that it is feasible for Area 16 to support in excess of 1% of the biogeographic population of great skua.

Area 16 also shows overlap with low intensity sandeel spawning and nursery grounds (Ellis *et al* 2012), areas of high intensity fishing activity (particularly demersal and shellfish fisheries) (Coull *et al* 1998; NAFC 2013) and the Shetland-Orkney thermal front. The importance of these features to great skua is likely to be linked to foraging behaviour. Great skua show varied foraging behaviours, predating fish, birds and mammals, but also klepto-parasitism of other seabirds and feeding on the discards from fishing vessels (Furness & Hislop 1981; Hudson & Furness 1989; Hamer *et al* 1991; Phillips *et al* 1997; Votier *et al* 2004, 2006). The importance of different food types varies both spatially and temporally in response to the local availability of different food types (Phillips *et al* 1997; Bearhop *et al* 2001).

Sandeel are an important prey species for many seabird species (Furness 1990; Monaghan 1992; Wanless *et al* 1998) and thermal fronts also offer predictable foraging areas for many species (Begg & Reid 1997). Whilst great skua may not directly forage on these resources, it is likely that they take advantage of them by klepto-parasitising the species that do (Andersson 1976; Furness 1978). The large concentrations of seabird colonies, in particular tern and black-legged kittiwake colonies, surrounding Area 16 suggests that there may be an abundance of other species to klepto-parasitise (Mitchell *et al* 2004).

In addition to klepto-parasitising other seabird species, data from Foula suggest that fisheries discards may also form a key part of the diet for birds at breeding colonies in the region surrounding Area 16 (Phillips *et al* 1997). The high intensity of fisheries operating within Area 16 (Coull *et al* 1998; NAFC 2013), which in itself may be linked to the presence of the Orkney-Shetland front, mean that discards may be a valuable food source for great skua colonies surrounding Area 16.

Area 16 is largely characterised by deep water (mean depth 112m ±34m SD). Consequently, whilst there are a number of submarine structures and reefs within Area 16, these are often beyond the diving depths of either great skua, or the species they may klepto-parasitise. For this reason, it is unlikely that these features may be influencing great skua distribution within Area 16.

The proximity of the area to a large number of breeding colonies and the presence of predictable food sources provide ecological explanations for the presence of an important aggregation of great skua within Area 16 during the breeding season.

3.11.4 Conclusions

Available evidence that directly supports the identification of Area 16 as being of importance to great skua during the breeding season is limited to two tracking studies from the grey literature. Both studies indicate that Area 16 may be an important foraging area for birds breeding on Foula. However, as no data have been collected from surrounding colonies, it is difficult to draw conclusions about the wider importance of the area. Despite this, the overlap with high intensity fishing grounds does provide circumstantial evidence to suggest that the area may be of importance to birds foraging on discards from fishing vessels.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to great skua in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 5/20 for supporting studies with no non-supporting studies. The strength of the additional evidence is weak but consistent (all studies with additional information support the identification of the area as important, Appendix 6).

3.12 Seabird Aggregation – Area 18

Black-legged kittiwake *Rissa tridactyla* – breeding season (May to September)

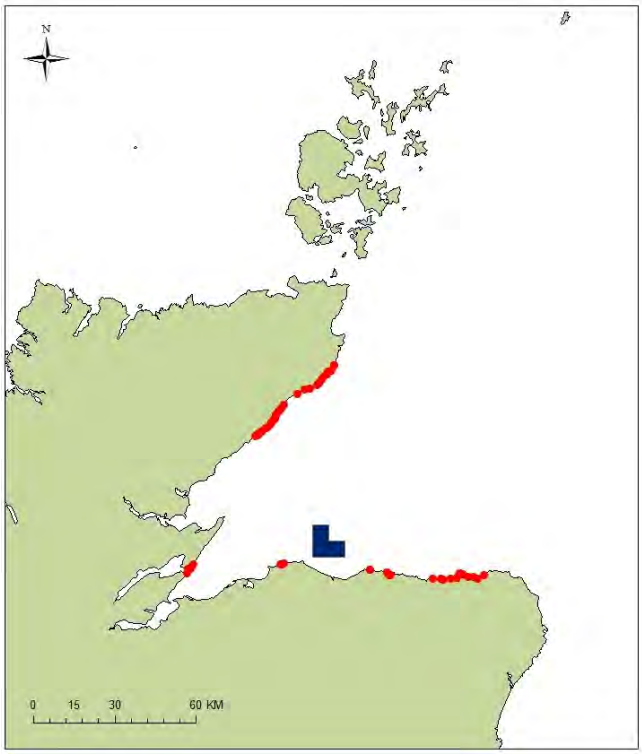


Figure 14. Area 18 (blue polygon), identified as an aggregation for black-legged kittiwake *Rissa tridactyla* during the breeding season (May to September). Breeding colonies of black-legged kittiwake potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.12.1 Identification of Area 18 as an important aggregation of black-legged kittiwake

Area 18 was identified by Kober *et al* (2010) as an important aggregation of black-legged kittiwake *Rissa tridactyla* during the breeding season. Based on analysis of ESAS data, the area supports a population of 3,167 birds, 0.04% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the hotspot persisted between years, and it was present in 3 of the 3 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.12.2 Literature review of additional evidence

Stage 1 of Assessment

Our literature review failed to identify any independent evidence regarding the identification of Area 18 as being of importance to the black-legged kittiwake in the breeding season in the peer-reviewed literature, grey literature or from expert knowledge.

Peer reviewed: No studies found.

Grey literature: No studies found.

Expert opinion: No relevant information received.

Stage 2 of Assessment

No evidence beyond that presented in Kober *et al* (2010, 2012) was identified.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*0*	*0*
Have surveyed Area 18 but do not provide supporting evidence	*0*	*0*

3.12.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of black-legged kittiwake in Area 18 are likely to be linked to the species' foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 3,167 birds are present within Area 18. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher. Based on the mean maximum foraging range, estimated by Thaxter *et al* (2012), of 60km for black-legged kittiwake, there are 83 breeding colonies with a total population of 56,152 pairs (Mitchell *et al* 2004) potentially within range of Area 18. The abundance of breeding birds within foraging range of Area 18 suggests that it is feasible for Area 18 to support the population of birds estimated by Kober *et al* (2010).

Area 18 is characterised by water of a moderate depth (mean depth 43m ±20m) (BODC 2010), with a low probability of thermal fronts (DEFRA 2013). Whilst there is an overlap with some reef structures (JNCC 2011), as black-legged kittiwake are predominantly surface feeders (Cramp & Simmons 1983), these features are unlikely to influence the distribution of black-legged kittiwake beyond the possible attraction of the reef structures to prey species as shelter from predation.

Sandeel are a key prey species for the black-legged kittiwake (Lewis *et al* 2001) and the recent closure of the sandeel fishery in eastern Scotland is believed to have led to an improvement in the breeding success of black-legged kittiwake at nearby colonies (Daunt *et al* 2008). The sand and muddy sand substrate of the area (JNCC 2011) make it an attractive spawning ground for sandeel, which are present in high concentrations within Area 18 (Ellis *et al* 2012). Hence the presence of a predictable food source close to a large number of breeding colonies is likely to provide a strong ecological explanation for the aggregation of black-legged kittiwake during the breeding season identified by Kober *et al* (2010) in Area 18. Although several fisheries operate at a moderate intensity within Area 18 (Coull *et al* 1998), black-legged kittiwake are less likely to scavenge behind fishing vessels than other gulls as their relatively small size means they be easily outcompeted by larger species (Hudson & Furness 1989; Valeiras 2003).

3.12.4 Conclusions

We were unable to identify evidence beyond that presented in Kober *et al* (2010, 2012) to support the identification of Area 18 as being of importance to black-legged kittiwake during the breeding season. However, given the large number of breeding black-legged kittiwake within the wider region, and the presence of strong ecological reasons for the presence of an

important aggregation in Area 18, the absence of this evidence is likely to reflect the fact that movements of black-legged kittiwakes within this region remain poorly researched.

Overall, no evidence, beyond that presented in Kober *et al* (2010, 2012), was available to provide support for or against the identification of Area 18 as being of importance to black-legged kittiwake during the breeding season.

3.13 Seabird Aggregation – Area 19

Black-legged kittiwake *Rissa tridactyla* – breeding season (May to September)

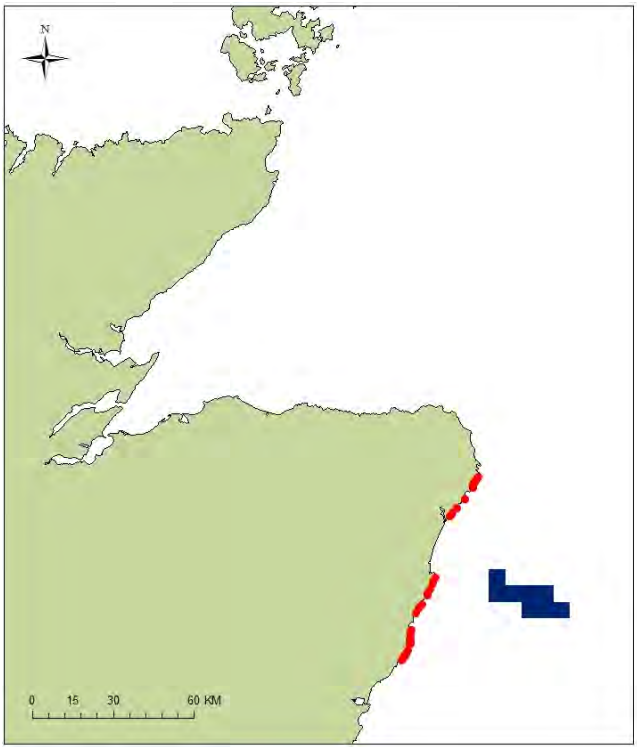


Figure 15. Area 19 (blue polygon), identified as an aggregation for black-legged kittiwake *Rissa tridactyla* during the breeding season (May to September). Breeding colonies of black-legged kittiwake potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.13.1 Identification of Area 19 as an important aggregation of black-legged kittiwake

Area 19 was identified by Kober *et al* (2010) as an important aggregation of black-legged kittiwake *Rissa tridactyla* during the breeding season. Based on analysis of ESAS data, the area supports a population of 8,236 birds, 0.10% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 4 of the 5 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.13.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to a single tracking study (see below). No evidence was located from boat or aerial survey data, seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: No studies found.

Grey literature: As part of the Environmental Impact Assessments for the Firth of Forth Alpha Offshore Wind Farm Zone, black-legged kittiwake from the Fowlsheugh, Isle of May and St. Abbs Head breeding colonies were fitted with GPS devices to monitor their movements over a two year period. The resultant data revealed birds from the Fowlsheugh colony, but not the Isle of May or St. Abbs Head colonies, foraging within Area 19. However, no analyses were undertaken on these datasets.

Expert opinion: No relevant information received.

Table 17. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 19* (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source											
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.	Type of source	Total adjusted score (max 15)	Supports Area as Important
Seagreen Wind Energy 2012	4	3	4	1	1	0	1	NA	3	3	**10.5**	**Y**

*Data from the RSPB FAME tracking project also show birds from the Muckle Skerry colony in 2011 and Fowlsheugh colony in 2012 using area 19. However, only raw track data were available from these studies and it was not possible to determine how many birds were represented by these tracks, or which part of the breeding season data originate from. For this reason, it was not possible to assess these studies in the same way as the others.

Stage 2 of Assessment

Evidence from the literature review provide only weak support for the identification of Area 19 as being of importance to black-legged kittiwake, with an overall score of 6.5/20 (Appendix 6, Stage 2 – Site Scores). However, this evidence is limited to data from a single tracking study, albeit one that was carried out over a two year period.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*1*	*6.5*
Have surveyed Area 19 but do not provide supporting evidence	*0*	*0*

3.13.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of black-legged kittiwake in Area 19 are likely to be linked to the species foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 8,236 birds are present within Area 19. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher. In addition to the tracking data collected as part of the Environmental Impact Assessment for the Firth of Forth Offshore Wind Farm Zone showing birds from Fowlsheugh using Area 19, additional unpublished tracking data from the RSPB FAME project also showed overlap between Area 19 and foraging birds from Muckle Skerry in 2011 and Fowlsheugh in 2012. Based on the mean maximum foraging range, estimated by Thaxter *et al* (2012), of 60km for black-legged kittiwake, there are 78 breeding colonies with a total population of 50,538 pairs (Mitchell *et al* 2004) potentially within range of Area 19. The abundance of breeding birds within foraging range of Area 19 suggests that it is feasible for Area 19 to support the population of birds estimated by Kober *et al* (2010).

Area 19 is characterised by relatively deep water (mean depth 77m ±15m) (BODC 2010), with a low probability of thermal fronts (DEFRA 2013).

Sandeel are a key prey species for the black-legged kittiwake (Lewis *et al* 2001) and the recent closure of the sandeel fishery in eastern Scotland is believed to have led to an improvement in the breeding success of black-legged kittiwake at nearby colonies (Daunt *et al* 2008). The sand and muddy sand substrate of the area (JNCC 2011) make it an attractive spawning ground for sandeel, which are present in high concentrations within Area 19 (Ellis *et al* 2012). Hence the presence of a predictable food source close to a large number of breeding colonies is likely to provide a strong ecological explanation for the aggregation of during the breeding season identified by Kober *et al* (2010) in Area 19. Although several fisheries operate at a moderate intensity within Area 19 (Coull *et al* 1998), black-legged kittiwake are less likely to scavenge behind fishing vessels than other gulls as their relatively small size means they be easily outcompeted by larger species (Hudson & Furness 1989; Valeiras 2003).

3.13.4 Conclusions

Available evidence that directly supports the identification of Area 19 as being of importance to black-legged kittiwake during the breeding season is limited to a single tracking study from the grey literature, which shows a link with birds from the Fowlsheugh breeding colony. However, with the onset of additional tracking studies in the region, for example the RSPB FAME project, the evidence base is likely to improve in future years. In addition, the overlap with a spawning area for sandeel, a key prey species for black-legged kittiwake, provides a strong ecological explanation for the presence of an important aggregation in Area 19.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to black-legged kittiwake in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 6.5/20 for supporting studies with no non-supporting studies. The strength of the additional evidence is weak, but it is consistent with Kober *et al* (2010) (Appendix 6).

3.14 Seabird Aggregation – Area 20

Black-legged kittiwake *Rissa tridactyla* – breeding season (May to September)

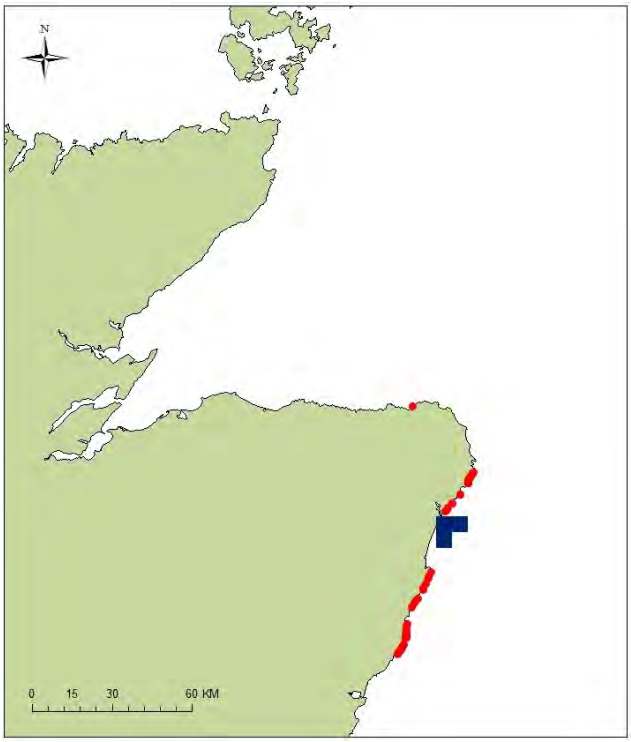


Figure 16. Area 20 (blue polygon), identified as an aggregation for black-legged kittiwake *Rissa tridactyla* during the breeding season (May to September). Breeding colonies of black-legged kittiwake potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.14.1 Identification of Area 20 as an important aggregation of black-legged kittiwake

Area 20 was identified by Kober *et al* (2010) as an important aggregation of black-legged kittiwake *Rissa tridactyla* during the breeding season. Based on analysis of ESAS data, the area supports a population of 4,199 birds, 0.05% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 8 of the 8 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.14.2 Literature review of additional evidence

Stage 1 of Assessment

Our literature review failed to identify any independent evidence regarding the identification of Area 20 as being of importance to the black-legged kittiwake in the breeding season in the peer-reviewed literature, grey literature or from expert knowledge.

Peer reviewed: No studies found.

Grey literature: No studies found.

Expert opinion: No relevant information received.

Data from the RSPB FAME tracking project also show birds from the Muckle Skerry colony in 2011 and the Fowlsheugh, Isle of May, Bullers of Buchan and Whinnyfold colonies in 2012 using area 20. However, only raw track data were available from these studies and it was not possible to determine how many birds were represented by these tracks, or which part of the breeding season data originate from. For this reason, it was not possible to assess these studies in the same way as the others.

Stage 2 of Assessment

No evidence beyond that presented in Kober *et al* (2010, 2012) was identified.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*0*	*0*
Have surveyed Area 20 but do not provide supporting evidence	*0*	*0*

3.14.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of black-legged kittiwake in Area 20 are likely to be linked to the species' foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 4,199 birds are present within Area 20. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher. Unpublished tracking data from the RSPB FAME project reveal overlap between Area 20 and foraging birds from four colonies in 2011 and 2012 – Muckle Skerry, Isle of May, Bullers of Buchan, and Whinnyfold. Based on the mean maximum foraging range, estimated by Thaxter *et al* (2012), of 60km for black-legged kittiwake, there are 79 breeding colonies with a total population of 50,550 pairs (Mitchell *et al* 2004) potentially within foraging range of Area 20. The abundance of breeding birds within foraging range of Area 20 suggests that it is feasible for Area 20 to support the population of birds estimated by Kober *et al* (2010).

Area 20 is characterised by water of a moderate depth (mean depth 31m ±17m) (BODC 2010), with a low probability of thermal fronts (DEFRA 2013).

Sandeel are a key prey species for the black-legged kittiwake (Lewis *et al* 2001) and the recent closure of the sandeel fishery in eastern Scotland is believed to have led to an improvement in the breeding success of black-legged kittiwake at nearby colonies (Daunt *et al* 2008). The sand and muddy sand substrate of the area (JNCC 2011) make it an attractive spawning ground for sandeel, which are present in high concentrations within Area 20 (Ellis *et al* 2012). Hence the presence of a predictable food source close to a large number of breeding colonies is likely to provide a strong ecological explanation for the aggregation of during the breeding season identified by Kober *et al* (2010) in Area 20. Although several fisheries operate at a moderate intensity within Area 20 (Coull *et al* 1998), black-legged kittiwake are less likely to scavenge behind fishing vessels than other gulls as their relatively small size means they be easily outcompeted by larger species (Hudson & Furness 1989; Valeiras 2003).

3.14.4 Conclusions

We were unable to identify evidence from the literature beyond that presented in Kober *et al* (2010, 2012) to support the identification of Area 20 as being of importance to black-legged kittiwake during the breeding season during our literature review. However, recent tracking data from the RSPB FAME project has revealed birds from at least five colonies may use the area for foraging. On top of this, seawatching accounts from sites on the Aberdeenshire coast close to Area 20 regularly report counts of several thousand black-legged kittiwakes during the breeding season (North East Bird Club 2008). Given the large number of breeding black-legged kittiwake within the wider region, and the presence of strong ecological reasons for the presence of an important aggregation in Area 20, the absence of published evidence is likely to reflect the fact that movements of black-legged kittiwakes have been relatively poorly researched until recently. However, the ongoing RSPB tracking studies are likely to address this problem.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to black-legged kittiwake in the breeding season is stronger than the evidence that does not. However, the additional evidence was limited to unpublished results from the RSPB FAME study and circumstantial evidence from seawatching, and therefore we have not been able to give a score for the strength of the evidence (as we have done where there is evidence in published literature). This limited evidence is weak but it is consistent with Kober *et al* (2010).

3.15 Seabird Aggregation – Area 21

Black-legged kittiwake *Rissa tridactyla* – breeding season (May to September)

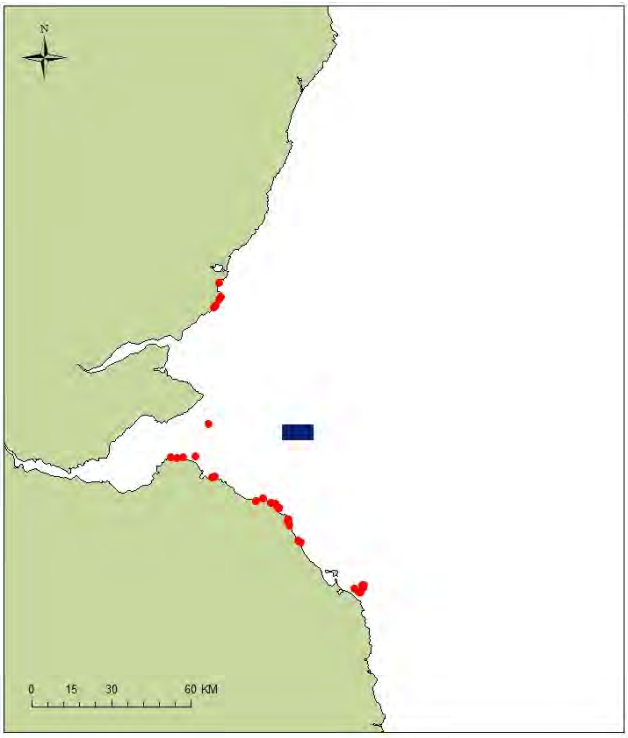


Figure 17. Area 21 (blue polygon), identified as an aggregation for black-legged kittiwake *Rissa tridactyla* during the breeding season (May to September). Breeding colonies of black-legged kittiwake potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.15.1 Identification of Area 21 as an important aggregation of black-legged kittiwake

Area 21 was identified by Kober *et al* (2010) as an important aggregation of black-legged kittiwake *Rissa tridactyla* during the breeding season. Based on analysis of ESAS data, the area supports a population of 3,123 birds, 0.04% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 3 of the 3 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.15.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was identified as two tracking studies, three boat surveys and an aerial survey (see below). No evidence was located from seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: Data were collected as part of two boat-based surveys (Wanless *et al* 1998; Cox *et al* 2013). An additional paper presenting the results of a boat-based survey, (Scott *et al* 2010), was also identified, but it was concluded that this presented the same data as

presented in Cox *et al* (2013). Both surveys were carried out over a limited time period during the breeding season, Wanless *et al* (1998) during the 1997 breeding season and Cox *et al* (2013) during the 2003 breeding season. Due to the way data were presented in these studies, it was not possible to determine numbers of birds within Area 21 but, both studies identified concentrations of black-legged kittiwake within Area 21, with Wanless *et al* (1998) producing density estimates based on a variable transect width and Cox *et al* (2013) employing a more advanced spatial modelling approach to determine population estimates for birds within the area surrounding Area 21.

Grey literature: Two tracking studies (Camphuysen 2005; Seagreen Wind Energy 2012), one boat survey (Natural Research Projects Ltd 2012) and an aerial survey (Seagreen Wind Energy 2012) were identified. Seagreen Wind Energy (2012) presents data from both a tracking study and an aerial study. However, the outputs from these pieces of work are presented in isolation from each other, and were therefore assessed as two separate studies. Tracking data were collected from the Isle of May (Camphuysen 2005; Seagreen Wind Energy 2012), Fowlsheugh and St Abbs Head (Seagreen Energy 2012). Whilst no detailed analyses were undertaken on either dataset, the studies revealed overlap between foraging birds from all three colonies and Area 21.

The aerial survey dataset was collected through a series of monthly surveys over the course of a year (Seagreen Wind Energy 2012). The boat surveys were also carried out on a monthly basis, but over the course of a two year period. Both surveys revealed concentrations of birds within Area 21, having used the data they collected to produce density estimates for the region surrounding Area 21.

Expert opinion: No relevant information received.

Table 18. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 21* (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source											
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.	Type of source	Total adjusted score (max 15)	Supports Area as Important
Camphuysen 2005	1	3	4	2	1	0	0	NA	3	2	**5.5**	**Y**
Cox *et al* 2013	1	1	5	1	NA	NA	NA	1	2	3	**6.75**	**Y**
Natural Research Projects Ltd 2012	4	3	4	2	NA	NA	NA	3	5	3	**12**	**Y**
Seagreen Wind Energy 2012	3	1	4	2	NA	NA	NA	3	5	3	**9.75**	**Y**
Seagreen Wind Energy 2012	4	3	4	1	1	0	1	NA	3	3	**10.5**	**Y**
Wanless *et al* 1998	1	1	4	1	NA	NA	NA	1	2	3	**6**	**Y**

*Data from the RSPB FAME tracking project also show birds from the Isle of May colony in 2012 and Isle of May and St. Abbs Head colonies in 2013 using area 21. However, only raw track data were available from these studies and it was not possible to determine how many birds were represented by these tracks, or which part of the breeding season data originate from. For this reason, it was not possible to assess these studies in the same way as the others.

Stage 2 of Assessment

The evidence supporting the identification of Area 21 as being of importance to breeding black-legged kittiwake, beyond the analyses undertaken by Kober *et al* (2010, 2012) is strong with an overall score of 10.81/20 (Appendix 6, Stage 2 – Site Scores). Data have been collected in four separate years, and in many instances cover the breeding season as a whole. Both aerial and boat-based surveys have revealed concentrations of black-legged kittiwake within Area 21 and tracking studies have revealed a link to three breeding colonies – Fowlsheugh, Isle of May and St. Abbs Head.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*6*	*10.81*
Have surveyed Area 21 but do not provide supporting evidence	*0*	*0*

3.15.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of black-legged kittiwake in Area 21 are likely to be linked to the species' foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 3,123 birds are present within Area 21. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher. In addition to the tracking studies described above, recent, unpublished data from the RSPB FAME project has also revealed an overlap between foraging birds from the Isle of May and St. Abbs Head, further highlighting the potential importance of this area to birds from these colonies. Based on the mean maximum foraging range, estimated by Thaxter *et al* (2012), of 60km for black-legged kittiwake, there are 47 breeding colonies with a total population of 35,276 pairs (Mitchell *et al* 2004) potentially within range of Area 21. The abundance of breeding birds within foraging range of Area 21 suggests that it is feasible for Area 21 to support the population of birds estimated by Kober *et al* (2010).

Area 21 is characterised by water of a moderate depth (mean depth 49m ±3m) (BODC 2010), with a low probability of thermal fronts (DEFRA 2013).

Sandeel are a key prey species for the black-legged kittiwake (Lewis *et al* 2001) and the recent closure of the sandeel fishery in eastern Scotland is believed to have led to an improvement in the breeding success of black-legged kittiwake at nearby colonies (Daunt *et al* 2008). The sand and muddy sand substrate of the area (JNCC 2011) make it an attractive spawning ground for sandeel, which are present in high concentrations within Area 21 (Ellis *et al* 2012). Hence the presence of a predictable food source close to a large number of breeding colonies is likely to provide a strong ecological explanation for the aggregation of during the breeding season identified by Kober *et al* (2010) in Area 21. Although several fisheries operate at a moderate intensity within Area 20 (Coull *et al* 1998), black-legged kittiwake are less likely to scavenge behind fishing vessels than other gulls as their relatively small size means they be easily outcompeted by larger species (Hudson & Furness 1989; Valeiras 2003).

3.15.4 Conclusions

Evidence that directly supports the identification of Area 21 as being of importance to black-legged kittiwake during the breeding season, in addition to that identified by Kober *et al* (2010, 2012) is available from both the grey and peer-reviewed literature. Two tracking studies revealed a direct link between the area and two breeding colonies, supported by additional, recent data from the RSPB FAME project. The potential importance of the site is reinforced by recent, regular boat and aerial surveys highlighting a significant concentration of birds within Area 21 during the breeding season. The overlap with sandeel spawning areas and proximity to a number of large breeding colonies provides a strong ecological explanation for the importance of Area 21 to breeding black-legged kittiwake.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to

black-legged kittiwake in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 10.8/20 for supporting studies, with no non-supporting studies. The strength of the additional evidence is strong and consistent (all studies with additional information support the identification of the area as important, Appendix 6).

3.16 Seabird Aggregation – Area 23

Herring gull *Larus argentatus* – breeding season (April to August)

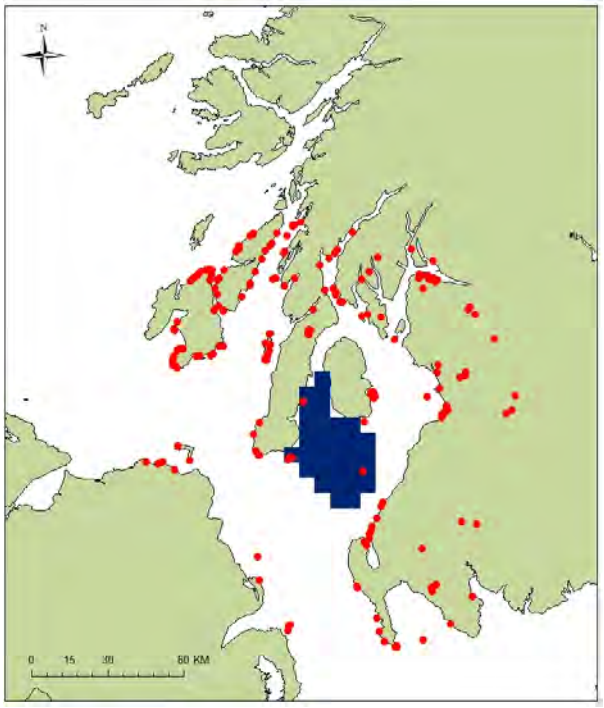


Figure 18. Area 23 (blue polygon), identified as an aggregation for herring gull *Larus argentatus* during the breeding season (April to August). Breeding colonies of herring gull potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.16.1 Identification of Area 23 as an important aggregation of herring gull

Area 23 was identified by Kober *et al* (2010) as an important aggregation of herring gull *Larus argentatus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 9,430 birds, 0.36% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 5 of the 7 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.16.2 Literature review of additional evidence

Stage 1 of Assessment

Our literature review failed to identify any independent evidence regarding the identification of Area 23 as being of importance to the herring gull in the breeding season in the peer-reviewed literature, grey literature or from expert knowledge.

Peer reviewed: No studies found.

Grey literature: No studies found.

Expert opinion: No relevant information received.

Stage 2 of Assessment

No evidence beyond that presented in Kober *et al* (2010, 2012) was identified.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*0*	*0*
Have surveyed Area 23 but do not provide supporting evidence	*0*	*0*

3.16.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of herring gull in Area 23 are likely to be linked to the species' foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 9,430 birds are present within Area 23. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher. Based on the mean maximum foraging range of 61.1km for herring hull identified in Thaxter *et al* (2012), Area 23 is within the foraging range of herring gulls from 212 breeding colonies, with 15,260 apparently occupied nests (Mitchell *et al* 2004). The size of this local population means that the number of birds associated with the aggregation estimated by Kober *et al* (2010, 2012) is entirely feasible.

At sea, herring gulls are typically surface feeders (Cramp & Simmons 1983), often scavenging behind fishing vessels during the breeding season (Hudson & Furness 1988, 1989; Furness *et al* 1992; Camphuysen 1995). The moderate to high intensity fisheries that operate within Area 23 (Coull *et al* 1998) may therefore offer a predictable source of food at a time when breeding adults are provisioning for their chicks.

The area is characterised as being 47m deep (±14m SD) with a mud and sandy substrate, with a low probability of thermal fronts occurring. However, as herring gulls are primarily surface feeders, and their main source of food within this area is likely to be fisheries discards, these features may not influence the distribution of gulls within the wider region.

3.16.4 Conclusions

We were unable to identify evidence beyond that presented in Kober *et al* (2010, 2012) to support the identification of Area 23 as being of importance to herring gulls during the breeding season. However, given the large number of breeding gulls within the wider region, and the presence of ecological reasons for the presence of an important aggregation in Area 23, the absence of this evidence is likely to reflect the fact that movements of herring gulls within this region remain poorly researched.

Overall, beyond that presented by Kober *et al* (2010, 2012), no evidence was available to provide support for or against the identification of Area 23 as being of importance to herring gulls during the breeding season.

3.17 Seabird Aggregation – Area 24

Arctic tern *Sterna paradisaea* – breeding season (May to August)

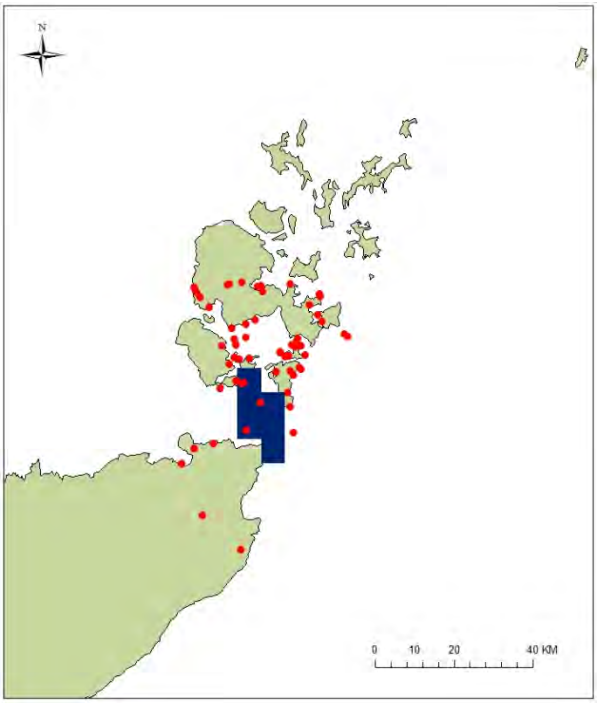


Figure 19. Area 24 (blue polygon), identified as an aggregation for Arctic tern *Sterna paradisaea* during the breeding season (May to August). Breeding colonies of Arctic tern potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.17.1 Identification of Area 24 as an important aggregation of Arctic tern

Area 24 was identified by Kober *et al* (2010) as an important aggregation of Arctic tern *Sterna paradisaea* during the breeding season. Based on analysis of ESAS data, the area supports a population of 692 birds, 0.43% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 5 of the 7 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.17.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to one boat-based study and one aerial survey in the grey literature. No evidence was located from tagging studies, seawatching or casual observations. No relevant expert knowledge of the area was received from the questionnaire survey returns.

Peer reviewed: No studies found.

Grey literature: Boat-based ornithological surveys were carried out by the JNCC for three days in June 2011 (JNCC 2011). Survey methods followed standard ESAS methods. The results were modelled to estimate density of usage. The model was based on a model derived from visual-tracking data collected on Arctic terns around several other colonies.

Areas of high usage overlapped with Area 24. This overlap indicates that Area 24 may be a key foraging area for birds from breeding colonies within foraging range.

Digital aerial surveys were carried out by APEM in the Pentland Firth on a monthly basis between November 2011 and August 2010. These followed the guidance set out for aerial survey by Camphuysen *et al* (2004). Survey data were modelled to produce density estimates for the survey area as a whole. Area 24 overlapped with several of the areas which were predicted to hold the highest densities of Arctic Terns (APEM 2013).

Expert opinion: No relevant information received.

Table 19. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 24 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
	Age of data	Number of years	Appropriate methodology	Representativeness								
				Season	Sex	Age of bird	Colony	Survey	Total represent.			
JNCC 2011	4	1	4	1	NA	NA	NA	1	2	3	**8.25**	**Y**
APEM 2013	4	1	5	2	NA	NA	NA	3	5	2	**7.5**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 24 as being of importance to breeding Arctic tern, beyond the analyses undertaken by Kober *et al* (2010, 2012) is weak with an overall score of 5.625/20 (Appendix 6, Stage 2 – Site Scores). Whilst the data collected was only collected for one year and did not cover the whole Arctic tern breeding season (May to August), the results highlighted Area 24 as being of important and revealed direct links to two different breeding colonies (JNCC 2011).

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*2*	*5.63*
Have surveyed Area 24 but do not provide supporting evidence	*0*	*0*

3.17.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of Arctic tern in Area 24 are likely to be linked to the species' foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 692 birds are present within Area 24. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher.

The JNCC's Pentland Firth surveys demonstrated that birds from the breeding colonies on Swona and Muckle Skerry make extensive use of Area 24 (JNCC 2011), as did aerial surveys carried out by APEM (APEM 2013). Based on the mean maximum foraging range for Arctic tern of 24.2km identified in Thaxter *et al* (2012), there are an additional 65 Seabird 2000 breeding colony count locations within foraging range. Although not all combined Orkney and North Caithness breeding colonies may be in foraging range, most recent estimates of numbers of breeding Arctic terns in this region total 13,476 (Mitchell *et al* 2004). This suggests that it is entirely feasible for Area 24 to support a population of the size suggested by Kober *et al* (2010).

Arctic terns typically have varied fish diet, feeding predominantly on lesser sandeels *Ammodytes marinus* (Cabot & Nisbet 2013). Area 24 does not overlap with Sandeel nursery grounds (Ellis *et al* 2012); although nursery grounds are known to occur elsewhere in the Pentland Firth and the water depths within Area 24 (mean depth 59m ±24m SD, BODC 2010) overlap with the optimum depth range of Sandeel (Shields *et al* 2009; Wright *et al* 2000). Furthermore, Area 24 is intensively fished (Coull *et al* 1998), which provides some support for the area as a foraging ground for Arctic terns as it indicates availability of prey species may be high in the area.

The proximity of the area to a large number of Arctic terns breeding within foraging range provide supporting ecological explanations for the presence of an important aggregation of Arctic tern within Area 24 during the breeding season. The strong tidal currents in the Pentland Firth may also attract Arctic terns to the area (Schwemmer *et al* 2009).

3.17.4 Conclusions

Evidence that directly supports the identification of Area 24 as being of importance to Arctic tern during the breeding season, in addition to that identified by Kober *et al* (2010, 2012) is available from one boat-based survey and one aerial survey in the grey literature. Area 24's close proximity to a large number of Arctic tern breeding sites within foraging range provides an ecological explanation for the presence of an aggregation in this area.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to Arctic tern in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 5.63/20 for supporting studies, with no non-supporting studies. The strength of the additional evidence is weak but consistent (all studies with additional information support the identification of the area as important, Appendix 6).

3.18 Seabird Aggregation – Area 26

Common guillemot *Uria aalge* – breeding season (May to June)

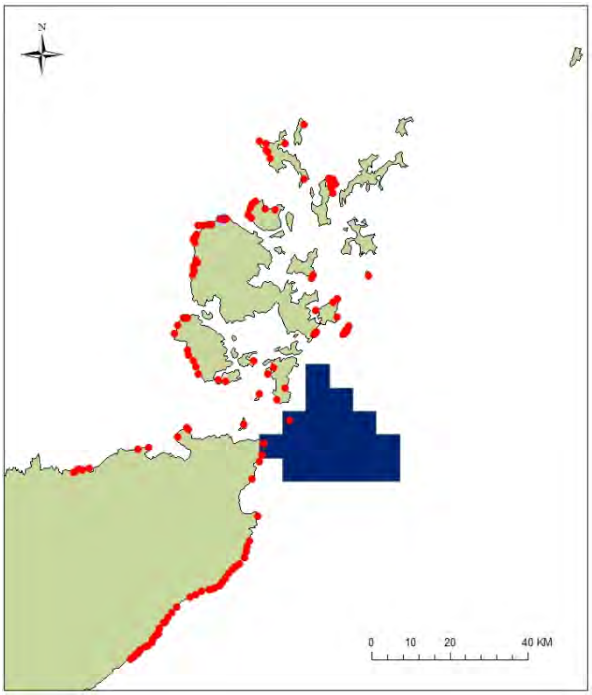


Figure 20. Area 26 (blue polygon), identified as an aggregation for common guillemot *Uria aalge* during the breeding season (May to June). Breeding colonies of common guillemot potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.18.1 Identification of Area 26 as an important aggregation of common guillemot

Area 26 was identified by Kober *et al* (2010) as an important aggregation of common guillemot *Uria aalge* during the breeding season. Based on analysis of ESAS data, the area supports a population of 28,356 birds, 0.33% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 3 of the 3 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.18.2 Literature review of additional evidence

Stage 1 of Assessment

Our literature review failed to identify any independent evidence regarding the identification of Area 26 as being of importance to the common guillemot in the breeding season in the peer-reviewed literature, grey literature or from expert knowledge.

Peer reviewed: No studies found.

Grey literature: No studies found.

Expert opinion: No relevant information received.

Data from the RSPB FAME tracking project also show birds from the Fair Isle colony in 2011 using area 26. However, only raw track data were available from this study and it was not possible to determine how many birds were represented by these tracks, or which part of the breeding season data originate from. For this reason, it was not possible to assess these studies in the same way as the others.

Stage 2 of Assessment

No evidence beyond that presented in Kober *et al* (2010, 2012) was identified.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*0*	*0*
Have surveyed Area 26 but do not provide supporting evidence	*0*	*0*

3.18.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of common guillemot in Area 26 are likely to be linked to the species' foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 28,536 birds are present within Area 26 during the breeding season. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher. Data from the RSPB Fame project demonstrated birds from the Fair Isle Breeding colony forage within Area 26 and an additional 164 breeding colonies with an estimated population of 400,107 individuals (Mitchell *et al* 2004) were within the mean maximum foraging range for common guillemot of 84.2km presented in Thaxter *et al* (2012). The size of this local population means that the number of birds associated with the aggregation estimated by Kober *et al* (2010, 2012) is entirely feasible.

Sandeel are a key prey species for common guillemot and Area 26 overlaps with a low intensity spawning area for this species. The mean depth of Area 26, 66m (±9m), means that the local sandeel population are unlikely to be beyond the maximum depths that can be reached by diving common guillemots, which are capable of reaching depths of up to 180m (Piatt & Nettleship 1985; Barrett & Furness 1990; Tremblay *et al* 2003; Thaxter *et al* 2010). In addition, the closure of the local sandeel fishery may attract birds as the highest concentrations of common guillemots are often associated with areas where sandeel stocks remain unexploited (Wright & Begg 1997).

3.18.4 Conclusions

Overall, no published evidence, beyond that presented in Kober *et al* (2010, 2012), was available to provide support for or against the identification of Area 26 as being of importance to common guillemots during the breeding season. However, recent unpublished data from the RSPB FAME project shows birds from the Fair Isle colony use Area 26, in addition to other areas. The large number of breeding colonies within the wider region, and the presence of a predictable food supply, offer ecological reasons for the presence of an important aggregation in Area 26. The current absence of published data showing movements of common guillemots within Area 26 is likely to reflect the fact the regions is poorly researched at present. However, the current RSPB FAME project is likely to address this issue in the near future.

3.19 Seabird Aggregation – Area 31

Common guillemot *Uria aalge* – winter (October to April)

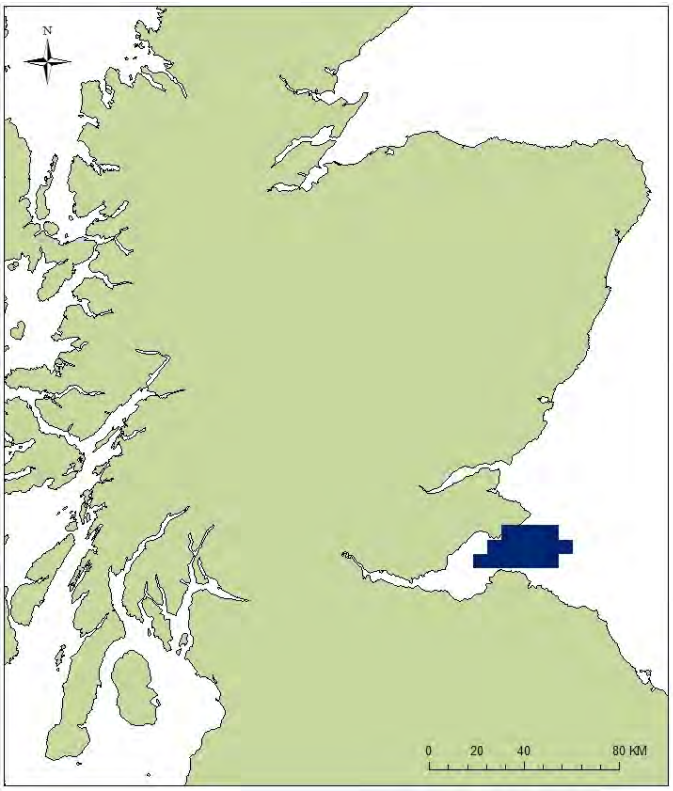


Figure 21. Area 31 (blue polygon), identified as an aggregation for common guillemot *Uria aalge* during the winter (October to April).

3.19.1 Identification of Area 31 as an important aggregation of common guillemot

Area 31 was identified by Kober *et al* (2010) as an important aggregation of common guillemot *Uria aalge* during the winter. Based on analysis of ESAS data, the area supports a population of 11,143 birds, 0.13% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 7 of the 10 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.19.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to a series of boat surveys carried out between 2009 and 2011 (see below). No evidence was located from tracking, seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: No studies found.

Grey literature: As part of the Environmental Impact Assessments for the Neart na Gaoithe Offshore Wind Farm Zone intensive, monthly boat surveys have been carried out in the

region surrounding Area 31 (Natural Research Projects Ltd 2012). The boat surveys were carried out throughout two winter periods (2009-10 and 2010-11) and analysed to correct for detection biases and produce density and population estimates for the study region. Whilst the data presented do not allow the number of birds within Area 31 to be estimated, they do show a concentration of common guillemots within the area (Natural Research Projects Ltd 2012).

Expert opinion: No relevant information received.

Table 20. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 31 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.			
Natural Research Projects Ltd 2012	4	3	4	2	NA	NA	NA	3	5	3	**12**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 31 as being of importance to wintering common guillemot is weak with an overall score of 7/20 (Appendix 6, Stage 2 - Site Scores). Data were obtained throughout the wintering period in 2009/10 and 2010/11 and indicated concentrations of common guillemots within Area 31.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*1*	*7*
Have surveyed Area 31 but do not provide supporting evidence	*0*	*0*

3.19.3 Ecological explanations

Processes underpinning the wintering distribution of common guillemot are poorly understood. Birds wintering within Area 31 may originate from a variety of different breeding colonies. One recent analysis of ringing recoveries of common guillemot outside the breeding season revealed that birds wintering within Area 31 may originate from colonies as far away as Canna on the West Coast of Scotland (Reynolds *et al* 2011). This indicates that common guillemots wintering within the Firth of Forth may, potentially be drawn from a much

larger population than the breeding colonies in the immediate, surrounding area. However, insufficient data are available to gain a fuller understanding of the breeding origins of birds wintering within Area 31 and the surrounding region.

Area 31 has a mud and sandy mud substrate, a good habitat for sandeel which spawn at a high intensity within this region (Ellis *et al* 2012) and are a key prey species for common guillemots (Wright & Begg 1997). Sandeel spawn between November and February (Ellis *et al* 2012), and the mean depth of Area 31 of 41m (±12m) means the larvae and adults are well within the reach of foraging common guillemot, which may dive up to 180m (Piatt & Nettleship 1985; Barrett & Furness 1990; Tremblay *et al* 2003; Thaxter *et al* 2010). Common guillemots tend to concentrate in areas where sandeel stocks are unexploited (Wright & Begg 1997). The sandeel fishery in south east Scotland has been closed since 2000 (Greenstreet *et al* 2006) which may increase the importance of the area to common guillemot due to increased availability of prey.

There is a low probability of thermal fronts within Area 31.The key attraction of Area 31 to wintering common guillemot may be a reliable and easily accessibly prey source which remains unexploited by commercial fisheries.

3.19.4 Conclusions

The available evidence that directly supports the identification of Area 31 as being of importance to wintering common guillemot comes from one study involving intensive boat surveys of the area carried out in the winters of 2009/10 and 2010/11. In addition to this study, regular seawatching activity from points close to Area 31 on the Fife and Lothian coasts frequently record high counts of common guillemots during the winter (Andrews *et al* 2011; Wave 2011). The wintering birds are likely to originate from breeding colonies from across a broad spatial scale and may be attracted by the presence of easily exploitable prey.

Overall, in combination with the analyses of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to common guillemot in the winter is stronger than the evidence that does not, with the strength of the evidence scored as 7/20 for supporting studies with no non-supporting studies. The strength of the additional evidence is weak, but it is consistent with the findings of Kober *et al* (2010) (Appendix 6).

3.20 Seabird Aggregation – Area 32

Common guillemot *Uria aalge* – winter (October to April)

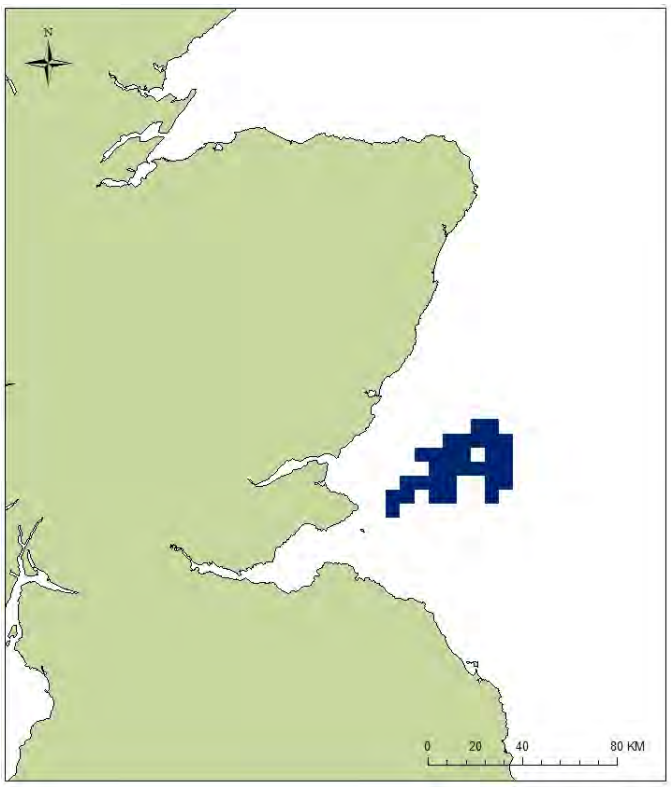


Figure 22. Area 32 (blue polygon), identified as an aggregation for common guillemot *Uria aalge* during the winter (October to April).

3.20.1 Identification of Area 32 as an important aggregation of common guillemot

Area 32 was identified by Kober *et al* (2010) as an important aggregation of common guillemot *Uria aalge* during the winter. Based on analysis of ESAS data, the area supports a population of 15,334 birds, 0.18% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 5 of the 7 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.20.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to a series of boat and aerial surveys carried out between 2009 and 2011 (see below). No evidence was located from tracking, seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: No studies found.

Grey literature: As part of the Environmental Impact Assessments for the Neart na Gaoithe and Firth of Forth Offshore Wind Farm Zones, intensive boat and aerial surveys have been

carried out in the region surrounding Area 32 on a monthly basis (Natural Research Projects Ltd 2012; Seagreen Wind Energy 2012). The boat surveys were carried out throughout two winter periods (2009-10 and 2010-11) and analysed to correct for detection biases and produce density and population estimates for the study region. The aerial surveys were carried out over winter 2009/10, and limitations of the survey methodology meant that it was not possible to refine species identification beyond the family level. However, the relative abundance of auks within the region during the winter suggests that a significant proportion of the birds present were likely to be common guillemots, boat surveys carried out in a neighbouring area at the same time estimated that 58% of auks present were common guillemots (Seagreen Wind Energy 2012). Whilst the data presented by these studies do not allow the number of birds within Area 32 to be estimated, they do show concentrations of common guillemots within the area.

Expert opinion: No relevant information received.

Table 21. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 32 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source											
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.	Type of source	Total adjusted score (max 15)	Supports Area as Important
Natural Research Projects Ltd 2012	4	3	4	2	NA	NA	NA	3	5	3	**12**	**Y**
Seagreen Wind Energy 2012	3	1	4	2	NA	NA	NA	3	5	3	**9.75**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 32 as being of importance to wintering common guillemot is weak with an overall score of 7.63/20 (Appendix 6, Stage 2 - Site Scores). Data were obtained throughout the wintering period in 2009 and 2010, and both aerial and boat survey data indicated concentrations of common guillemots within Area 32.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*2*	*7.63*
Have surveyed Area 32 but do not provide supporting evidence	*0*	*0*

3.20.3 Ecological explanations

Processes underpinning the wintering distribution of common guillemot are poorly understood. Birds wintering within Area 32 may originate from a variety of different breeding colonies. One recent analysis of ringing recoveries of common guillemot outside the breeding season revealed that birds wintering within Area 32 may originate from as far away as Canna on the West Coast of Scotland (Reynolds *et al* 2011). This indicates that common guillemots wintering within the Firth of Forth may, potentially be drawn from a much larger population than the breeding colonies in the immediate, surrounding area. However, insufficient data are available to gain a fuller understanding of the breeding origins of birds wintering within Area 32 and the surrounding region.

Area 32 has a mud and sandy mud substrate, a good habitat for sandeel which spawn at a high intensity within this region (Ellis *et al* 2012) and are a key prey species for common guillemots (Wright & Begg 1997). Sandeel spawn between November and February (Ellis *et al* 2012), and the mean depth of Area 32 of 51m (±5m) means the larvae and adults are well within the reach of foraging common guillemot, which may dive up to 180m (Piatt & Nettleship 1985; Barrett & Furness 1990; Tremblay *et al* 2003; Thaxter *et al* 2010). Common guillemots tend to concentrate in areas where sandeel stocks are unexploited (Wright & Begg 1997). The sandeel fishery in south east Scotland has been closed since 2000 (Greenstreet *et al* 2006) which may increase the importance of the area to common guillemot through increased prey availability.

There is a low probability of thermal fronts within Area 32. The key attraction of Area 32 to wintering common guillemot may be a reliable and easily accessibly prey source which remains unexploited by commercial fisheries.

3.20.4 Conclusions

The available evidence that directly supports the identification of Area 32 as being of importance to wintering common guillemot comes from two studies involving intensive boat and aerial surveys of the area carried out in the winters of 2009 and 2010. The wintering birds are likely to originate from breeding colonies from across a broad spatial scale and may be attracted by the presence of easily exploitable prey.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to common guillemot in the winter is stronger than the evidence that does not, with the strength of the evidence being scored as 7.63/20 for supporting studies, with no non-supporting studies. The strength of this evidence is weak but consistent (all studies with additional information support the identification of the area as important, Appendix 6).

3.21 Seabird Aggregation – Area 33

Atlantic puffin *Fratercula arctica* – breeding season (April to July)

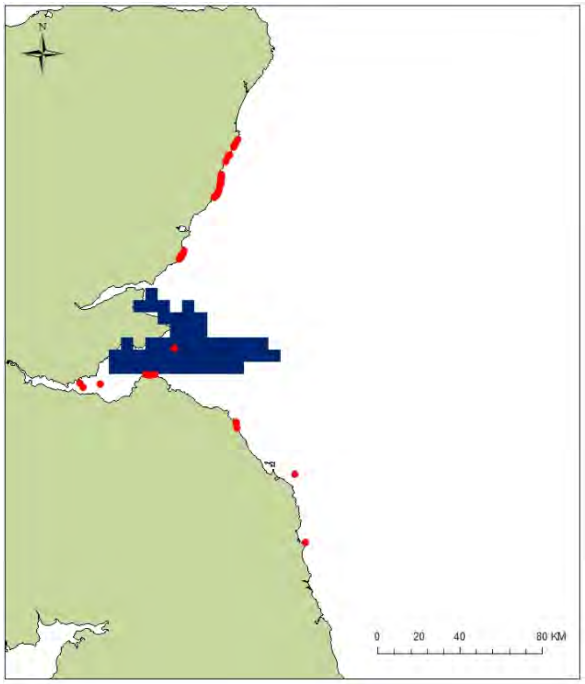


Figure 23. Area 33 (blue polygon), identified as an aggregation for Atlantic puffin *Fratercula arctica* during the breeding season (April to July). Breeding colonies of Atlantic puffin potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.21.1 Identification of Area 33 as an important aggregation of Atlantic puffin

Area 33 was identified by Kober *et al* (2010) as an important aggregation of Atlantic puffin *Fratercula arctica* during the breeding season. Based on analysis of ESAS data, the area supports a population of 56,732 birds, 0.42% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 10 of the 11 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.21.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to three tracking studies, one boat-based study and one aerial study. Some supporting evidence was located from seawatching records and other casual observations (Appendix 1). No evidence was based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: Harris *et al* (2012) fitted 13 adult Atlantic puffins from the Isle of May breeding colony with GPS tags between 3 May and 2 June 2010 in order to assess colony feeding areas. This study used kernel density analysis to identify areas of importance to the birds. The 90% utilization distribution produced from the tagged individual's tracks (diving locations and all locations) overlapped partially with Area 33. This indicates that Area 33 may be part of a key foraging area for birds from this colony.

Wanless *et al* (1990) also showed Atlantic puffin to use the area during the breeding season when one adult Atlantic puffin from the Isle of May was fitted with a radio tagging device.

Further support was found in a study looking at seabird consumption of sandeel in the Firth of Forth area (Wanless *et al* 1998). Boat-based surveys, using modified standard shipboard transect survey methods (Tasker *et al* 1984; Webb & Durinck 1992), were conducted as part of this, between 21 and 25 June 1997. Using the results, distance estimates were generated without application of correction factors for environmental covariates or issues with detection. The study found high densities of Atlantic puffin present in Area 33 (2 birds km^{-2}) giving support to Area 33 as an important foraging ground for breeding Atlantic puffin.

Grey literature: Between May 2009 and February 2010, digital aerial surveys were carried out to inform an assessment of Round 3 Firth of Forth development sites (Seagreen Wind Energy 2012). The methods used for the two years of baseline seabird surveys followed standard COWRIE approved survey methodology (Camphuysen *et al* 2004). Although the survey area overlapped with only the eastern parts of Area 33, distribution maps of all birds recorded suggest high densities of auks present in the area during the summer months, with a peak population estimate of 149,502 in July. Based on calculations made from other boat-based surveys within the report, approximately 13% of auks recorded in the region were Atlantic puffin. This indicates that Atlantic puffin may use Area 33 frequently during the breeding season. Seabird tagging was also carried out in order to inform this assessment. Ten adult Atlantic puffins were fitted with GPS data-loggers on the Isle of May. Only seven tags were retrieved. The tracks showed all seven birds to use Area 33, adding further support to Area 33's evidence base. No further data analysis was carried out.

Expert opinion: No relevant information received.

Table 22. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 33 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.			
Harris *et al* 2012	3	1	4	1	1	0	0	NA	2	3	**7.5**	**Y**
Wanless *et al* 1998	1	1	4	1	NA	NA	NA	1	2	3	**6**	**Y**
Wanless *et al* 1990	1	1	3	1	NA	NA	NA	0	1	3	**4.5**	**Y**
Seagreen Wind Energy 2012	3	1	4	2	NA	NA	NA	3	5	3	**9.75**	**Y**
Seagreen Wind Energy 2012	3	1	2	1	1	0	0	NA	2	3	**6**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 33 as being of importance to breeding Atlantic puffin, beyond the analyses undertaken by Kober *et al* (2010, 2012) is strong with an overall score of 10.25/20 (Appendix 6, Stage 2 – Site Scores). Whilst the data collected rarely covered the whole of the breeding season (April – July), studies were carried out in four separate years. Three tagging studies showed all individuals tagged from the Isle of May to use Area 33 during the breeding season (Harris *et al* 2012; Seagreen Wind Energy 2012; Wanless *et al* 1990) and two other studies indicated high densities of Atlantic puffin within Area 33 (Wanless *et al* 1998; Seagreen Wind Energy 2012).

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*5*	*10.25*
Have surveyed Area 33 but do not provide supporting evidence	*0*	*0*

3.21.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of Atlantic puffin in Area 33 are likely to be linked to the species foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 56,732 birds are

present within Area 33 during the breeding season. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher.

Harris *et al* (2012), Wanless *et al* (1990) and a report by Seagreen Energy (2012) demonstrated that birds from the breeding colony on the Isle of May used Area 33. Based on the mean maximum foraging range for Atlantic puffin of 105km identified in Thaxter *et al* (2012), there are 55 Seabird 2000 breeding colony count locations within foraging range. Of these, the two largest colonies - Farne Islands and Isle of May – combined, are estimated to support 97,674 apparently occupied burrows (Mitchell *et al* 2004). Other smaller colonies within the Forth e.g. Inchkeith, are also in close proximity. This suggests that it is entirely feasible for Area 33 to support a population of the size suggested by Kober *et al* (2010).

Atlantic puffin typically have a varied fish diet, but by far the commonest fish brought back to breeding colonies is lesser sandeel *Ammodytes marinus* (Harris *et al* 2011). Little evidence was found in support of Area 33 containing a high abundance of sandeel. Area 33 does not overlap with sandeel nursery or spawning grounds (Ellis *et al* 2012), although the depths within Area 33 (mean depth 43m ±16m SD) (BODC 2010) are within optimum depth range of sandeel *Ammodytes marinus* (Wright *et al* 2000). Furthermore, this area is characterised as having a low probability of thermal fronts (mean 36% ±23%) (DEFRA 2013), the presence of which typically suggests high levels of prey availability (Begg & Reid 1997; Durazo *et al* 1998).

Whilst sandeel may not be present within Area 33 in high numbers, evidence indicated a large presence of other prey species such as sprat *Sprattus sprattus* and Atlantic herring *Clupea harengus* (Ellis *et al* 2012; Coull *et al* 1998). Both these members of the Clupeidae family form an important part of the Atlantic puffin diet throughout their range (Harris *et al* 2011). Further evidence, indicating high presence of prey, comes from levels of fishing activity, which is thought to be high in Area 33 (Coull *et al* 1998).

The proximity of the area to a large number of breeding colonies and a high abundance of some prey species during the summer months provides ecological explanations for the presence of an important aggregation of Atlantic puffin within Area 33 during the breeding season.

3.21.4 Conclusions

Evidence that directly supports the identification of Area 33 as being of importance to Atlantic puffin during the breeding season, in addition to that identified by Kober *et al* (2010, 2012) is available from both the grey and peer-reviewed literature. Three tracking studies revealed a direct link between the area and the Isle of May breeding colony, whilst recent aerial surveys, boat surveys, and casual records from the grey literature also confirmed high concentrations of Atlantic puffin in the area. Furthermore, Area 33 is in foraging range of several other large breeding colonies. An overlap with areas containing potential prey species also suggests that Area 33 may represent an important foraging ground for the species.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to Atlantic puffin in the breeding season is stronger than the evidence that does not, with the strength of the evidence being scored as 10.25/20 for supporting studies with no non-supporting studies. The strength of the additional evidence is strong and consistent (all studies with additional information support the identification of the area as important, Appendix 6).

3.22 Seabird Aggregation – Area 36

Atlantic puffin *Fratercula arctica* – breeding season (April to July)

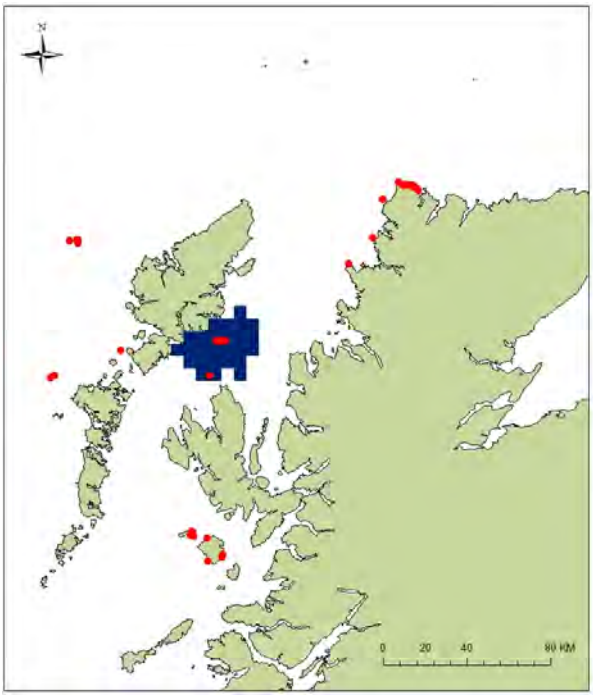


Figure 24. Area 36 (blue polygon), identified as an aggregation for Atlantic puffin *Fratercula arctica* during the breeding season (April to July). Breeding colonies of Atlantic puffin potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)), taken from the Seabird 2000 database, are also shown (red points).

3.22.1 Identification of Area 36 as an important aggregation of Atlantic puffin

Area 36 was identified by Kober *et al* (2010) as an important aggregation of Atlantic puffin *Fratercula arctica* during the breeding season. Based on analysis of ESAS data, the area supports a population of 18,520 birds, 0.14% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 7 of the 7 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.22.2 Literature review of additional evidence

Stage 1 of Assessment

No evidence was located in the literature or from the questionnaire survey.

Peer reviewed: No studies found.

Grey literature: No studies found.

Expert opinion: No relevant information received.

Stage 2 of Assessment

No evidence beyond that presented in Kober *et al* (2010, 2012) was identified. However, it is important to note that although Atlantic puffin are well studied on the UK's east coast, fewer studies are available from the west.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*0*	*0*
Have surveyed Area 36 but do not provide supporting evidence	*0*	*0*

3.22.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of Atlantic puffin in Area 36 are likely to be linked to the species' foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 18,520 birds are present within Area 36 during the breeding season. However, the effects of population turnover mean that the total number of birds using the area is likely to be substantially higher.

Area 36 is within foraging range of several large breeding colonies. Based on the mean maximum foraging range for Atlantic puffin of 105.4km identified in Thaxter *et al* (2012), there are 44 Seabird 2000 breeding colony count locations within foraging range. The most recent estimates of numbers of apparently occupied burrows in the Western Isles-Comhairle nan eilean recording area total 234,666 (Mitchell *et al* 2004). However, this may be an over-estimate of the total number of breeding birds within reach of Area 36 as not all breeding colonies in this region are within foraging range. Nevertheless, this suggests that it is entirely feasible for Area 36 to support a population of the size suggested by Kober *et al* (2010).

Atlantic puffin typically have a varied fish diet, but by far the commonest fish brought back to breeding colonies is lesser sandeel *Ammodytes marinus* (Harris *et al* 2011). Little evidence was found in support of Area 36 containing a high abundance of sandeel. Area 36 does not overlap with sandeel nursery or spawning grounds (Ellis *et al* 2012), and much of the depths within Area 36 (mean depth 81m ±35m SD) (BODC 2010) fall just beyond the optimum depth range of sandeel *Ammodytes marinus* (Wright *et al* 2000). Furthermore, this area is characterised as having a low probability of thermal fronts (mean 25% ±17%) (DEFRA 2013), the presence of which typically suggest high levels of prey availability (Begg & Reid 1997; Durazo *et al* 1998).

Whilst sandeel may not be present within Area 36 in high numbers, other evidence indicated a large presence of other prey species such as sprat *Sprattus sprattus* and Atlantic herring *Clupea harengus* (Ellis *et al* 2012; Coull *et al* 1998). Both these members of the Clupeidae family form an important part of the Atlantic puffin diet throughout their range (Harris *et al* 2011). Further evidence indicating high presence of prey comes from levels of fishing activity, which are thought to be high in Area 36 (Coull *et al* 1998).

Thus, the proximity of the area to a large number of breeding colonies and a high abundance of some prey species during the summer months provides ecological explanations for the presence of an important aggregation of Atlantic puffin within Area 36 during the breeding season.

3.22.4 Conclusions

No evidence beyond that presented in Kober *et al* (2010, 2012) was identified from the literature or from the expert questionnaires. Only the area's close proximity to several large breeding colonies and the presence of a high abundance of some prey species provides support for Area 36 as a foraging ground during the breeding season.

Overall, no evidence, beyond that presented by Kober *et al* (2010, 2012), was available to provide support for or against the identification of Area 36 as being of importance to Atlantic puffin during the breeding season.

3.23 Seabird Aggregation – Area 40

Atlantic puffin *Fratercula arctica* – winter (August to March)

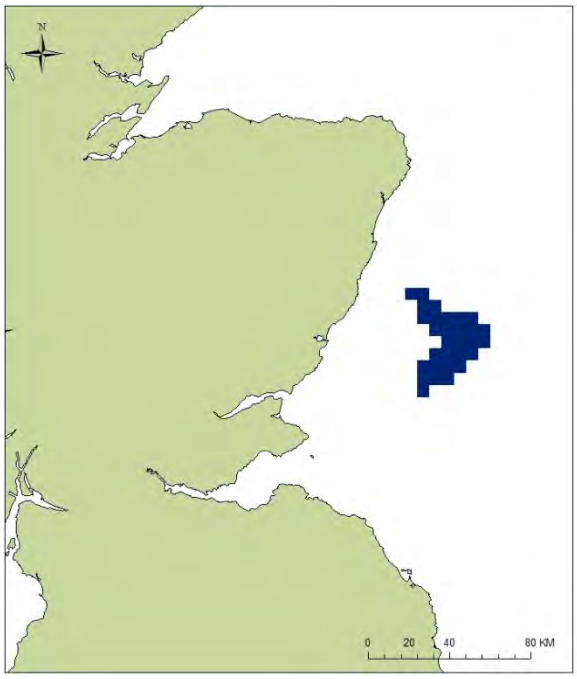


Figure 25. Area 40 (blue polygon), identified as an aggregation for Atlantic puffin *Fratercula arctica* during the winter (August to March).

3.23.1 Identification of Area 40 as an important aggregation of Atlantic puffin

Area 40 was identified by Kober *et al* (2010) as an important aggregation of Atlantic puffin *Fratercula arctica* during the winter. Based on analysis of ESAS data, the area supports a population of 3,776 birds, 0.03% of the biogeographic population of the species (Kober *et al* 2012). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 7 of the 10 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012).

3.23.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) was limited to two tracking studies and one aerial survey. No evidence came from boat-based surveys, seawatching or casual observations, and no relevant expert knowledge was gained from the questionnaire survey.

Peer reviewed: Harris *et al* (2010) fitted 50 adult Atlantic puffins from the Isle of May breeding colony with geo-locators in the 2007 in order to identify over-wintering areas. Fourteen birds were retrieved and data were successfully downloaded from thirteen of the devices. This study used kernel density analysis to identify areas of importance to the birds over the entire winter period. The maps produced show Area 40 to be intensively used throughout the winter. A second study used these results in combination with further tagging on the Isle of May in June 2009 (Harris *et al* 2013). By combining both studies, a total of 39 re-captures were analysed. The downloaded data were used to produce kernel density maps

showing winter distributions by month for the North Sea and Western Atlantic. Although some birds ranged far into the Atlantic Ocean, 50% utilization distributions overlapped with Area 40 for all months, indicating that adult Atlantic puffins breeding on the Isle of May use Area 40 throughout the winter. As Harris *et al* (2013) incorporates data included in Harris *et al* (2010), we only assess Harris *et al* (2013) as it has a larger sample size, over a greater number of years.

Grey literature: Between May 2009 and February 2010, digital aerial surveys were carried out to inform an assessment Round 3 Firth of Forth development sites (Seagreen Wind Energy 2012). The methods used for the two years of baseline seabird surveys followed standard COWRIE approved survey methodology (Camphuysen *et al* 2004). Distance sampling techniques with corrections were applied to produce density and population estimates. High densities of auk were recorded throughout the 2009 winter, with a population peak in February 2010 of 94,706. Whilst these records are notable, it is important to note that the survey area overlapped with only the western part of Area 40 and, based on calculations made from other boat-based surveys within the report, Atlantic puffin make up, approximately, only 13% of the auk assemblage. Nevertheless, this overlap indicates that parts of Area 40 are used by high densities of wintering auks, including Atlantic puffin.

Expert opinion: No relevant information received.

Table 23. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 40 (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.			
Harris *et al* 2013	3	3	5	2	1	1	0	NA	4	3	**11.25**	**Y**
Seagreen Wind Energy 2012	3	1	4	2	NA	NA	NA	3	5	3	**9.75**	**Y**

Stage 2 of Assessment

The evidence supporting the identification of Area 40 as being of importance to wintering Atlantic puffin, beyond the analyses undertaken by Kober *et al* (2010, 2012) is of weak quality with an overall score of 8.5/20 (Appendix 6, Stage 2 – Site Scores). These data represent two entire winter seasons and showing that Atlantic puffins use Area 40 throughout that period (Harris *et al* 2013; Seagreen Wind Energy 2012).

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*2*	*8.5*
Have surveyed Area 40 but do not provide supporting evidence	*0*	*0*

3.23.3 Ecological explanations

Processes underpinning the wintering distribution of Atlantic puffin are poorly understood. Birds wintering within Area 40 may originate from a variety of different breeding colonies. Harris *et al* (2010, 2013) demonstrated that birds from Isle of May use Area 40 during the winter, but some also go on foraging trips far into the Atlantic. Due to the large winter foraging distances demonstrated through these studies, it is quite possible that individuals from other large breeding colonies from further afield (e.g. Farne Islands) also use Area 40 during the winter period. Individuals already shown to use Area 40 may do so year on year, as tracked individual Atlantic puffin show consistency in winter migration routes between years (Guilford *et al* 2011).

Area 40 has a mud and sandy mud substrate, a good habitat for sandeel *Ammodytes marinus* which spawn at a high intensity within this region between November and February (Ellis *et al* 2012). During the winter Atlantic puffin feed less on sandeels and are thought to have a more varied diet (Falk *et al* 1992; Hedd *et al* 2010). Individuals may therefore use Area 40 as foraging grounds for other prey species such as Atlantic herring *Clupea harengus* – a species which also spawn at a high intensity within the area (Ellis *et al* 2012; Coull *et al* 1998).

The proximity of the area to a large number of breeding colonies and a high abundance of some prey species during the winter months provides ecological explanations for the presence of an important aggregation of Atlantic puffin within Area 40 during the breeding season.

3.23.4 Conclusions

Evidence that directly supports the identification of Area 40 as being of importance to Atlantic puffin during the winter, in addition to that identified by Kober *et al* (2010, 2012) is available from both the grey and peer-reviewed literature. Data from tracked birds (Harris *et al* 2010, 2013) revealed a direct link between the area and the Isle of May breeding colony, whilst a recent aerial survey also confirmed high concentrations of auks, including Atlantic puffin, within in the area. Area 40's close proximity to breeding grounds and overlap with areas containing potential prey, provide further support for the area.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to Atlantic puffin in the winter is stronger than the evidence that does not, with the strength of the evidence being scored as 8.5/20 for supporting studies with no non-supporting studies. The strength of the additional evidence is weak but consistent (all studies with additional information support the identification of the area as important, Appendix 6).

3.24 Seabird Aggregation – Area 41

All species – combined breeding seasons

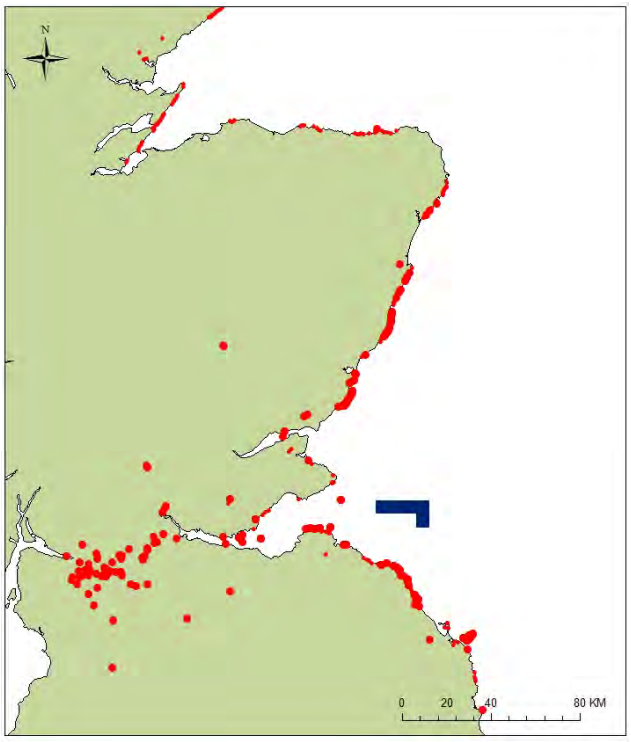


Figure 26. Area 41 (blue polygon), identified as an aggregation for all seabird species during their breeding seasons and seabird breeding colonies potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)).

3.24.1 Identification of Area 41 as an important aggregation of seabirds

Area 41 was identified by Kober *et al* (2010) as an important aggregation for all seabird species during their breeding seasons. Based on analysis of ESAS data, the area supports a population of 22,131 birds of all species (Kober *et al* 2010). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 4 of the 7 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012). Kober *et al* (2012) determined that the key species contributing to the aggregation were northern fulmar (35 individuals), Manx shearwater (48 individuals), Leach's storm-petrel (<1 individual), northern gannet (1,366 individuals), Arctic skua (12 individuals), black-legged kittiwake (3,692 individuals), common gull (4 individuals), lesser black-backed gull (77 individuals), herring gull (196 individuals), common guillemot (5,143 individuals), razorbill (128 individuals) and Atlantic puffin (11,162 individuals).

3.24.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) consisted of seven tracking studies, three boat surveys and an aerial survey. No evidence was located from seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: Data have been collected from a number of detailed tracking studies in the region surrounding Area 41. Wanless *et al* (1990), Thaxter *et al* (2010) and Harris *et al* (2012) fitted tracking devices to auks breeding on the Isle of May. Whilst Thaxter *et al* (2010), did not find common guillemots feeding within Area 41, Wanless *et al* (1990) collected data from a single Atlantic puffin, three razorbill and six common guillemots which did appear to show birds utilising the area. Similarly, Harris *et al* (2012) found Atlantic puffins tagged on the Isle of May feeding within Area 41. Whilst Wanless *et al* (1990) presented simple plots of birds at sea locations, both Thaxter *et al* (2010) and Harris *et al* (2012) used kernel density analysis to investigate species at sea distributions. Whilst Thaxter *et al* (2010) revealed that Area 41 was just outside the 95% utilization area for common guillemot, Harris *et al* (2012) found that it was within the 70% utilization area for Atlantic puffin. An additional study, Thaxter *et al* (2009), was identified, but it was determined to contain the same data as Thaxter *et al* (2010) and excluded from our assessment.

Hamer *et al* (2007) and Wakefield *et al* (2013) both found that northern gannets fitted with satellite tags from the Bass Rock colony foraged within Area 41. Both studies used kernel density analysis to investigate the at sea-distribution of birds. Hamer *et al* (2007) found Area 41 overlapped with the 50% utilization area for northern gannets in 1998 and 2002 while Wakefield found that it overlapped with the 75% utilization area in 2011. Two additional studies were identified, Hamer *et al* (2009) and Skov *et al* (2008), however, these contained the same data as Hamer *et al* (2007) and were consequently excluded from our assessment.

In addition to the tracking studies, we identified two boat surveys of the region surrounding the area (Cox *et al* 2013; Wanless *et al* 1998). Whilst it was not possible to identify precise numbers of birds within Area 41 from either study, both identified concentrations of a number of species in Area 41, including northern gannet, European shag, black-legged kittiwake, Arctic tern, common tern, common guillemot, razorbill and Atlantic puffin. Whilst Wanless *et al* (1998) used a simple approach involving transects of variable width to estimate the density of birds within the region, Cox *et al* (2013) used a more sophisticated spatial modelling approach which showed that species distributions were linked to tidal conditions and thermal stratification levels, which influence the distribution of prey species. We identified an additional analysis of boat survey data, Scott *et al* (2010), but it contained the same data as presented in Cox *et al* (2013) and consequently we excluded it from our assessment.

Grey literature: We identified two tracking studies, a boat survey and an aerial survey during our review of the grey literature. Camphuysen (2005) collected tracking data, black-legged kittiwakes and common guillemots breeding on the Isle of May and northern gannets breeding on the Bass Rock. The northern gannet data was described in Hamer *et al* (2007), section 3.5, and therefore not assessed here. There was overlap with breeding black-legged kittiwakes and common guillemots and Area 41. In a similar study, Seagreen Wind Energy (2012) found black-legged kittiwakes breeding on the Isle of May and St. Abbs Head, and Atlantic puffins and common guillemots breeding on the Isle of May foraged within Area 41. However, neither of these tracking studies undertook analysis of the distribution of birds at sea.

Seagreen Wind Energy carried out aerial surveys of the region surrounding Area 41 throughout the 2009 breeding season. They revealed significant concentrations of auks, black-legged kittiwakes and northern gannets within Area 41. Similarly, Natural Research Projects Ltd (2012) carried out intensive boat surveys of the region 2010 and 2011 breeding seasons. These revealed significant concentrations of auks, black-legged kittiwakes and northern fulmar within Area 41, in addition to Arctic terns and Manx shearwater. Neither study undertook detailed analysis beyond that required to produce density estimates for the regions concerned.

Expert opinion: No relevant information received.

Table 24. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 41* (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source									Type of source	Total adjusted score (max 15)	Supports Area as Important
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.			
Camphuysen 2005	1	3	4	2	1	0	0	NA	3	2	**5.5**	**Y**
Cox *et al* 2013	1	1	5	1	NA	NA	NA	1	2	3	**6.75**	**Y**
Hamer *et al* 2007	1	5	5	1	1	1	0	NA	3	3	**10.5**	**Y**
Harris *et al* 2012	3	1	4	1	1	0	0	NA	2	3	**7.5**	**Y**
Natural research Projects Ltd 2012	4	3	4	2	NA	NA	NA	3	5	3	**12**	**Y**
Seagreen Wind Energy 2012	3	1	4	2	NA	NA	NA	3	5	3	**9.75**	**Y**
Seagreen Wind Energy 2012	4	3	4	1	1	0	1	NA	3	3	**10.5**	**Y**
Thaxter *et al* 2010	2	5	5	1	1	1	0	NA	3	3	**11.25**	**N**
Wakefield *et al* 2013	4	3	5	1	1	1	NA	NA	3	3	**11.25**	**Y**
Wanless *et al* 1998	1	1	4	1	NA	NA	NA	1	2	3	**6**	**Y**
Wanless *et al* 1990	1	1	3	1	1	0	0	NA	2	3	**5.25**	**Y**

*Data from the RSPB FAME tracking project also show black-legged kittiwake from the St. Abbs Head and Isle of May colonies and common guillemot from the Isle of May colony using Area 41 in 2012, and razorbill, black-legged kittiwake and common guillemot from the Isle of May using Area 41 in 2013. However, only raw track data were available from these studies and it was not possible to determine how many birds were represented by these tracks, or which part of the breeding season data originate from. For this reason, it was not possible to assess these studies in the same way as the others.

Stage 2 of Assessment

The available evidence, beyond that presented in Kober *et al* (2010, 2012), strongly supports the identification of Area 41 as being important to seabirds in the breeding season, with an overall score of 15.83/20 (Appendix 6, Stage 2 – Site Scores). Data have been collected in 11 separate years, and in several cases throughout the breeding season. Tracking data reveals that seabirds breeding on the Isle of May, St. Abbs Head and the Bass Rock all forage within the area. In addition to this, recent, intensive boat and aerial surveys, carried out throughout the breeding season, have revealed concentrations of a variety of different species within the area.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*10*	*15.83*
Have surveyed Area 41 but do not provide supporting evidence	*1*	*5.75*

3.24.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of seabirds in Area 41 during the breeding season are likely to be linked to the species' foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 22,131 birds are present within Area 41 during the breeding season. However, the effects of population turnover mean that the total number of birds using the area is likely to be higher. Tracking data showed black-legged kittiwake from the Isle of May and St. Abbs Head, razorbill, common guillemot and Atlantic puffin from the Isle of May and northern gannets from the Bass Rock all foraging within Area 41. Additional, unpublished tracking data from the RSPB FAME project reinforces these findings, also showing black-legged kittiwakes from the Isle of May and St. Abbs Head and common guillemots, razorbills and Atlantic puffins from the Isle of May foraging within Area 41. Based on the mean maximum foraging range for different species identified in Thaxter *et al* (2012), there are a large number of breeding pairs at colonies which are potentially within foraging range of Area 41 (Table 24). The abundance of breeding birds within foraging range of Area 41 suggests that it is feasible for Area 41 to support a population of the size suggested by Kober *et al* (2010, 2012).

Area 41 is located over a sand and muddy sand substrate, ideal habitat for sandeel, a key prey species for many of the seabird species within Area 41, which spawn at high intensity in the area (Ellis *et al* 2012). The mean depth of the area is 53m (±4m), meaning that even sandeel on the sea floor are well within reach of pursuit diving species, such as auks (Burger & Simpson 1986; Piatt & Nettleship 1985; Barrett & Furness 1990).

However, sandeel availability has been highly variable in recent years, largely in response to the commercial fishery which operated on Wee Bankie until 2000 (Greenstreet *et al* 2006). This fishery is widely believed to have had a negative impact on seabird populations within the wider region (Daunt *et al* 2006; Frederiksen *et al* 2004; Cook *et al* 2014). Despite the variable sandeel availability, Area 41 may have remained an important foraging area for the seabirds breeding in the wider region as it overlaps with the nursery and spawning grounds for a variety of other species including, mackerel, herring and whiting (Ellis *et al* 2012) which seabirds, including northern gannets, Manx shearwaters and auks may prey upon (Cramp & Simmons 1977; Hamer *et al* 2007; Thaxter *et al* 2013). This diversity of different prey is also likely to attract foraging seabirds to the area.

The abundance of spawning fish within the region surrounding Area 41 means that there a number of moderate to high intensity fisheries operating in the area (Coull *et al* 1998). Discards from commercial fisheries offer an important foraging opportunity for several key species, notably northern gannets, northern fulmar and gulls (Hudson & Furness 1988, 1989; Furness *et al* 1992; Camphuysen 1995; Votier *et al* 2004). In particular, discards from fisheries may constitute a significant proportion of the diets of gull chicks (Furness *et al* 1992). The presence of fisheries may therefore represent a key component of the diets of gulls in the wider region, whilst offering a valuable alternative foraging opportunity for species such as northern gannets and northern fulmar.

Table 25. Number of colonies and breeding pairs within foraging range of Area 41 broken down by species, based on data from Mitchell *et al* (2004).

Species	Foraging Range (mean maximum, Thaxter *et al* 2012)	Number of Colonies	Number of Breeding Pairs
northern fulmar	400	1,119	175,018
northern gannet	229.4	2	45,195
black-legged kittiwake	60	49	35,923
common gull	50	1	2
lesser black-backed gull	141	114	15,337
herring gull	61.1	82	13,267
great black-backed gull	60*	16	49
common guillemot	84.2	72	92,788
razorbill	48.5	29	8,385
Atlantic puffin	105.4	53	73,025

*Great black-backed gull foraging range based on observations made by Seys *et al* (2001).

The proximity of Area 41 to a large number of seabird breeding colonies, combined with predictable foraging opportunities from a variety of different sources, is likely to provide an ecological explanation for the presence of an important seabird aggregation during the breeding season.

3.24.4 Conclusions

Evidence that directly supports the identification of Area 41 as being of importance to seabird during the breeding season, in addition to that identified by Kober *et al* (2010, 2012) is available from both the grey and peer-reviewed literature. Several tracking studies revealed a direct link between the area and breeding colonies, supported by additional, recent data from the RSPB FAME project. The potential importance of the site is reinforced by recent, regular boat and aerial surveys highlighting a significant concentration of birds within Area 41 during the breeding season. The overlap with spawning areas for several potential prey species, as well as a number of commercial fisheries, and proximity to a number of large breeding colonies provides an ecological explanation for the importance of Area 41 to breeding seabirds.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to seabirds in the breeding season (15.83/20) is stronger than the evidence that does not (5.75/20). The strength of the additional evidence is strong and consistent (91% studies with additional information support the identification of the area as important, Appendix 6).

3.25 Seabird Aggregation – Area 42

All species – summer (July to August)

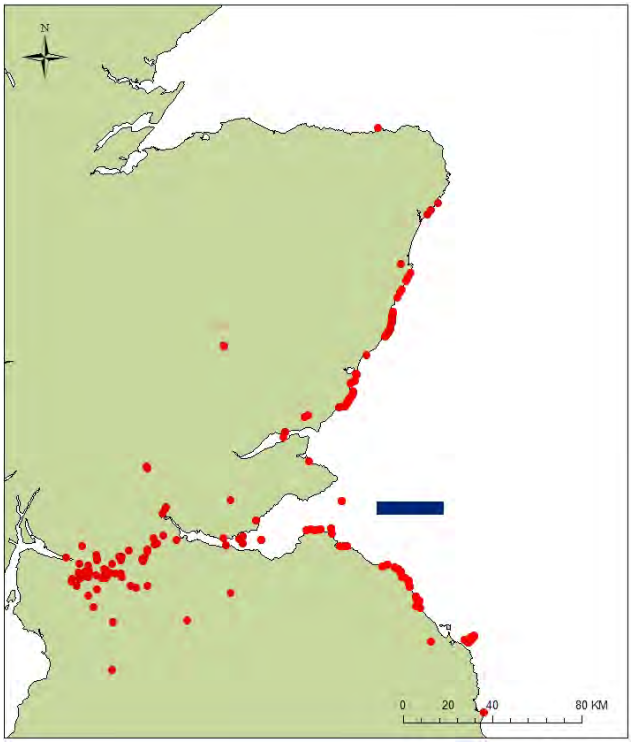


Figure 27. Area 42 (blue polygon), identified as an aggregation for all seabird species during the summer (July to August) seasons and seabird breeding colonies potentially within foraging range of the area (identified using the mean maximum foraging ranges presented in Thaxter *et al* (2012)).

3.25.1 Identification of Area 42 as an important aggregation of seabirds

Area 42 was identified by Kober *et al* (2010) as an important aggregation for all seabird species during the summer. Based on analysis of ESAS data, the area supports a population of 68,946 birds of all species (Kober *et al* 2010). Further analysis of the ESAS data indicated that the importance of the hotspot persisted between years, and it was present in 3 of the 5 years between 1980 and 2004 for which there were sufficient data to test (Kober *et al* 2012). Kober *et al* (2012) determined that the key species contributing to the aggregation were northern fulmar (39 individuals), sooty shearwater (<1), Manx shearwater (48 individuals), northern gannet (1,029 individuals), Arctic skua (12 individuals), black-legged kittiwake (4,036 individuals), common gull (4 individuals), lesser black-backed gull (72 individuals), herring gull (191 individuals), great black-backed gull (<1), Arctic tern (<1), common guillemot (3,180 individuals), razorbill (154 individuals) and Atlantic puffin (11,640 individuals).

3.25.2 Literature review of additional evidence

Stage 1 of Assessment

The available evidence base (other than ESAS data already analysed by JNCC) consisted of seven tracking studies, three boat surveys and an aerial survey. No evidence was located from seawatching records or other casual observations, or based on expert knowledge of the area from our questionnaire survey.

Peer reviewed: Data have been collected from a number of detailed tracking studies in the region surrounding Area 42. Wanless *et al* (1990), Thaxter *et al* (2010) and Harris *et al* (2012) fitted tracking devices to auks breeding on the Isle of May. Whilst Thaxter *et al* (2010), did not find common guillemots feeding within Area 42, Wanless *et al* (1990) collected data from a single Atlantic puffin, three razorbill and six common guillemots which did appear to show birds utilising the area. Similarly, Harris *et al* (2012) found Atlantic puffins tagged on the Isle of May feeding within Area 42. Whilst Wanless *et al* (1990) presented simple plots of birds at sea locations, both Thaxter *et al* (2010) and Harris *et al* (2012) used kernel density analysis to investigate species at sea distributions. Whilst Thaxter *et al* (2010) revealed that Area 42 was just outside the 95% utilization area for common guillemot, Harris *et al* (2012) found that it was within the 70% utilization area for Atlantic puffin. An additional study, Thaxter *et al* (2009) was identified, but it was determined to contain the same data as Thaxter *et al* (2010) and excluded from our assessment.

Hamer *et al* (2007) and Wakefield *et al* (2013) both found that northern gannets fitted with satellite tags from the Bass Rock colony foraged within Area 42. Both studies used kernel density analysis to investigate the at sea-distribution of birds. Hamer *et al* (2007) found Area 42 overlapped with the 50% utilization area for northern gannets in 1998 and 2002 while Wakefield found that it overlapped with the 75% utilization area in 2011. Two additional studies were identified, Hamer *et al* (2009) and Skov *et al* (2008), however, it was determined that these contained the same data as Hamer *et al* (2007) and were consequently excluded from our assessment.

In addition to the tracking studies, we identified two boat surveys of the region surrounding the area (Cox *et al* 2013) and Wanless *et al* (1998). Whilst it was not possible to identify precise numbers of birds within Area 42 from either study, both identified concentrations of a number of species including northern gannet, European shag, black-legged kittiwake, Arctic tern, common tern, common guillemot, razorbill and Atlantic puffin. Whilst Wanless *et al* (1998) used a simple approach involving transects of variable width to estimate the density of birds within the region, Cox *et al* (2013) used a more sophisticated spatial modelling approach which showed that species distributions were linked to tidal conditions and thermal stratification levels, which influence the distribution of prey species. We identified an additional analysis of boat survey data, Scott *et al* (2010), but determined that it contained the same data as presented in Cox *et al* (2013) and consequently excluded it from our assessment.

Grey literature: We identified two tracking studies, a boat survey and an aerial survey during our review of the grey literature. Camphuysen (2005) collected tracking data from European shags, black-legged kittiwakes and common guillemots breeding on the Isle of May and northern gannets breeding on the Bass Rock. The northern gannet data was described in Hamer *et al* (2007), above, and therefore not assessed here. Whilst no overlap was found with European shags breeding on the Isle of May and Area 42, there was overlap with breeding black-legged kittiwakes and common guillemots. In a similar study, Seagreen Wind Energy (2012) found black-legged kittiwakes breeding on the Isle of May and St. Abbs Head, and Atlantic puffins and common guillemots breeding on the Isle of May foraged within Area 42. However, neither of these tracking studies undertook analysis of the distribution of birds at sea.

Seagreen Wind Energy carried out aerial surveys of the region surrounding Area 42 throughout the 2009 breeding season. They revealed significant concentrations of auks, black-legged kittiwakes and northern gannets within Area 42. Similarly, Natural Research Projects Ltd (2012) carried out intensive boat surveys of the region 2010 and 2011 breeding seasons. These revealed significant concentrations of auks, black-legged kittiwakes and northern fulmar within Area 42, in addition to Arctic terns and Manx shearwater. Neither

study undertook detailed analysis beyond that required to produce density estimates for the regions concerned.

Expert opinion: No relevant information received.

Table 26. Stage 1 score for the quality of evidence presented in each individual data source reviewed for the assessment of evidence for Area 42* (see methodology for further information on how scores are derived, and Appendix 6 (supplied as a separate spreadsheet file) for further details of each source score). Scores in the four grey columns are summed to give a total score for representativeness ("Total Represent"). The "Total adjusted score" for each source is calculated by taking the average of the scores for "Age of data", "Number of years", "Appropriate methodology" and "Total Representativeness" (each of which are scored on a 1-5 scale), and then multiplying this by the score for the "Type of source" (scored on a 1-3 scale), such that the maximum possible "Total adjusted score" is 15.

Reference	Stage 1 score for each individual source											
				Representativeness								
	Age of data	Number of years	Appropriate methodology	Season	Sex	Age of bird	Colony	Survey	Total represent.	Type of source	Total adjusted score (max 15)	Supports Area as Important
Camphuysen 2005	1	3	4	2	1	0	0	NA	3	2	**5.5**	**Y**
Cox *et al* 2013	1	1	5	1	NA	NA	NA	1	2	3	**6.75**	**Y**
Hamer *et al* 2007	1	5	5	1	1	1	0	NA	3	3	**10.5**	**Y**
Harris *et al* 2012	3	1	4	1	1	0	0	NA	2	3	**7.5**	**Y**
Natural Research Projects Ltd 2012	4	3	4	2	NA	NA	NA	3	5	3	**12**	**Y**
Seagreen Wind Energy 2012	3	1	4	2	NA	NA	NA	3	5	3	**9.75**	**Y**
Seagreen Wind Energy 2012	4	3	4	1	1	0	1	NA	3	3	**10.5**	**Y**
Thaxter *et al* 2010	2	5	5	1	1	1	0	NA	3	3	**11.25**	**N**
Wakefield *et al* 2013	4	3	5	1	1	1	0	NA	3	3	**11.25**	**Y**
Wanless *et al* 1998	1	1	4	1	NA	NA	NA	1	2	3	**6**	**Y**
Wanless *et al* 1990	1	1	3	1	1	0	0	NA	2	3	**5.25**	**Y**

*Data from the RSPB FAME tracking project also show black-legged kittiwake from the St. Abbs Head and Isle of May colonies and common guillemot from the Isle of May colony using Area 42 in 2012, and razorbill, black-legged kittiwake and common guillemot from the Isle of May using Area 42 in 2013. However, only raw track data were available from these studies and it was not possible to determine how many birds were represented by these tracks, or which part of the breeding season data originate from. For this reason, it was not possible to assess these studies in the same way as the others.

Stage 2 of Assessment

The available evidence, beyond that presented in Kober *et al* (2010, 2012), strongly supports the identification of Area 42 as being important to seabirds in the breeding season, with an overall score of 15.83/20 (Appendix 6, Stage 2 – Site Scores). Data have been collected in 11 separate years, and in several cases throughout the breeding season. Tracking data reveals that seabirds breeding on the Isle of May, St. Abbs Head and the Bass Rock all forage within the area. In addition to this, recent, intensive boat and aerial surveys, carried out throughout the breeding season, have revealed concentrations of a variety of different species within the area.

Summary

	Number of studies	*Strength of evidence (Appendix 6)*
Supporting evidence	*10*	*15.83*
Have surveyed Area 42 but do not provide supporting evidence	*1*	*5.75*

3.25.3 Ecological explanations

Ecological explanations for the presence of an important aggregation of seabirds in Area 42 during the breeding season are likely to be linked to the species' foraging behaviour and the proximity to a number of important breeding colonies. Kober *et al* (2010) estimate that 147,987 birds are present within Area 42 during the breeding season. However, the effects of population turnover mean that the total number of birds using the area is likely to be higher. Tracking data showed black-legged kittiwake from the Isle of May and St. Abbs Head, razorbill, common guillemot and Atlantic puffin from the Isle of May and northern gannets from the Bass Rock all foraging within Area 42. Additional, unpublished tracking data from the RSPB FAME project reinforces these findings, also showing black-legged kittiwakes from St. Abbs Head and common guillemots and razorbills from the Isle of May foraging within Area 42. Based on the mean maximum foraging range for different species identified in Thaxter *et al* (2012), there are a large number of breeding pairs at colonies which are potentially within foraging range of Area 42 (Table 26). The abundance of breeding birds within foraging range of Area 42 suggests that it is feasible for Area 42 to support a population of the size suggested by Kober *et al* (2010, 2012).

Area 42 is located over a sand and muddy sand substrate, ideal habitat for sandeel, a key prey species for many of the seabird species within Area 42, which spawn at high intensity in the area (Ellis *et al* 2012). The mean depth of the area is 52m (±4m), meaning that even sandeel on the sea floor are well within reach of pursuit diving species, such as auks (Burger & Simpson 1986; Piatt & Nettleship 1985; Barrett & Furness 1990).

However, sandeel availability has been highly variable in recent years, largely in response to the commercial fishery which operated on Wee Bankie until 2000 (Greenstreet *et al* 2006). This fishery is widely believed to have had a negative impact on seabird populations within the wider region (Daunt *et al* 2006; Frederiksen *et al* 2004; Cook *et al* 2014). Despite the variable sandeel abundance, Area 42 may have remained an important foraging area for the seabirds breeding in the wider region as it overlaps with the nursery and spawning grounds for a variety of other species including, mackerel, herring and whiting (Ellis *et al* 2012) which seabirds, including northern gannets, Manx shearwaters and auks may prey upon (Cramp & Simmons 1977; Hamer *et al* 2007; Thaxter *et al* 2013). This diversity of different prey is also likely to attract foraging seabirds to the area.

The abundance of spawning fish within the region surrounding Area 42 means that there a number of moderate to high intensity fisheries operating in the area (Coull *et al* 1998). Discards from commercial fisheries offer an important foraging opportunity for several key species, notably northern gannets, northern fulmar and gulls (Hudson & Furness 1988, 1989; Furness *et al* 1992; Camphuysen 1995; Votier *et al* 2004). In particular, discards from fisheries may constitute a significant proportion of the diets of gull chicks (Furness *et al* 1992). The presence of fisheries may therefore represent a key component of the diets of gulls in the wider region, whilst offering a valuable alternative foraging opportunity for species such as northern gannets and northern fulmar.

Table 27. Number of colonies and breeding pairs within foraging range of Area 42 broken down by species, based on data from Mitchell *et al* (2004).

Species	Foraging Range (mean maximum, Thaxter *et al* 2012)	Number of Colonies	Number of Breeding Pairs
northern fulmar	400	1,118	175,015
northern gannet	229.4	2	45,195
black-legged kittiwake	60	48	35,625
common gull	50	1	2
lesser black-backed gull	141	113	15,318
herring gull	61.1	82	13,267
great black-backed gull	60*	16	49
Arctic tern	24.2	3	908
common guillemot	84.2	72	92,788
razorbill	48.5	29	8,385
Atlantic puffin	105.4	53	73,025

*Great black-backed gull foraging range based on observations made by Seys *et al* (2001).

The proximity of Area 42 to a large number of seabird breeding colonies, combined with predictable foraging opportunities from a variety of different sources, is likely to provide an ecological explanation for the presence of an important seabird aggregation during the breeding season.

3.25.4 Conclusions

Evidence that directly supports the identification of Area 42 as being of importance to seabird during the breeding season, in addition to that identified by Kober *et al* (2010, 2012) is available from both the grey and peer-reviewed literature. Several tracking studies revealed a direct link between the area and breeding colonies, supported by additional, recent data from the RSPB FAME project. The potential importance of the site is reinforced by recent, regular boat and aerial surveys highlighting a significant concentration of birds within Area 42 during the breeding season. The overlap with spawning areas for several potential prey species, as well as a number of commercial fisheries, and proximity to a number of large breeding colonies provides an ecological explanation for the importance of Area 42 to breeding seabirds.

Overall, in combination with the analysis of ESAS data carried out by Kober *et al* (2010, 2012), the evidence that supports the identification of the aggregation as being important to seabirds in the breeding season (15.83/20) is stronger than the evidence that does not (5.75/20). The strength of the additional evidence is strong and consistent (91% studies with additional information support the identification of the area as important, Appendix 6).

4 Final Conclusions

Both the quantity, and quality, of evidence regarding of each of the aggregations identified by Kober *et al* (2010, 2012) showed strong variation (Table 28). This variation is linked to the research activity in different regions. For example aggregations 3 and 6 for Manx shearwater scored highly as a result of both the intensive studies carried out on the species at the Skomer breeding colony, and also through surveys carried out for offshore wind farms in the Celtic and Irish Seas. Aggregations in the vicinity of the Firth of Forth scored highly for similar reasons, particularly in respect to breeding birds. However, even where the published evidence regarding the aggregations was limited, there were often strong ecological reasons to expect a seabird aggregation may be present. Unpublished tracking data from the RSPB FAME project often showed birds using these aggregations. In the future, research of this nature may provide additional support for those aggregations identified by Kober *et al* (2010, 2012) which, at present have a limited evidence base.

Table 28. Summary of the strength of additional evidence (beyond that presented in Kober *et al* 2010, 2012) available regarding the identification of each seabird aggregation considered in this report. The method for assessing the strength of evidence presented here is described in Table 5.

Aggregation	N Supporting Studies (Total Studies)	Site Score (out of 20)	Strength of evidence
1	0 (1)	0	None
3	5 (6)	11.7	Strong
6	7 (7)	12.77	Strong
7	1 (1)	6.25	Weak
10	4 (4)	11.63	Strong
11	1 (1)	6.25	Weak
12	2 (2)	5.88	Weak
13	2 (2)	6.13	Weak
14	1 (1)	6.25	Weak
15	1 (1)	6.25	Weak
16	2 (2)	5	Weak
18	0 (0)	0	None
19	1 (1)*	6.5	Weak
20	0 (0)*	0	None
21	6 (6) *	10.81	Strong
23	0 (0)	0	None
24	2 (2)	5.63	Weak
26	0 (0)*	0	None
31	1 (1)	7	Weak
32	2 (2)	7.63	Weak
33	5 (5)	10.25	Strong
36	0 (0)	0	None
40	2 (2)	8.5	Weak
41	10 (11)*	15.83	Strong
42	10 (11)*	15.83	Strong

*For these sites there is also evidence from FAME that suggests the aggregations are used by tracked birds from nearby breeding colonies. This evidence is not included in the total number of studies shown in this table as providing support for the identification of these aggregations.

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Appendix 1

Evidence obtained in the grey literature: descriptive accounts lacking geo-referenced datasets.

The evidence presented here is made up of descriptive accounts sourced from species monographs, national and regional reference books, survey reports, and county bird club reports. These accounts were not based on systematic recording methods and, without geo-referenced data, this information could not be run through the assessment in the main body of this report. However, as each account gave details of location, it was thought that some additional useful information could be obtained from these sources when compared to the populations reported within each of the 25 seabird aggregations identified by Kober *et al* (2010, 2012).

The search was limited to include only species monographs and national and regional reference books available in the Chris Mead Library, BTO headquarters. To reduce the time spent searching through bird reports, only those published between 2007 and the present were considered. This cut off was chosen because the period immediately followed the years sampled from the ESAS database by Kober *et al* (2010, 2012). All available online reports produced by MARINElife were also searched if an aggregation overlapped with a ferry route surveyed during the season of interest.

Notable counts sourced from bird reports, species monographs and reference books were included as *Supporting Evidence* if the count location overlapped with an aggregation. Other notable counts were included under the heading *Other Evidence* if they indicated a notable regional presence of seabirds but if the count location did not overlap with an aggregation. Total counts obtained from MARINElife survey reports were included under the heading *Other Evidence* because each count includes numbers recorded outwith the identified aggregation as well as numbers that may have been recorded passing through the aggregation. Breeding colony counts found in the search were not included as evidence, as breeding colonies within foraging range were reported within the site account for each aggregation.

It is important to note that many of the counts recorded in the literature are not based on systematic recording methods and should be treated with caution when assessing the evidence for each aggregation.

Area 1: *Northern fulmar, breeding (Mar– Jul)*

Area 1 was identified by Kober *et al* (2010) as an important aggregation of northern fulmar *Fulmarus glacialis* during the breeding season. Based on analysis of ESAS data, the area supports a population of 40,755 birds, 0.40% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

FISHER, J. 1984. The Fulmar. Collins, London.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

HEUBECK, M. & MELLOR, M. 2008. SOTEAG Ornithological Monitoring Programme: 2007 Summary Report. Aberdeen Institute of Coastal Science and Management, University of Aberdeen, Aberdeen.

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HEUBECK, M. & MELLOR, M. 2012. SOTEAG Ornithological Monitoring Programme: 2011 Summary Report. Aberdeen Institute of Coastal Science and Management, University of Aberdeen, Aberdeen.

HEUBECK, M. & MELLOR, M. 2013. SOTEAG Ornithological Monitoring Programme: 2012 Summary Report. Aberdeen Institute of Coastal Science and Management, University of Aberdeen, Aberdeen.

Supporting Evidence:
None found

Other Evidence:
None found

Area 3: *Manx shearwater, breeding (May – Sep)*

Area 3 was identified by Kober *et al* (2010) as an important aggregation of Manx shearwater *Puffinus puffinus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 51,792 birds, 4.60% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

BERRY, S., DEVONALD, K.J.S., JAMES, J., GREEN, J. & ROGERS, A. (eds). 2008. Pembrokeshire Bird Report 2008. The Wildlife Trust South and West Wales, Cardigan.

BERRY, S., DEVONALD, K.J.S., JAMES, J., GREEN, J. & ROGERS, A. (eds). 2009. Pembrokeshire Bird Report 2009. The Wildlife Trust South and West Wales, Cardigan.

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BERRY, S., HURFORD, J., GREEN, J. & ROGERS, A. (eds). 2010. Pembrokeshire Bird Report 2010. The Wildlife Trust South and West Wales, Cardigan.

BERRY, S., HURFORD, J., GREEN, J. & ROGERS, A. (eds). 2011. Pembrokeshire Bird Report 2011. The Wildlife Trust South and West Wales, Cardigan.

BROOKE, M. 1990. The Manx Shearwater. T & AD Poyser, London.

DONOVAN, J. & REES, G. 1994. Birds of Pembrokeshire. Dyfed Wildlife Trust.

Supporting Evidence:
None found

Other Evidence:
Manx shearwaters use all the sea areas around the county of Pembrokeshire for feeding, particularly the Southern Celtic Deep (Donovan & Rees 1994), an area relatively close to the south-east boundaries of Area 3. No evidence was found within the boundaries of Area 3. However, notable counts include an estimated 70,000 per hour during a two hour sea watch from Strumble Head on 9 July 2010, and a similar number recorded on Ramsey Island on the same day (Berry *et al* 2010).

Area 6: *Manx shearwater, breeding (May – Sept)*

Area 6 was identified by Kober *et al* (2010) as an important aggregation of Manx shearwater *Puffinus puffinus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 12,039 birds, 1.07% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:
BROOKE, M. 1990. *The Manx Shearwater. T* & AD Poyser, London.

MARINELIFE SURVEY REPORTS (Online): Brittany Ferries '*Anglia Seaways*' and '*Clipper Panorama*' Heysham - Warrenpoint (August 2011 – September 2013).

Supporting Evidence:
None found

Other Evidence:
Data from MARINElife ferry surveys that pass through Area 6 confirm that high concentrations of Manx shearwater are regularly seen along the Heysham - Warrenpoint route. Total Manx shearwater numbers recorded by MARINElife on each survey during the season of interest are as follows: 2,571 on 12-13 September 2013; 524 on 6-7 June 2013; 185 on 10 May 2013; 5,492 on 13-14 September 2012; 3,746 on 16-17 August 2012; 966 on 19-20 July 2012; 806+ on 14-15 June 2012; 120 on 10-11 May 2012; 6,679 on 8-9 September 201;1 and 4,366 on 25-26 August 2011.

Area 7: *Northern gannet, breeding (May – Sept)*

Area 7 was identified by Kober *et al* (2010) as an important aggregation of northern gannet *Morus bassanus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 51,784 birds, 4.47% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:
FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

NELSON, B. 2002. The Atlantic Gannet. Fenix, Great Yarmouth.

RABBITS, B. (ed). 2007. Outer Hebrides Bird Report 2007. Western Isles Natural History Society.

RABBITS, B. (ed). 2010. Outer Hebrides Bird Report 2008-2010. Western Isles Natural History Society.

Supporting Evidence:
None found

Other Evidence:
Area 7 lies approximately 30km from Lewis and Harris and 36km from South Uist. Recent notable counts from these islands include 5,242 at Rubha Ardvule (South Uist) on 25 August 2008 (Rabbits 2010) and 2,140 south, from the same location on 31 July 2007 (Rabbits 2007).

Area 10: *Northern gannet, breeding (May – Sept)*

Area 10 was identified by Kober *et al* (2010) as an important aggregation of northern gannet *Morus bassanus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 7,915 birds, 0.68% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:
ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2010. Lothian Bird Report 2007. Scottish Ornithologists Club, East Lothian.

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COOK, J. (ed). Angus and Dundee Bird Report 2009. Angus and Dundee Bird Club, Carnoustie.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

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ISLE OF MAY BIRD OBSERVATORY 2012. Isle of May Bird Observatory Annual Report 2011. Isle of May Bird Observatory & Field Station Trust.

ISLE OF MAY BIRD OBSERVATORY 2013. Isle of May Bird Observatory Annual Report 2012. Isle of May Bird Observatory & Field Station Trust.

NELSON, B. 2002. The Atlantic Gannet. Fenix, Great Yarmouth.

SHAND, R. (eds). 2008. Fife Bird Report 2007. Fife Bird Club, Fife.

SHAND, R. (eds). 2010. Fife Bird Report 2008. Fife Bird Club, Fife.

WAVE, M. (eds). 2011. Fife Bird Report 2009. Fife Bird Club, Fife.

WAVE, M. (eds). 2012. Fife Bird Report 2010. Fife Bird Club, Fife.

Supporting Evidence:
The boundaries of Area 10 overlap with several parts of the coastline that fall within the recording areas of Fife and Lothian bird clubs. Notable counts reported in the literature include c.2000 past Anstruther on the evening of 8 May 2010 (Wave 2012) and 180 (in five minutes) at Dunbar in 27 September 2007 (Andrews 2010).

Other Evidence:
The Fife Bird Club reports several notable count records from Kincraig Point, a vantage point approximately 5km west of Area 10. These include 1,460 east on 8 May 2010 (Wave 2012) and 260 on 12 July 2009 (Wave 2011). Other records from Fife Ness (a vantage point approximately 5km of Area 10) include 475 on 15 May 2009 and 400 south on 4 August 2009 (Wave 2011).

Area 11: *Northern gannet, breeding (May – Sept)*

Area 11 was identified by Kober *et al* (2010) as an important aggregation of northern gannet *Morus bassanus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 5,276 birds, 0.46% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:
CALLAN, T. (ed). 2013. Argyll Bird Report 2010-2011. Argyll Bird Club, Argyll.

CALLAN, T. (ed). 2012. Argyll Bird Report 2008-2009. Argyll Bird Club, Argyll.

CASSILS, J. (ed). 2008. Arran Bird Report 2007. Arran Natural History Society, Ardrossan.

CASSILS, J. (ed). 2009. Arran Bird Report 2008. Arran Natural History Society, Ardrossan.

CASSILS, J. (ed). 2010. Arran Bird Report 2009. Arran Natural History Society, Ardrossan.

CASSILS, J. (ed). 2011. Arran Bird Report 2010. Arran Natural History Society, Ardrossan.

CASSILS, J. (ed). 2012. Arran Bird Report 2011. Arran Natural History Society, Ardrossan.

CASSILS, J. (ed). 2013. Arran Bird Report 2012. Arran Natural History Society, Ardrossan.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

NELSON, B. 2002. The Atlantic Gannet. Fenix, Great Yarmouth.

Supporting Evidence:
The boundaries of Area 11 overlap with the coastal areas of east Cambletown and south Arran. The Argyll Bird Report (Callan 2013) reported that by May/June, large numbers of northern gannets were feeding in the coastal and offshore waters of Argyll. However, there were no notable counts of northern gannet recorded in the grey literature search.

Other Evidence:
Counts carried out during the breeding season from coastal sites close to the boundaries of Area 11 include: 30 off Kildonan (south-east Arran) on 12 September 2012 (Cassils 2012); 30 passing Kildonan on 12 June 2008 (Cassils 2009); and 65 passing Kildonan in half an hour on 25 July 2007 (Cassils 2007).

Area 12: *Northern gannet, winter (Oct – Apr)*

Area 12 was identified by Kober *et al* (2010) as an important aggregation of northern gannet *Morus bassanus* during the winter. Based on analysis of ESAS data, the area supports a population of 2,144 birds, 0.18% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:
FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

MARINELIFE SURVEY REPORTS (Online): Brittany Ferries '*Armorique'* Plymouth-Roscoff (April 2009 – April 2013).

NELSON, B. 2002. The Atlantic Gannet. Fenix, Great Yarmouth.

Supporting Evidence:
None found

Other Evidence:
After the breeding season, most northern gannets leave the North Sea via the English Channel. Heavy south-west passage occurs off Cornwall in September (Nelson 2002). Data from MARINElife ferry surveys that pass through Area 12 confirm that high concentrations of northern gannet are regularly seen along the Plymouth to Roscoff route. Total northern gannet numbers recorded by MARINElife on each survey during the season of interest are as follows: 54 on 13 April 2013; 112 on 28 February – 1 March 2013; 79 on 14-15 February 2013; 144 on 6 October 2012; 168 on 14 April 2012; 41 on 12 March 2012; 82 on 27 February 2012; 40+ on 6-7 November 2011; 150 on 8 October 2011; 54 on 9 April 2011; 191 on 22 March 2011; 151 on 22 February 2011; 322 on 3 October 2010; 141 on 4 April 2010; 128 on 5 March 2010; 304 on 3 October 2009; and 374 on 4 April 2009.

Area 13: *European shag, breeding (Mar – Sept)*

Area 13 was identified by Kober *et al* (2010) as an important aggregation of European shag *Phalacrocorax aristotelis* during the breeding season. Based on analysis of ESAS data, the area supports a population of 4,606 birds, 2.28% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:
BUTTERFIELD, D. 2009. Highland Bird Report 2007. Scottish Ornithologists Club, East Lothian.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

JOSS, A. (ed). 2010. Highland Bird Report 2008. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2011. Highland Bird Report 2009. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2012. Highland Bird Report 2010. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2013. Highland Bird Report 2011. Scottish Ornithologists Club, East Lothian.

LITTLEWOOD, N. (ed). 2007. North East Scotland Bird Report 2007. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2008. North East Scotland Bird Report 2008. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2009. North East Scotland Bird Report 2009. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2012. North East Scotland Bird Report 2010. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2013. North East Scotland Bird Report 2011. North East Scotland Bird Club.

NELSON, B. 2006. Pelicans, Cormorants and their relatives. OUP, Oxford.

Supporting Evidence:
None found

Other Evidence:
None found

Area 14: *European shag, winter (Oct – Feb)*

Area 14 was identified by Kober *et al* (2010) as an important aggregation of European shag *Phalacrocorax aristotelis* during the winter. Based on analysis of ESAS data, the area supports a population of 3,179 birds, 1.58% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

BUTTERFIELD, D. 2009. Highland Bird Report 2007. Scottish Ornithologists Club, East Lothian.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

JOSS, A. (ed). 2010. Highland Bird Report 2008. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2011. Highland Bird Report 2009. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2012. Highland Bird Report 2010. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2013. Highland Bird Report 2011. Scottish Ornithologists Club, East Lothian.

LITTLEWOOD, N. (ed). 2007. North East Scotland Bird Report 2007. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2008. North East Scotland Bird Report 2008. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2009. North East Scotland Bird Report 2009. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2012. North East Scotland Bird Report 2010. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2013. North East Scotland Bird Report 2011. North East Scotland Bird Club.

NELSON, B. 2006. Pelicans, Cormorants and their relatives. OUP, Oxford.

Supporting Evidence:
In 2007, the Highland Bird Report's highest European shag count was "80 off Brora" on 7 October (Butterfield 2009). This town lies on the boundaries of Area 14.

Other Evidence:
High seawatching counts from Tarbet Ness, an outcrop approximately 15km south of Area 14, are regularly submitted through the Highland Bird Report e.g. 100 off Tarbet Ness on 17 February 2008 (Joss 2010).

Area 15: *European shag, winter (Oct – Feb)*

Area 15 was identified by Kober *et al* (2010) as an important aggregation of European shag *Phalacrocorax aristotelis* during the winter. Based on analysis of ESAS data, the area supports a population of 1,967 birds, 0.97% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:
FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

LITTLEWOOD, N. (ed). 2007. North East Scotland Bird Report 2007. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2008. North East Scotland Bird Report 2008. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2009. North East Scotland Bird Report 2009. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2012. North East Scotland Bird Report 2010. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2013. North East Scotland Bird Report 2011. North East Scotland Bird Club.

NELSON, B. 2006. Pelicans, Cormorants and their relatives. OUP, Oxford.

THORPE, A.W. 2007. The North Sea Bird Club Twenty-Fifth Annual Report for the year 2007. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2008. The North Sea Bird Club Twenty-Sixth Annual Report for the year 2008. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2009. The North Sea Bird Club Twenty-Seventh Annual Report for the year 2009. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2010. The North Sea Bird Club Twenty-Eighth Annual Report for the year 2010. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2011. The North Sea Bird Club Twenty-Ninth Annual Report for the year 2011. North Sea Bird Club, Aberdeen.

Supporting Evidence:
None found

Other Evidence:
Substantial roosts, both nocturnal and when birds are resting between bouts of feeding activity are known to occur at Portnockie, a small town approximately 2km west of Area 15's boundaries e.g. 1,610 in January 1990 (Forrester & Andrews 2007).

Area 16: *Great skua, breeding (May – Aug)*

Area 16 was identified by Kober *et al* (2010) as an important aggregation of great skuas *Stercorarius skua* during the breeding season. Based on analysis of ESAS data, the area supports a population of 1,620 birds, 3.97% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

FURNESS, R. 1987. Skuas. T & AD Poyser, Calton.

HEUBECK, M. & MELLOR, M. 2008. SOTEAG Ornithological Monitoring Programme: 2007 Summary Report. Aberdeen Institute of Coastal Science and Management, University of Aberdeen, Aberdeen.

HEUBECK, M. & MELLOR, M. 2009. SOTEAG Ornithological Monitoring Programme: 2008 Summary Report. Aberdeen Institute of Coastal Science and Management, University of Aberdeen, Aberdeen.

HEUBECK, M. & MELLOR, M. 2010. SOTEAG Ornithological Monitoring Programme: 2009 Summary Report. Aberdeen Institute of Coastal Science and Management, University of Aberdeen, Aberdeen.

HEUBECK, M. & MELLOR, M. 2011. SOTEAG Ornithological Monitoring Programme: 2010 Summary Report. Aberdeen Institute of Coastal Science and Management, University of Aberdeen, Aberdeen.

HEUBECK, M. & MELLOR, M. 2012. SOTEAG Ornithological Monitoring Programme: 2011 Summary Report. Aberdeen Institute of Coastal Science and Management, University of Aberdeen, Aberdeen.

HEUBECK, M. & MELLOR, M. 2013. SOTEAG Ornithological Monitoring Programme: 2012 Summary Report. Aberdeen Institute of Coastal Science and Management, University of Aberdeen, Aberdeen.

Supporting Evidence:
None found

Other Evidence:
None found

Area 18: *Black-legged kittiwake, breeding (May – Sep)*

Area 18 was identified by Kober *et al* (2010) as an important aggregation of black-legged kittiwake *Rissa tridactyla* during the breeding season. Based on analysis of ESAS data, the area supports a population of 3,167 birds, 0.04% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:
COULSON, J. 2011. The Kittiwake. T & AD Poyser, London.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

LITTLEWOOD, N. (ed). 2007. North East Scotland Bird Report 2007. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2008. North East Scotland Bird Report 2008. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2009. North East Scotland Bird Report 2009. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2012. North East Scotland Bird Report 2010. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2013. North East Scotland Bird Report 2011. North East Scotland Bird Club.

THORPE, A.W. 2007. The North Sea Bird Club Twenty-Fifth Annual Report for the year 2007. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2008. The North Sea Bird Club Twenty-Sixth Annual Report for the year 2008. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2009. The North Sea Bird Club Twenty-Seventh Annual Report for the year 2009. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2010. The North Sea Bird Club Twenty-Eighth Annual Report for the year 2010. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2011. The North Sea Bird Club Twenty-Ninth Annual Report for the year 2011. North Sea Bird Club, Aberdeen.

Supporting Evidence:
None found

Other Evidence:
None found

Area 19: *Black-legged kittiwake, breeding (May – Sep)*

Area 19 was identified by Kober *et al* (2010) as an important aggregation of black-legged kittiwake *Rissa tridactyla* during the breeding season. Based on analysis of ESAS data, the area supports a population of 8,236 birds, 0.10% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

COULSON, J. 2011. The Kittiwake. T & AD Poyser, London.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

LITTLEWOOD, N. (ed). 2007. North East Scotland Bird Report 2007. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2008. North East Scotland Bird Report 2008. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2009. North East Scotland Bird Report 2009. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2012. North East Scotland Bird Report 2010. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2013. North East Scotland Bird Report 2011. North East Scotland Bird Club.

THORPE, A.W. 2007. The North Sea Bird Club Twenty-Fifth Annual Report for the year 2007. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2008. The North Sea Bird Club Twenty-Sixth Annual Report for the year 2008. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2009. The North Sea Bird Club Twenty-Seventh Annual Report for the year 2009. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2010. The North Sea Bird Club Twenty-Eighth Annual Report for the year 2010. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2011. The North Sea Bird Club Twenty-Ninth Annual Report for the year 2011. North Sea Bird Club, Aberdeen.

Supporting Evidence:

None found

Other Evidence:

None found

Area 20: *Black-legged kittiwake, breeding (May – Sep)*

Area 20 was identified by Kober *et al* (2010) as an important aggregation of black-legged kittiwake *Rissa tridactyla* during the breeding season. Based on analysis of ESAS data, the area supports a population of 4,199 birds, 0.05% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

COULSON, J. 2011. The Kittiwake. T & AD Poyser, London.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

LITTLEWOOD, N. (ed). 2007. North East Scotland Bird Report 2007. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2008. North East Scotland Bird Report 2008. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2009. North East Scotland Bird Report 2009. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2012. North East Scotland Bird Report 2010. North East Scotland Bird Club.

LITTLEWOOD, N. (ed). 2013. North East Scotland Bird Report 2011. North East Scotland Bird Club.

THORPE, A.W. 2007. The North Sea Bird Club Twenty-Fifth Annual Report for the year 2007. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2008. The North Sea Bird Club Twenty-Sixth Annual Report for the year 2008. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2009. The North Sea Bird Club Twenty-Seventh Annual Report for the year 2009. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2010. The North Sea Bird Club Twenty-Eighth Annual Report for the year 2010. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2011. The North Sea Bird Club Twenty-Ninth Annual Report for the year 2011. North Sea Bird Club, Aberdeen.

Supporting Evidence:

None found

Other Evidence:

Several counts through seawatching have been reported for the east coast of Aberdeenshire. Counts carried out from Peterhead, 40km north of Area 20, are regularly in their thousands during the summer months. The highest monthly counts from this vantage point in the 2011 breeding season were: 3,600 north and 1,000 south in May; 3,100 north and 460 south in June; 2,000 north and 1,100 south in July; 250 north and 1000 south in August; and 1,600 north and 40 south in September (Littlewood 2013). Other counts from the Aberdeenshire coastline include 1,100 from Blackdog Beach on 31 August 2008 (Littlewood 2008).

Area 21: *Black-legged kittiwake, breeding (May – Sep)*

Area 21 was identified by Kober *et al* (2010) as an important aggregation of black-legged kittiwake *Rissa tridactyla* during the breeding season. Based on analysis of ESAS data, the area supports a population of 3,123 birds, 0.04% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2010. Lothian Bird Report 2007. Scottish Ornithologists Club, East Lothian.

ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2011. Lothian Bird Report 2009. Scottish Ornithologists Club, East Lothian.

BICKERSTAFF, H., COOK, J., MACCURLEY, B. & MCKAY, C (eds). 2007. Angus and Dundee Bird Report 2007. Angus and Dundee Bird Club, Carnoustie.

COOK, J. (ed). Angus and Dundee Bird Report 2009. Angus and Dundee Bird Club, Carnoustie.

COULSON, J. 2011. The Kittiwake. T & AD Poyser, London.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

ISLE OF MAY BIRD OBSERVATORY 2008. Isle of May Bird Observatory Annual Report 2007. Isle of May Bird Observatory & Field Station Trust.

ISLE OF MAY BIRD OBSERVATORY 2009. Isle of May Bird Observatory Annual Report 2008. Isle of May Bird Observatory & Field Station Trust.

ISLE OF MAY BIRD OBSERVATORY 2010. Isle of May Bird Observatory Annual Report 2009. Isle of May Bird Observatory & Field Station Trust.

ISLE OF MAY BIRD OBSERVATORY 2011. Isle of May Bird Observatory Annual Report 2010. Isle of May Bird Observatory & Field Station Trust.

ISLE OF MAY BIRD OBSERVATORY 2012. Isle of May Bird Observatory Annual Report 2011. Isle of May Bird Observatory & Field Station Trust.

ISLE OF MAY BIRD OBSERVATORY 2013. Isle of May Bird Observatory Annual Report 2012. Isle of May Bird Observatory & Field Station Trust.

SHAND, R. (ed). 2008. Fife Bird Report 2007. Fife Bird Club, Fife.

SHAND, R. (ed). 2010. Fife Bird Report 2008. Fife Bird Club, Fife.

WAVE, M. (ed). 2011. Fife Bird Report 2009. Fife Bird Club, Fife.

WAVE, M. (ed). 2012. Fife Bird Report 2010. Fife Bird Club, Fife.

Supporting Evidence:

None found

Other Evidence:
None found

Area 23: *Herring gull, breeding (Apr – Aug)*

Area 23 was identified by Kober *et al* (2010) as an important aggregation of herring gull *Larus argentatus* during the breeding season. Based on analysis of ESAS data, the area supports a population of 9,430 birds, 0.36% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

CALLAN, T. (ed). 2013. Argyll Bird Report 2010-2011. Argyll Bird Club, Argyll.

CALLAN, T. (ed). 2012. Argyll Bird Report 2008-2009. Argyll Bird Club, Argyll.

CASSILS, J. (ed). 2008. Arran Bird Report 2007. Arran Natural History Society, Ardrossan.

CASSILS, J. (ed). 2009. Arran Bird Report 2008. Arran Natural History Society, Ardrossan.

CASSILS, J. (ed). 2010. Arran Bird Report 2009. Arran Natural History Society, Ardrossan.

CASSILS, J. (ed). 2011. Arran Bird Report 2010. Arran Natural History Society, Ardrossan.

CASSILS, J. (ed). 2012. Arran Bird Report 2011. Arran Natural History Society, Ardrossan.

CASSILS, J. (ed). 2013. Arran Bird Report 2012. Arran Natural History Society, Ardrossan.

SIMPSON, F. (ed). 2008. Ayrshire Bird and Butterfly Report 2007. Ayrshire Branch of the Scottish Ornithologists' Club, Ayrshire.

SIMPSON, F. (ed). 2009. Ayrshire Bird Report 2008. Ayrshire Branch of the Scottish Ornithologists' Club, Ayrshire.

SIMPSON, F. (ed). 2010. Ayrshire Bird Report 2009. Ayrshire Branch of the Scottish Ornithologists' Club, Ayrshire.

SIMPSON, F. (ed). 2012. Ayrshire Bird Report 2010. Ayrshire Branch of the Scottish Ornithologists' Club, Ayrshire.

SIMPSON, F. (ed). 2013. Ayrshire Bird Report 2011. Ayrshire Branch of the Scottish Ornithologists' Club, Ayrshire.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

Supporting Evidence:
None found

Other Evidence:
None found

Area 24: *Arctic tern, breeding (May – Aug)*

Area 24 was identified by Kober *et al* (2010) as an important aggregation of Arctic tern *Sterna paradisaea* during the breeding season. Based on analysis of ESAS data, the area supports a population of 692 birds, 0.43% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

BUTTERFIELD, D. 2009. Highland Bird Report 2007. Scottish Ornithologists Club, East Lothian.

CABOT, D. & NISBET, I. 2013. Terns. New Naturalist, 123, Collins, London.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume I. The Scottish Ornithologist's Club, East Lothian.

JOSS, A. (ed). 2010. Highland Bird Report 2008. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2011. Highland Bird Report 2009. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2012. Highland Bird Report 2010. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2013. Highland Bird Report 2011. Scottish Ornithologists Club, East Lothian.

WILLIAMS, J. (ed). 2008. Orkney Bird Report 2007. Orkney Bird Club Report Committee, Kirkwall.

WILLIAMS, J. (ed). 2009. Orkney Bird Report 2008. Orkney Bird Club Report Committee, Kirkwall.

WILLIAMS, J. (ed). 2010. Orkney Bird Report 2009. Orkney Bird Club Report Committee, Kirkwall.

WILLIAMS, J. (ed). 2011. Orkney Bird Report 2010. Orkney Bird Club Report Committee, Kirkwall.

WILLIAMS, J. (ed). 2012. Orkney Bird Report 2011. Orkney Bird Club Report Committee, Kirkwall.

WILLIAMS, J. (ed). 2013. Orkney Bird Report 2012. Orkney Bird Club Report Committee, Kirkwall.

Supporting Evidence:

None found

Other Evidence:

None found

Area 26: *Common guillemot, breeding (May – Jun)*

Area 26 was identified by Kober *et al* (2010) as an important aggregation of common guillemot *Uria aalge* during the breeding season. Based on analysis of ESAS data, the area supports a population of 28,356 birds, 0.33% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

BUTTERFIELD, D. 2009. Highland Bird Report 2007. Scottish Ornithologists Club, East Lothian.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume II. The Scottish Ornithologist's Club, East Lothian.

JOSS, A. (ed). 2010. Highland Bird Report 2008. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2011. Highland Bird Report 2009. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2012. Highland Bird Report 2010. Scottish Ornithologists Club, East Lothian.

JOSS, A. (ed). 2013. Highland Bird Report 2011. Scottish Ornithologists Club, East Lothian.

GASTON, A.J. & JONES, I.L. 1998. The Auks. OUP, Oxford.

NETTLESHIP, D.N. & BIRKHEAD, T. 1985. The Atlantic *Alcidae*. Academic Press, London.

WILLIAMS, J. (ed). 2008. Orkney Bird Report 2007. Orkney Bird Club Report Committee, Kirkwall.

WILLIAMS, J. (ed). 2009. Orkney Bird Report 2008. Orkney Bird Club Report Committee, Kirkwall.

WILLIAMS, J. (ed). 2010. Orkney Bird Report 2009. Orkney Bird Club Report Committee, Kirkwall.

WILLIAMS, J. (ed). 2011. Orkney Bird Report 2010. Orkney Bird Club Report Committee, Kirkwall.

WILLIAMS, J. (ed). 2012. Orkney Bird Report 2011. Orkney Bird Club Report Committee, Kirkwall.

WILLIAMS, J. (ed). 2013. Orkney Bird Report 2012. Orkney Bird Club Report Committee, Kirkwall.

Supporting Evidence:
None found

Other Evidence:
None found

Area 31: *Common guillemot, winter (Oct – Apr)*

Area 31 was identified by Kober *et al* (2010) as an important aggregation of common guillemot *Uria aalge* during the winter. Based on analysis of ESAS data, the area supports a population of 11,143 birds, 0.13% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2010. Lothian Bird Report 2007. Scottish Ornithologists Club, East Lothian.

ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2011. Lothian Bird Report 2009. Scottish Ornithologists Club, East Lothian.

BICKERSTAFF, H., COOK, J., MACCURLEY, B. & MCKAY, C (eds). 2007. Angus and Dundee Bird Report 2007. Angus and Dundee Bird Club, Carnoustie.

COOK, J. (ed). Angus and Dundee Bird Report 2009. Angus and Dundee Bird Club, Carnoustie.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume II. The Scottish Ornithologist's Club, East Lothian.

GASTON, A.J. & JONES, I.L. 1998. The Auks. OUP, Oxford.

ISLE OF MAY BIRD OBSERVATORY 2008. Isle of May Bird Observatory Annual Report 2007. Isle of May Bird Observatory & Field Station Trust.

ISLE OF MAY BIRD OBSERVATORY 2009. Isle of May Bird Observatory Annual Report 2008. Isle of May Bird Observatory & Field Station Trust.

ISLE OF MAY BIRD OBSERVATORY 2010. Isle of May Bird Observatory Annual Report 2009. Isle of May Bird Observatory & Field Station Trust.

ISLE OF MAY BIRD OBSERVATORY 2011. Isle of May Bird Observatory Annual Report 2010. Isle of May Bird Observatory & Field Station Trust.

ISLE OF MAY BIRD OBSERVATORY 2012. Isle of May Bird Observatory Annual Report 2011. Isle of May Bird Observatory & Field Station Trust.

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SHAND, R. (ed). 2010. Fife Bird Report 2008. Fife Bird Club, Fife.

WAVE, M. (ed). 2011. Fife Bird Report 2009. Fife Bird Club, Fife.

WAVE, M. (ed). 2012. Fife Bird Report 2010. Fife Bird Club, Fife.

Supporting Evidence:
None found

Other Evidence:
Fife seawatching sites Kincraig Point and Fife Ness lie approximately 1km north and 5km north of Area 31's boundaries, respectively. Several seawatches report low numbers during the winter season. However, some larger counts include 1,163 east at Kincraig Point on 10 October 2009 (Wave 2011) and 627 (mixed auk flock) north in three hours at Fife Ness on 27 September 2007 (Shand 2008). Within the Lothian recording area there is one report of 400 per hour (north) past Barns Ness on 9 October 2009 and 4,200 per hour (south) from the same location on 11 October 2009 (Andrews *et al* 2011). Barns Ness is approximately 10km south of Area 31's boundaries.

Area 32: *Common guillemot, winter (Oct – Apr)*

Area 32 was identified by Kober *et al* (2010) as an important aggregation of common guillemot *Uria aalge* during the winter. Based on analysis of ESAS data, the area supports a population of 15,334 birds, 0.18% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

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SHAND, R. (ed). 2010. Fife Bird Report 2008. Fife Bird Club, Fife.

WAVE, M. (ed). 2011. Fife Bird Report 2009. Fife Bird Club, Fife.

WAVE, M. (ed). 2012. Fife Bird Report 2010. Fife Bird Club, Fife.

Supporting Evidence:

None found

Other Evidence:
None found

Area 33: *Atlantic puffin, breeding (Apr – Jul)*

Area 33 was identified by Kober *et al* (2010) as an important aggregation of Atlantic puffin *Fratercula arctica* during the breeding season. Based on analysis of ESAS data, the area supports a population of 56,732 birds, 0.42% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:
ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2010. Lothian Bird Report 2007. Scottish Ornithologists Club, East Lothian.

ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2011. Lothian Bird Report 2009. Scottish Ornithologists Club, East Lothian.

BICKERSTAFF, H., COOK, J., MACCURLEY, B. & MCKAY, C (eds). 2007. Angus and Dundee Bird Report 2007. Angus and Dundee Bird Club, Carnoustie.

COOK, J. (ed). Angus and Dundee Bird Report 2009. Angus and Dundee Bird Club, Carnoustie.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume II. The Scottish Ornithologist's Club, East Lothian.

GASTON, A.J. & JONES, I.L. 1998. The Auks. OUP, Oxford.

HARRIS, M.P., WANLESS, S. & BROCKIE, K. 2011. The Puffin. T & AD Poyser, London

NETTLESHIP, D.N. & BIRKHEAD, T. 1985. The Atlantic *Alcidae*. Academic Press, London.

SHAND, R. (ed). 2008. Fife Bird Report 2007. Fife Bird Club, Fife.

SHAND, R. (ed). 2010. Fife Bird Report 2008. Fife Bird Club, Fife.

WAVE, M. (ed). 2011. Fife Bird Report 2009. Fife Bird Club, Fife.

WAVE, M. (ed). 2012. Fife Bird Report 2010. Fife Bird Club, Fife.

Supporting Evidence:
Puffins can be seen regularly in the coastal waters of the East Neuk and east coast of Fife, particularly between Kinghorn and Inchkeith during the breeding season (Shand 2008). Notable counts from overlapping recording areas include 380 north in one hour at Fife Ness on 4 June 2010 (Wave 2012). In 2008, the Forth Seabird Group reported 646 on land and sea at Inchkeith on 6 July. On the same year, 85 were counted in one hour at Fife Ness on 22 June and 100+ were observed from the same location on 6 July (Shand 2010). In 2007, the Forth Seabird Group counted approximately 970 on land and sea at Inchkeith in the breeding season and 70 were observed from Anstruther on 24 June (Shand 2008).

Other Evidence:
Notable observations have been reported from Kincraig Point, approximately 1km from the boundary of Area 33. From there, 270 birds were observed flying east in two hours on 26 June 2010 (Wave 2012). In 2008, 140 were observed on 20 June (Shand 2010).

Area 36: *Atlantic puffin, breeding (Apr - Jul)*

Area 36 was identified by Kober *et al* (2010) as an important aggregation of Atlantic puffin *Fratercula arctica* during the breeding season. Based on analysis of ESAS data, the area supports a population of 18,520 birds, 0.14% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volume II. The Scottish Ornithologist's Club, East Lothian.

GASTON, A.J. & JONES, I.L. 1998 The Auks. OUP, Oxford.

HARRIS, M.P., WANLESS, S. & BROCKIE, K. 2011. The Puffin. T & AD Poyser, London.

NETTLESHIP, D.N. & BIRKHEAD, T. 1985. The Atlantic *Alcidae*. Academic Press, London.

RABBITS, B. (ed). 2007. Outer Hebrides Bird Report 2007. Western Isles Natural History Society.

RABBITS, B. (ed). 2010. Outer Hebrides Bird Report 2008-2010. Western Isles Natural History Society.

Supporting Evidence:

None found

Other Evidence:

None found

Area 40: *Atlantic puffin, winter (Aug – Mar)*

Area 40 was identified by Kober *et al* (2010) as an important aggregation of Atlantic puffin *Fratercula arctica* during the winter. Based on analysis of ESAS data, the area supports a population of 3,776 birds, 0.03% of the biogeographic population of the species (Kober *et al* 2012).

Literature Considered:

FORRESTER, R. & ANDREWS, I. 2007. *The Birds of Scotland. Volume II. The Scottish Ornithologist's Club, East Lothian.*

GASTON, A.J. & JONES, I.L. 1998. The Auks. OUP, Oxford.

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NETTLESHIP, D.N. & BIRKHEAD, T. 1985. The Atlantic Alcidae. Academic Press, London.

THORPE, A.W. 2007. The North Sea Bird Club Twenty-Fifth Annual Report for the year 2007. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2008. The North Sea Bird Club Twenty-Sixth Annual Report for the year 2008. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2009. The North Sea Bird Club Twenty-Seventh Annual Report for the year 2009. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2010. The North Sea Bird Club Twenty-Eighth Annual Report for the year 2010. North Sea Bird Club, Aberdeen.

THORPE, A.W. 2011. The North Sea Bird Club Twenty-Ninth Annual Report for the year 2011. North Sea Bird Club, Aberdeen.

Supporting Evidence:
None found

Other Evidence:
None found

Area 41: *seabird assemblage, breeding (all breeding seasons combined)*

Area 41 was identified by Kober *et al* (2010) as an important aggregation of all species combined during the breeding season. Based on analysis of ESAS data, the area supports a population of 22,131 birds (Kober *et al* 2012).

Literature Considered:

ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2010. Lothian Bird Report 2007. Scottish Ornithologists Club, East Lothian.

ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2011. Lothian Bird Report 2009. Scottish Ornithologists Club, East Lothian.

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CABOT, D. & NISBET, I. 2013. Terns. New Naturalist, 123, Collins, London.

COOK, J. (ed). Angus and Dundee Bird Report 2009. Angus and Dundee Bird Club, Carnoustie.

COULSON, J. 2011. The Kittiwake. T & AD Poyser, London.

FISHER, J. 1984. The Fulmar. Collins, London.

FORRESTER, R. & ANDREWS, I. 2007. The Birds of Scotland. Volumes I & II. The Scottish Ornithologist's Club, East Lothian.

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SHAND, R. (ed). 2010. Fife Bird Report 2008. Fife Bird Club, Fife.

WAVE, M. (ed). 2011. Fife Bird Report 2009. Fife Bird Club, Fife.

WAVE, M. (ed). 2012. Fife Bird Report 2010. Fife Bird Club, Fife.

Supporting Evidence:
None found

Other Evidence:
None found

Area 42: *seabird assemblage, summer (Jul – Aug)*

Area 42 was identified by Kober *et al* (2010) as an important aggregation of all species combined during the summer. Based on analysis of ESAS data, the area supports a population of 13,690 birds (Kober *et al* 2012).

Literature Considered:

ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2010. Lothian Bird Report 2007. Scottish Ornithologists Club, East Lothian.

ANDREWS, J., GILLON, K. & HUNTER, S. (eds). 2011. Lothian Bird Report 2009. Scottish Ornithologists Club, East Lothian.

BICKERSTAFF, H., COOK, J., MACCURLEY, B. & MCKAY, C. (eds). 2007. Angus and Dundee Bird Report 2007. Angus and Dundee Bird Club, Carnoustie.

CABOT, D. & NISBET, I. 2013. Terns. New Naturalist, 123, Collins, London.

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GASTON, A.J. & JONES, I.L. 1998. The Auks. OUP, Oxford.

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WAVE, M. (ed). 2011. Fife Bird Report 2009. Fife Bird Club, Fife.

WAVE, M. (ed). 2012. Fife Bird Report 2010. Fife Bird Club, Fife.

Supporting Evidence:
None found

Other Evidence:
None found

Appendix 2

Experts to whom questionnaires were sent to request that they share their knowledge of areas of importance for seabirds.

Contact	Expert Knowledge	Area	Response
Moray Souter	BTO Regional Rep	Aberdeenshire	N
Formartine Ranger Service	warden / ranger	Aberdeenshire	N
Alex Robbins (SNH)	government agency	All	N
Jared Wilson (Marine Scotland)	government agency	All	N
Matt Murphy (Natural Resources Wales)	government agency	All	N
Alex Banks (NE)	government agency	All	N
Keith Hamer	research	All	Y
Ailsa Craig Tours	ecotourism	Argyll	N
Ocean Breeze rib tours	ecotourism	Argyll	N
Glasgow Sea Safari	ecotourism	Argyll	N
Campbeltown - Mull of Kintyre Seatours	ecotourism	Argyll	N
Bernard Zonfrillo	research	Argyll	N
RSPB Ailsa Craig Wardens	warden / ranger	Argyll	Y
NessRibs	ecotourism	Caithness & Sutherland	N
Highland Council (Marina Swanson)	warden / ranger	Caithness & Sutherland	N
Orca Sea Safaris	ecotourism	English Channel	N
AK Wildlife Cruises	ecotourism	English Channel	Y
Louise Soanes	research	English Channel	N
David Grémillet	research	English Channel	N
Emma Webb (Marine Life)	research / ecotourism	English Channel	N
Marine Life	research / ecotourism	English Channel	N
Russell Neave (Marine Life)	research / ecotourism	English Channel	N
Norman Elkins	BTO Regional Rep	Firth of Forth	Y
Alan Heavisides	BTO Regional Rep	Firth of Forth	Y
Maid of the Forth	ecotourism	Firth of Forth	N
Anstruther Pleasure Cruises	ecotourism	Firth of Forth	N
Osprey of Anstruther	ecotourism	Firth of Forth	N
Scottish Seabird Centre	ecotourism	Firth of Forth	N
Sarah Wanless	research	Firth of Forth	N
Simon Greenstreet	research	Firth of Forth	Y
Isle of May Bird Observatory	warden / ranger	Firth of Forth	N
Dave Pickett (Isle of May Reserves Manager)	warden / ranger	Firth of Forth	N
East Lothian Ranger Service	warden / ranger	Firth of Forth	N

Contact	Expert Knowledge	Area	Response
Graham Cooper	BTO Regional Rep	Forth	N
Kees Camphuysen	research	Forth	Y
Tim Guildford	research	Irish sea	N
Paul Thompson	research	Moray Firth	N
Bob Proctor	BTO Regional Rep	Morayshire	N
Gemini Explorer	ecotourism	Morayshire	N
North 58 Sea Adventures	ecotourism	Morayshire	N
Moray First Marine Ltd	ecotourism	Morayshire	N
Puffin Cruises	ecotourism	Morayshire	N
The Guide – Charter and Cruises	ecotourism	Morayshire	N
WDCS	ecotourism	Morayshire	N
Cetacean Research and Rescue Unit	research / ecotourism	Morayshire	Y
Chris Reynolds	BTO Regional Rep	Outer Hebs	Y
Yvonne Benting	BTO Regional Rep	Outer Hebs	Y
SeaTreck	ecotourism	Outer Hebs	N
Lewis Boat Trips	ecotourism	Outer Hebs	N
Hebridean Whale and Dolphin Trust	research / ecotourism	Outer Hebs	N
Gina Prior	warden / ranger	Outer Hebs	N
Bob Haycock	BTO Regional Rep	Pembrokeshire	Y
Thousand Island Expeditions	ecotourism	Pembrokeshire	N
Venture Jet	ecotourism	Pembrokeshire	Y
Shearwater Safaris	ecotourism	Pembrokeshire	N
Rich Brown – Skokholm warden	warden / ranger	Pembrokeshire	N
Colin Corse	BTO Regional Rep	Pentland Firth	N
Pettlandssker boat trips	ecotourism	Pentland Firth	N
Highland Council	warden / ranger	Pentland Firth	Y
Donald Omand	BTO Regional Rep	Pentland Firth / Caithness & Sutherland	N
Caithness Seacoast Ltd.	Ecotourism	Pentland Firth / Caithness & Sutherland	N
Ellie Owen/Valerie de Liedekerke (RSPB)	research	Pentland Firth / Forth	Y
Liz Masden	research	Pentland Firth/Shetland	N
Stephen Votier	research	Shetland	N
Stuart Bearhop	research	Shetland	N
Bob Furness	research	Shetland / All	Y

Appendix 3

Questionnaire sent to experts to request that they share their knowledge of areas of importance for seabirds.

Dear XXXX

The British Trust for Ornithology (BTO) and the Joint Nature Conservation Committee (JNCC) are currently developing an evidence base for important areas for seabirds in the UK. The evidence base will support the identification of possible marine Special Protection Areas currently taking place in the UK. As part of this process we are reviewing published data from surveys and tracking studies as well as seeking expert opinion. We have identified you as someone who may have expert knowledge of seabirds in XXXX. We would be extremely grateful if you could complete the enclosed questionnaire by identifying areas that are likely to be important for either breeding or wintering species of seabird or species assemblages. This information will contribute to the evidence base within our report and each completed questionnaire will be presented within an appendix.

If you have any questions, please feel free to get in touch (E: david.still@bto.org, T: 01842 750 050). Alternatively, if you feel you are unable to contribute, or would like to suggest an alternative or additional expert(s) please let us know.

Please return completed questionnaires by email, fax or post, by 17th January 2014, to:

Email: David.Still@bto.org.

Post: David Still, British Trust for Ornithology, The Nunnery, Thetford, Norfolk, IP24 2PU

Fax: 01842 750 030

The information you provide will make a valuable contribution to the future conservation of our seabirds. Thank you in advance for your time and effort.

With best wishes,

David Still.

Q1. *Have you made observations or obtained data on seabirds within the area of sea shown on the map above?*

Yes – please continue with the questionnaire ☐

No – please do not complete the questionnaire and return ☐

Q2. *Have your observations / data been sent to the JNCC European Seabirds at Sea (ESAS) group?*

YES (entirely) ☐

YES (partially) ☐

NO ☐

*If you have ticked YES (entirely) and your data were collected **between 1980 and 2006 only**, you do not need to complete the rest of the questionnaire. However, please continue with the questionnaire using any ESAS data you may have collected in other years, or with any other seabird data / observations.*

Q3. *How did you make your observations/obtain these data?*

Chartered bird watching boat trips ☐

Standardised surveys on board dedicated survey vessels ☐

Standardised surveys on board vessels of opportunity ☐

Tracking Studies ☐

Aerial surveys ☐

Seawatching ☐

Other ☐

Please provide details:

Q4. *Have your observations previously been published in a format that could inform the identification of potential marine SPAs (e.g. distribution maps or as spatially referenced data)?*

YES (Entirely) – Please give details, you do not need to complete questions 5-9 ☐

YES (Partially) – Please give details and continue with questions 5-9 ☐

NO – Please continue with questions 5-9 ☐

If yes (partially or entirely), please give details here.

Q5. *On the map below, please identify:*

(a) The areas which you regularly visit; OR, if your evidence is based on tagged birds, the location(s) of your study colony(ies).

(b) Any areas which you feel regularly hold important numbers of a seabird species. (By "important numbers" we mean areas with higher densities than average of particular species. If your evidence is based on tagged birds, this could be an area where tagged birds spend a large proportion of time or are known foraging areas. An area can be important for one or several species).

The best way to identify areas on the map, if using Microsoft Word, is to adjust the shapes on the map below. Each shape can be copied to indicate multiple areas. Use the blue transparent shape to show the area(s) you regularly visit and use the red shape to indicate the area(s) you feel regularly hold important numbers of seabirds. Place a number in each box for reference. It may be best to then save your completed questionnaire as a pdf to ensure that the shape does not move if opened in a different version of Microsoft Word.

If the above option is not possible, please return annotated maps (use the blank map provided) either

by fax or post, or by scanning images into your computer and returning by email.

Q6. *For each numbered red area (drawn in Q5), please indicate the species present in important numbers. Please also include the months when those species are most abundant within the area (add more rows if you need to)*

Red area number	***Species***	***Months when most abundant***
1		
2		
3		

Q7. *Are you able to supply any additional information about the birds using the areas you have identified? For example, do they tend to be used by immature/juvenile or adult birds (or both)? Is there evidence of foraging or rafting behaviour? (add more rows if you need to)*

Red area number	***Additional information***
1	
2	
3	

Q8. *Within which years and months were your observations/data recorded?*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1971	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1972	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1973	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1974	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1975	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1976	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1977	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1978	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1979	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1980	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1981	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1982	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1983	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1984	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1985	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1986	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1987	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1988	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1989	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1990	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1991	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1992	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1993	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1994	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1995	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1996	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1997	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1998	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1999	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2000	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2001	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2002	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2003	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2004	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2005	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2006	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2007	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2008	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2009	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

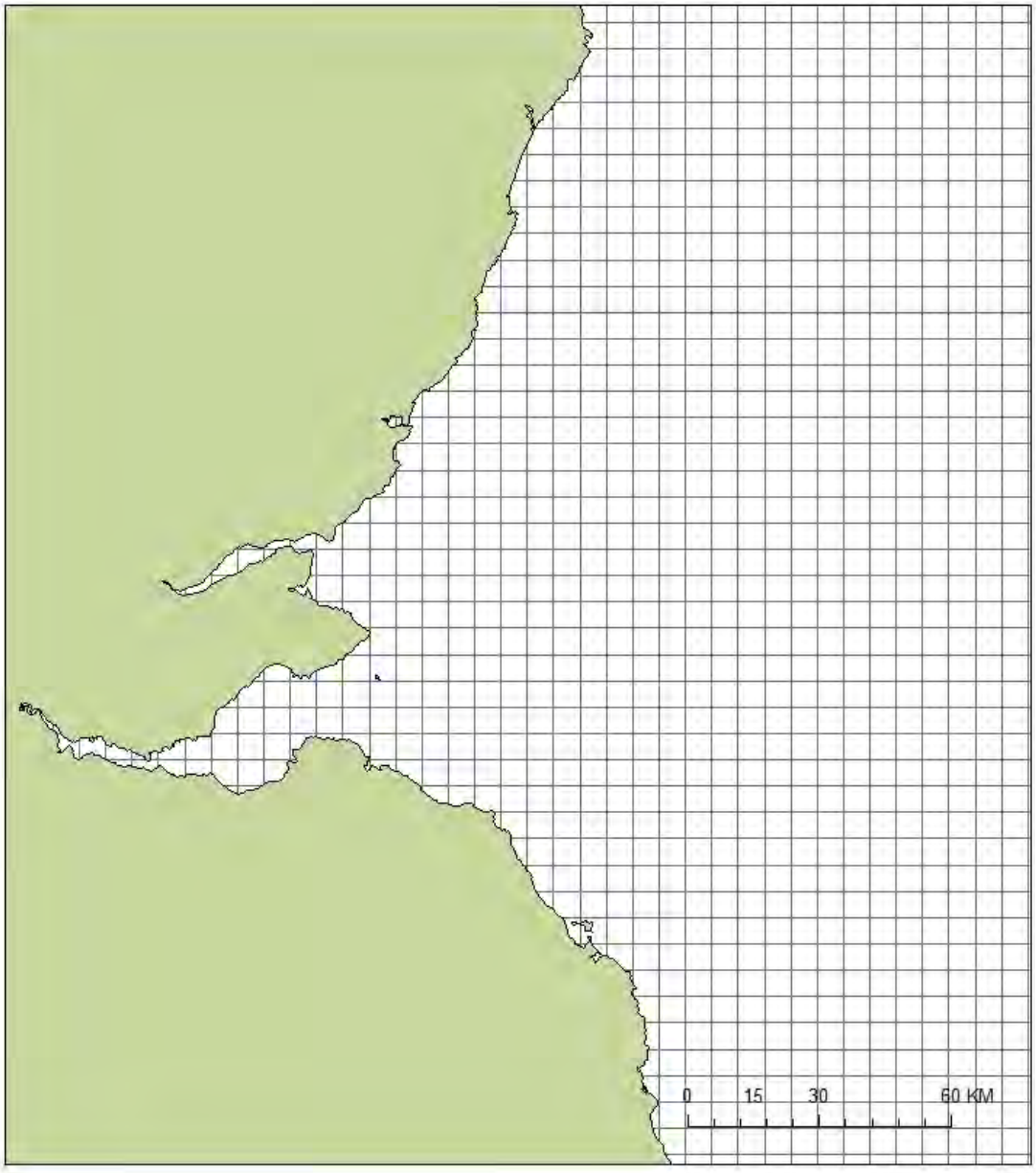
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2010	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2011	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2012	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
2013	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
If earlier, please give details:												

Q9. *Please, briefly, describe your experience (e.g. as a researcher/boat handler/warden etc.).*

Appendix 4

Completed questionnaires returned by experts who agreed to share their knowledge of areas of importance for seabirds.

BTO Seabirds at Sea Questionnaire: Forth Area



Q1. *Have you made observations or obtained data on seabirds within the area of sea shown on the map above?*

Yes – please continue with the questionnaire X

No – please do not complete the questionnaire and return ☐

Q2. *Have your observations / data been sent to the JNCC European Seabirds at Sea (ESAS) group?*

YES (entirely) ☐

YES (partially) ☐

NO X

*If you have ticked YES (entirely) and your data were collected **between 1980 and 2006 only**, you do not need to complete the rest of the questionnaire. However, please continue with the questionnaire using any ESAS data you may have collected in other years, or with any other seabird data / observations.*

Q3. *How did you make your observations/obtain these data?*

Chartered bird watching boat trips ☐

Standardised surveys onboard dedicated survey vessels X

Standardised surveys onboard vessels of opportunity ☐

Tracking Studies ☐

Aerial surveys ☐

Seawatching ☐

Other ☐

Please provide details:

Q4. *Have your observations previously been published in a format that could inform the identification of potential marine SPAs (e.g. distribution maps or as spatially referenced data)?*

YES (Entirely) – Please give details, you do not need to complete questions 5-9 ☐

YES (Partially) – Please give details and continue with questions 5-9 X

NO – Please continue with questions 5-9 ☐

If yes (partially or entirely), please give details here.

Wanless et al1998 ICES J Mar Sci 55 1141-1151,
Daunt et al 2008 Can J Fish Aquat Sci 65 362-381.

Q5. *On the map below, please identify:*

(c) The areas which you regularly visit; OR, if your evidence is based on tagged birds, the location(s) of your study colony(ies).

(d) Any areas which you feel regularly hold important numbers of a seabird species. (By "important numbers" we mean areas with higher densities than average of particular species. If your evidence is based on tagged birds, this could be an area where tagged birds spend a large proportion of time or are known foraging areas. An area can be important for one or several species).

The best way to identify areas on the map, if using Microsoft Word, is to adjust the shapes on the map below. Each shape can be copied to indicate multiple areas. Use the blue transparent shape to show the area(s) you regularly visit and use the red shape to indicate the area(s) you feel regularly hold important numbers of seabirds. Place a number in each box for reference. It may be best to then save your completed questionnaire as a pdf to ensure that the shape does not move if opened in a different version of Microsoft Word.

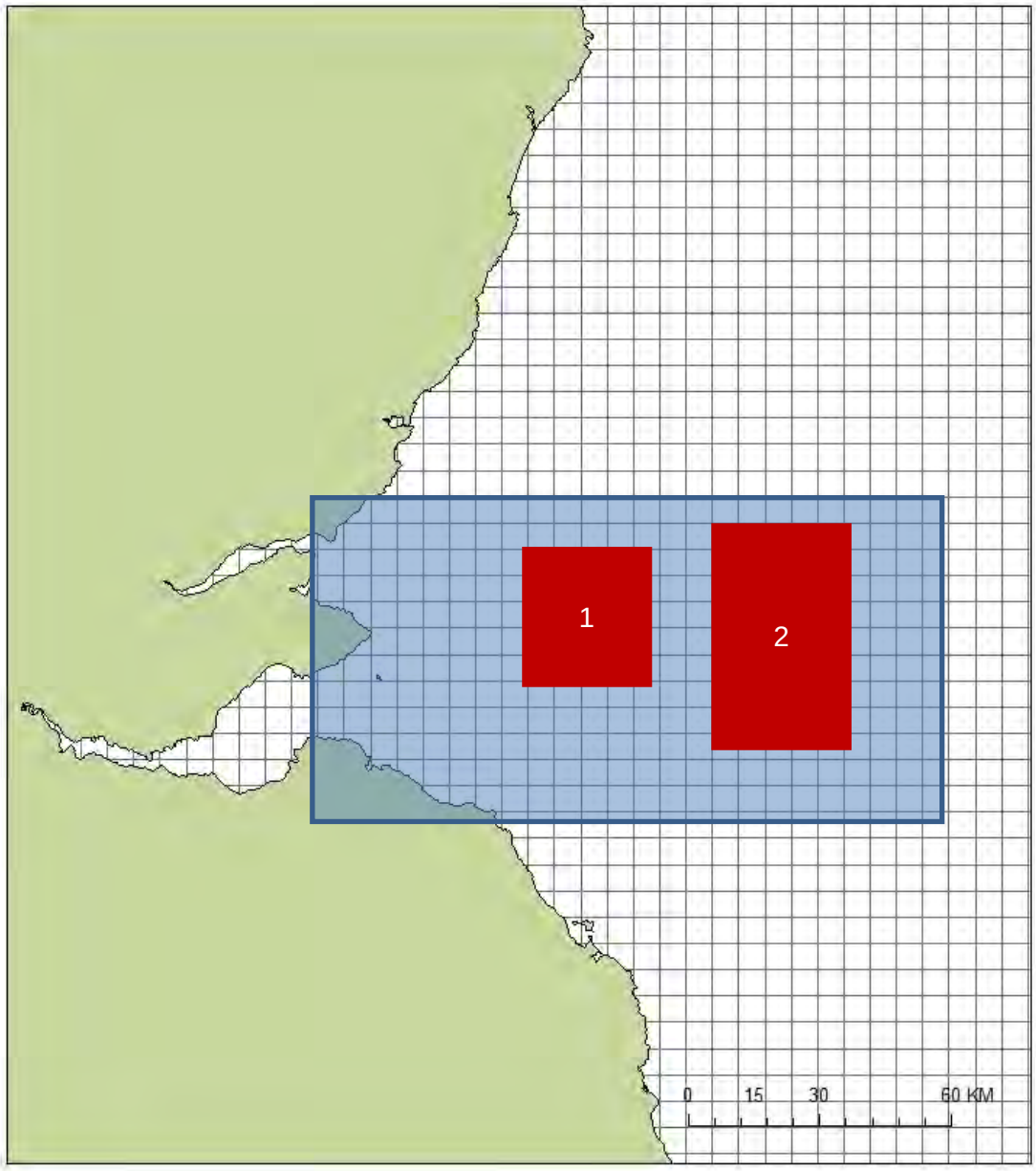
If the above option is not possible, please return annotated maps (use the blank map provided) either by fax or post, or by scanning images into your computer and returning by email.

Q6. *For each numbered red area (drawn in Q5), please indicate the species present in important numbers. Please also include the months when those species are most abundant within the area (add more rows if you need to)*

Red area number	***Species***	***Months when most abundant***
1	Guillemots, puffins kittiwakes gannets fulmars	
2	Guillemots, puffins kittiwakes gannets fulmars	
3		

Q7. *Are you able to supply any additional information about the birds using the areas you have identified? For example, do they tend to be used by immature/juvenile or adult birds (or both)? Is there evidence of foraging or rafting behaviour? (add more rows if you need to)*

Red area number	***Additional information***
1	*Often foraging – do not record ages, but most surveys in breeding season.*
2	
3	



PLEASE ADJUST THE SHAPES ON THE MAP ABOVE TO SHOW THE EXTENT OF YOUR STUDY AREA AND TO MARK AREAS THAT YOU THINK HOLD IMPORTANT NUMBERS OF SEABIRDS

Full extent of the area that you have knowledge of (e.g. have visited or encompassed for seabird research)

Areas that you think regularly hold important numbers of seabirds

Much easier if you showed Lat – Longs! This is a bit of a guess, but probably close enough.

Q8. *Within which years and months were your observations/data recorded?*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1971	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1972	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1973	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1974	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1975	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1976	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1977	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1978	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1979	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1980	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1981	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1982	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1983	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1984	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1985	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1986	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1987	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1988	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1989	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1990	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1991	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1992	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1993	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1994	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1995	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1996	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1997	☐	☐	☐	☐	☐	X	☐	☐	☐	☐	☐	☐
1998	☐	☐	☐	☐	☐	Jun X	☐	☐	☐	☐	☐	☐
1999	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2000	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2001	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2002	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2003	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2004	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2005	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2006	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2007	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2008	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2009	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2010	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2011	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2012	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2013	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

If earlier, please give details:
Approximately – Cruises mainly in June each year (not 2004) Some other months as well in some years

Q9. *Please, briefly, describe your experience (e.g. as a researcher/boat handler/warden etc.).*

Scientist in Charge of Cruise

BTO Seabirds at Sea Questionnaire: Moray

Q1. *Have you made observations or obtained data on seabirds within the area of sea shown on the map above?*

Yes – please continue with the questionnaire X

No – please do not complete the questionnaire and return ☐

Q2. *Have your observations / data been sent to the JNCC European Seabirds at Sea (ESAS) group?*

YES (entirely) ☐

YES (partially) ☐

NO X

*If you have ticked YES (entirely) and your data were collected **between 1980 and 2006 only**, you do not need to complete the rest of the questionnaire. However, please continue with the questionnaire using any ESAS data you may have collected in other years, or with any other seabird data / observations.*

Q3. *How did you make your observations/obtain these data?*

Chartered bird watching boat trips ☐

Standardised surveys onboard dedicated survey vessels X

Standardised surveys onboard vessels of opportunity X

Tracking Studies ☐

Aerial ☐

Seawatching ☐

Other ☐

Please provide details:

Q4. *Have your observations previously been published in a format that could inform the identification of potential marine SPAs (e.g. distribution maps or as spatially referenced data)?*

YES (Entirely) – Please give details, you do not need to complete questions 5-9	☐
YES (Partially) – Please give details and continue with questions 5-9	☐
NO – Please continue with questions 5-9	X

If yes (partially or entirely), please give details here.

Q5. *On the map below, please identify:*

(a) The areas which you regularly visit; OR, if your evidence is based on tagged birds, the location(s) of your study colony(ies).

(b) Any areas which you feel regularly hold important numbers of a seabird species. (By "important numbers" we mean areas with higher densities than average of particular species. If your evidence is based on tagged birds, this could be an area where tagged birds spend a large proportion of time or are known foraging areas. An area can be important for one or several species).

The best way to identify areas on the map, if using Microsoft Word, is to adjust the shapes on the map below. Each shape can be copied to indicate multiple areas. Use the blue transparent shape to show the area(s) you regularly visit and use the red shape to indicate the area(s) you feel regularly hold important numbers of seabirds. Place a number in each box for reference. It may be best to then save your completed questionnaire as a pdf to ensure that the shape does not move if opened in a different version of Microsoft Word.

If the above option is not possible, please return annotated maps (use the blank map provided) either by fax or post, or by scanning images into your computer and returning by email.

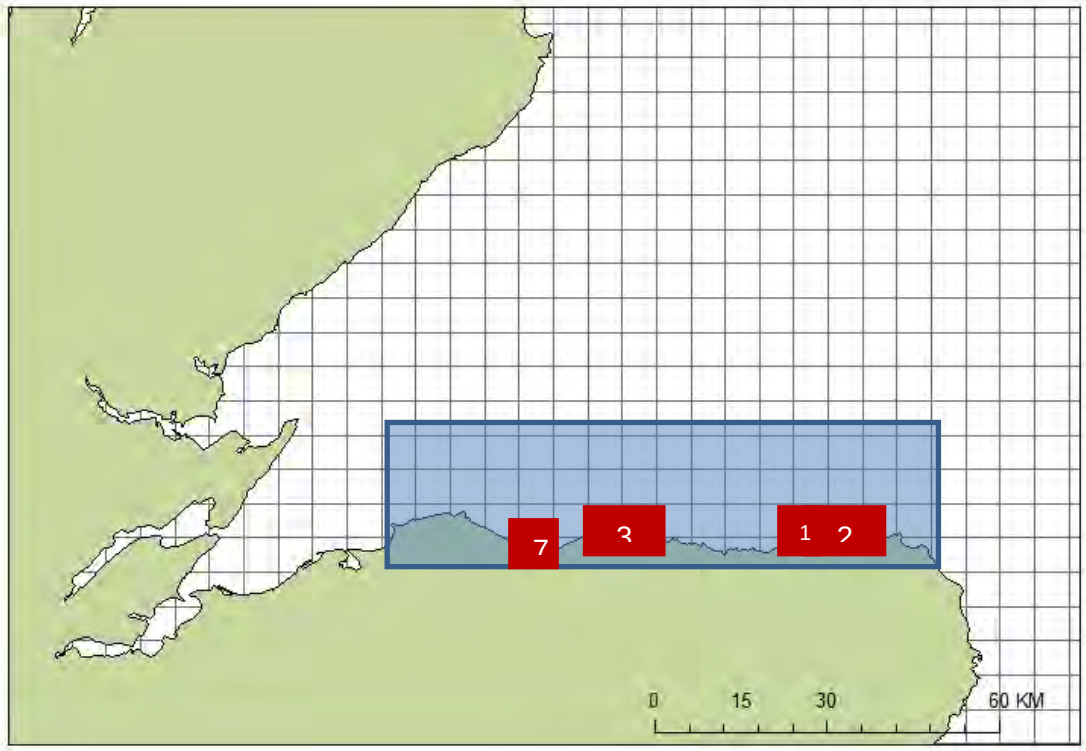
Q6. *For each numbered red area (drawn in Q5), please indicate the species present in important numbers. Please also include the months when those species are most abundant within the area (add more rows if you need to)*

Red area number	***Species***	***Months when most abundant***
1	Northern gannet (*Morus bassanus*)	Apr to Oct
2	Atlantic puffin (*Fratercula arctica*)	Mar to Aug, then seen offshore in Sep and Oct (many pufflings)
3	Guillemot	May to Sep, then offshore thereafter
3	Razorbill (*Alca torda*)	May to Sep, then offshore thereafter
3	Kittiwake (*Rissa tridactyla*)	May to Aug/Sep
3	Fulmar (*Fulmarus glacialis*)	May to Oct
	Various gulls: herring, lesser and greater black backs	May to Oct
3	Cormorants and shags	May to Oct
4	Black guillemot (*Cepphus grylle*)	May to Sep
5	King eider duck (*Somateria spectabilis*)	Apr to May
6	Common eider duck (*Somateria mollissima*)	Apr to Oct
7	Sandwich tern (*Thalasseus sandvicensis*)	June to Sep
7	Osprey (*Pandion haliaetus*)	June to Sep
8	Skua species regularly sighted: great skua, pomarine and Arctic	May to Oct

	skua with rare sightings of long-tailed skua	
9	Various shearwaters and petrels regularly identified on offshore surveys including manx, sooty, great and storm petrels	Jul to Oct
10	Peregrine falcon (*Falco peregrinus*)	May to Jul
11	Various waders: oyster catchers, curlew, turnstones, red shanks, dunlin, plovers, heron	May to Oct

Q7. *Are you able to supply any additional information about the birds using the areas you have identified? For example, do they tend to be used by immature/juvenile or adult birds (or both)? Is there evidence of foraging or rafting behaviour? (add more rows if you need to)*

Red area number	***Additional information***
1	*Onshore breeding colony at Troup Head*
2	*Onshore breeding colonies, east Troup Head and cliffs to the east of Pennan.*
3	*Various breeding sites between Aberdour Bay and Portknockie/Findochty, but particularly abundant at between Pennan and Gardenstown (Troup Head area) and between Cullen and Portknockie*
4	*Pairs seen regularly nesting on rocky headlands along the outer southern firth coastline. Seen most regularly between Strathlene and Portsoy.*
5	*Seen annually in large numbers inshore between Portsoy and Pennan*
6	*Sighted throughout the summer between Fraserburgh and Lossiemouth. Many well-known breeding sites in shallow inshore bays e.g. Gamrie Bay, Aberdour Bay, Craigenroan.*
7	*Seen regularly at River Spey*
8	*All along the coastline, but when sighted inshore, most often seen hunting around Troup Head or offshore around bird feeding rafts, generally harassing kittiwakes and gannets.*
9	*Generally offshore*
10	*Known nest sites at Strathangles Point, Gamrie Bay and Findochty/Portknockie*
11	*In sheltered bays along the coastline: Frserburgh/Cairnbulg, Aberdour Bay, Gamrie Bay, Banff Bay,*



PLEASE ADJUST THE SHAPES ON THE MAP ABOVE TO SHOW THE EXTENT OF YOUR STUDY AREA AND TO MARK AREAS THAT YOU THINK HOLD IMPORTANT NUMBERS OF SEABIRDS

Full extent of the area that you have knowledge of (e.g. have visited or encompassed for seabird research)

Areas that you think regularly hold important numbers of seabirds

Q8. *Within which years and months were your observations/data recorded?*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1971	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1972	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1973	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1974	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1975	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1976	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1977	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1978	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1979	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1980	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1981	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1982	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1983	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1984	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1985	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1986	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1987	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1988	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1989	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1990	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1991	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1992	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1993	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1994	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1995	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

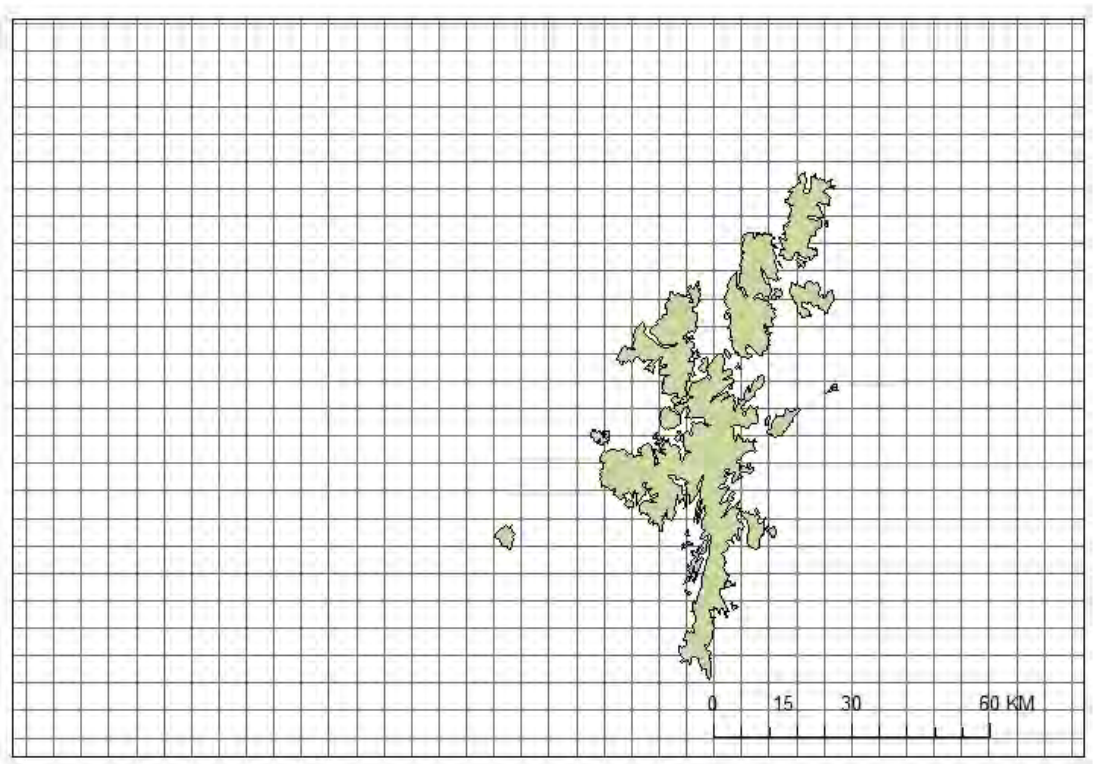
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1996	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1997	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1998	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1999	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2000	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2001	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2002	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2003	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2004	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2005	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2006	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2007	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2008	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2009	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2010	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2011	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2012	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2013	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

If earlier, please give details:
Observations made between Apr/May and Oct 2001 to 2013 inclusive

Q9. *Please, briefly, describe your experience (e.g. as a researcher/boat handler/warden etc.).*

PhD in Marine Zoology. Director of the Banffshire-based Cetacean Research & Rescue Unit. have worked in the Moray Firth area since July 1997.

BTO Seabirds at Sea Questionnaire: Shetland



Q1. *Have you made observations or obtained data on seabirds within the area of sea shown on the map above?*

Yes – please continue with the questionnaire x

No – please do not complete the questionnaire and return ☐

Q2. *Have your observations / data been sent to the JNCC European Seabirds at Sea (ESAS) group?*

YES (entirely) ☐

YES (partially) ☐

NO x

*If you have ticked YES (entirely) and your data were collected **between 1980 and 2006 only**, you do not need to complete the rest of the questionnaire. However, please continue with the questionnaire using any ESAS data you may have collected in other years, or with any other seabird data / observations.*

Q3. *How did you make your observations/obtain these data?*

Chartered bird watching boat trips ☐

Standardised surveys onboard dedicated survey vessels ☐

Standardised surveys onboard vessels of opportunity x

Tracking Studies x

Aerial surveys x

Seawatching x

Other ☐

Please provide details:

Q4. *Have your observations previously been published in a format that could inform the identification of potential marine SPAs (e.g. distribution maps or as spatially referenced data)?*

YES (Entirely) – Please give details, you do not need to complete questions 5-9	☐
YES (Partially) – Please give details and continue with questions 5-9	☐
NO – Please continue with questions 5-9	x

If yes (partially or entirely), please give details here.

Q5. *On the map below, please identify:*

(a) The areas which you regularly visit; OR, if your evidence is based on tagged birds, the location(s) of your study colony(ies).

(b) Any areas which you feel regularly hold important numbers of a seabird species. (By "important numbers" we mean areas with higher densities than average of particular species. If your evidence is based on tagged birds, this could be an area where tagged birds spend a large proportion of time or are known foraging areas. An area can be important for one or several species).

The best way to identify areas on the map, if using Microsoft Word, is to adjust the shapes on the map below. Each shape can be copied to indicate multiple areas. Use the blue transparent shape to show the area(s) you regularly visit and use the red shape to indicate the area(s) you feel regularly hold important numbers of seabirds. Place a number in each box for reference. It may be best to then save your completed questionnaire as a pdf to ensure that the shape does not move if opened in a different version of Microsoft Word.

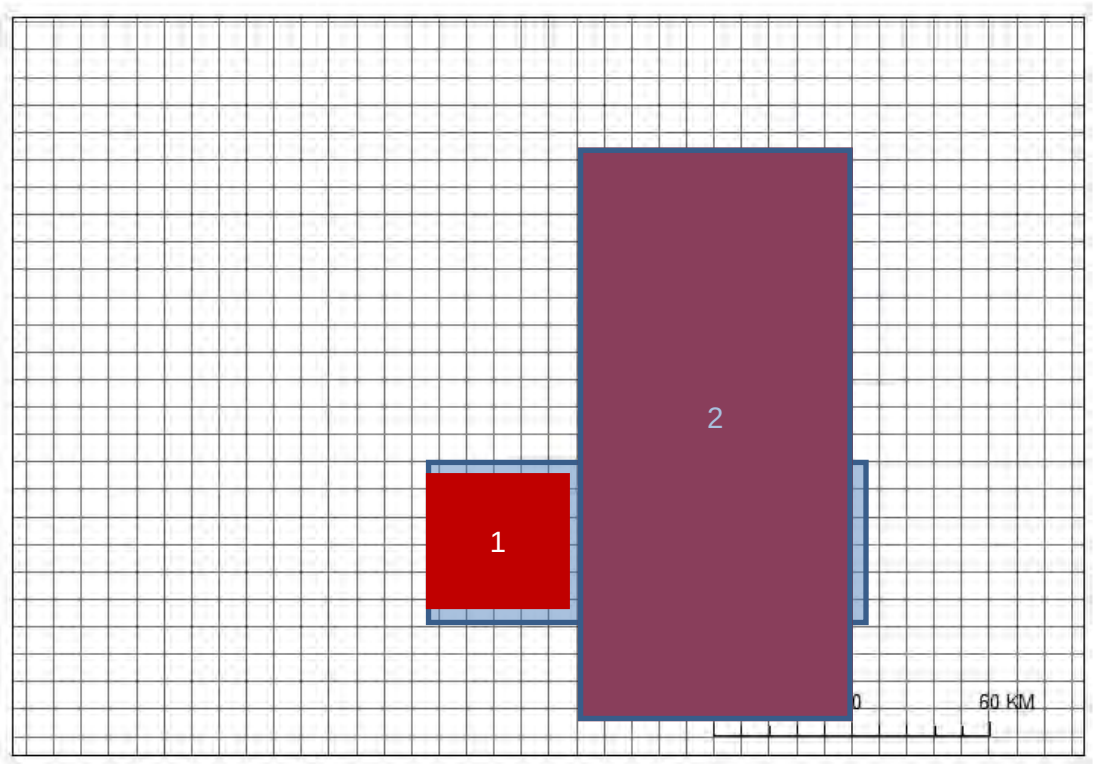
If the above option is not possible, please return annotated maps (use the blank map provided) either by fax or post, or by scanning images into your computer and returning by email.

Q6. *For each numbered red area (drawn in Q5), please indicate the species present in important numbers. Please also include the months when those species are most abundant within the area (add more rows if you need to)*

Red area number	***Species***	***Months when most abundant***
1	Red-throated diver, fulmar, shag, great skua, great black-backed gull, kittiwake, arctic tern, puffin, black guillemot, guillemot, razorbill	Varies by species
2	Red-throated diver, great northern diver, gannet, fulmar, shag, great skua, Arctic skua, herring gull, great black-backed gull, kittiwake, arctic tern, puffin, black guillemot, guillemot, razorbill	Varies by species
3		

Q7. *Are you able to supply any additional information about the birds using the areas you have identified? For example, do they tend to be used by immature/juvenile or adult birds (or both)? Is there evidence of foraging or rafting behaviour? (add more rows if you need to)*

Red area number	***Additional information***
1	
2	
3	



PLEASE ADJUST THE SHAPES ON THE MAP ABOVE TO SHOW THE EXTENT OF YOUR STUDY AREA AND TO MARK AREAS THAT YOU THINK HOLD IMPORTANT NUMBERS OF SEABIRDS

Full extent of the area that you have knowledge of (e.g. have visited or encompassed for seabird research)

Areas that you think regularly hold important numbers of seabirds

Q8. *Within which years and months were your observations/data recorded?*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1971	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1972	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1973	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1974	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1975	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1976	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1977	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1978	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1979	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1980	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1981	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1982	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1983	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1984	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1985	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1986	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1987	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1988	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1989	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1990	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1991	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1992	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1993	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1994	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1995	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

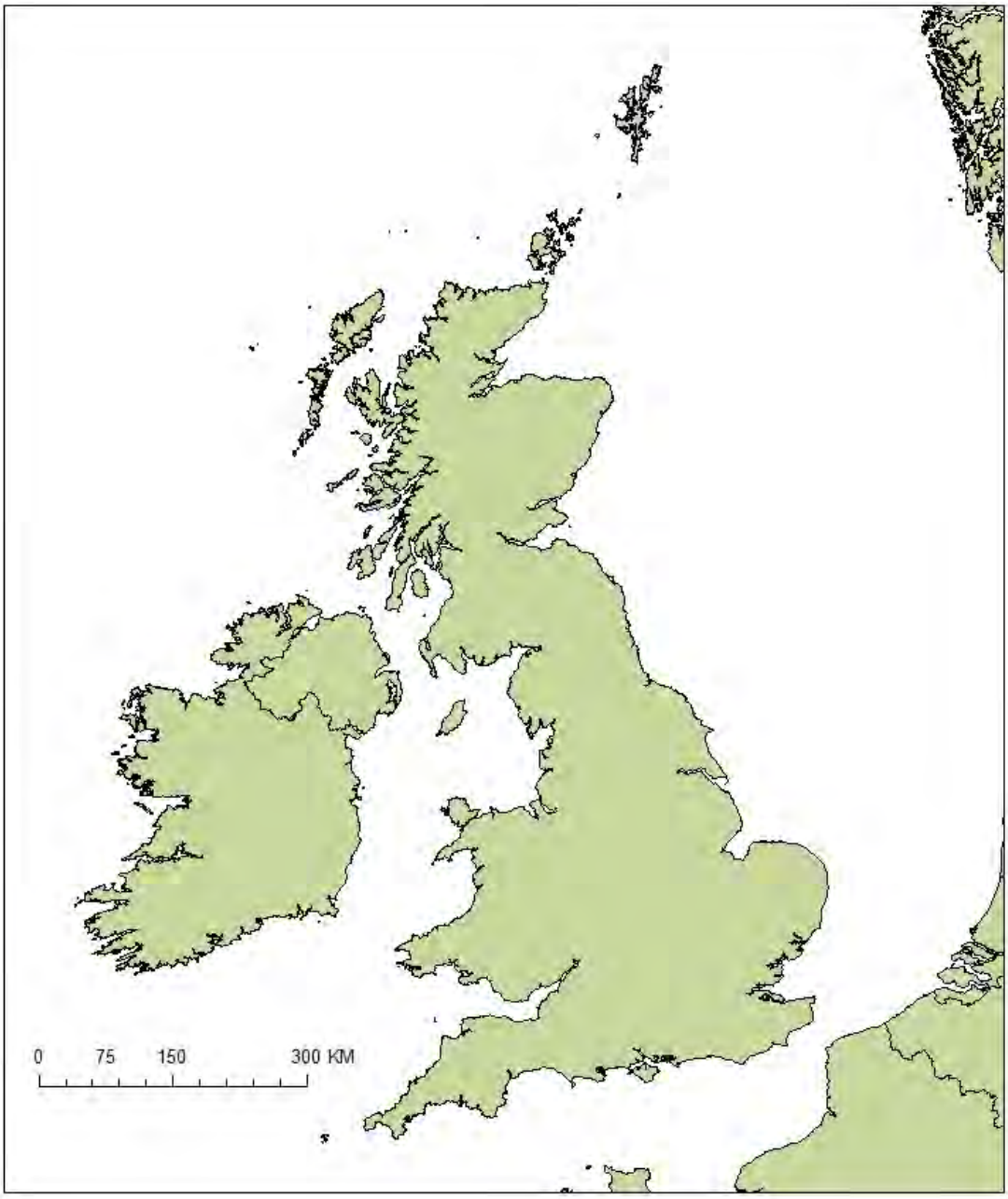
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1996	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1997	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1998	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1999	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2000	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2001	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2002	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2003	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2004	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2005	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2006	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2007	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2008	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2009	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2010	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2011	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2012	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2013	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

If earlier, please give details:

Q9. *Please, briefly, describe your experience (e.g. as a researcher/boat handler/warden etc.).*

Led research team working in Shetland, with about 25 PhD students and large numbers of volunteers over the period.

BTO Seabirds at Sea Questionnaire: UK



Q1. *Have you made observations or obtained data on seabirds within the area of sea shown on the map above?*

Yes – please continue with the questionnaire x

No – please do not complete the questionnaire and return ☐

Q2. *Have your observations / data been sent to the JNCC European Seabirds at Sea (ESAS) group?*

YES (entirely) ☐

YES (partially) ☐

NO x

*If you have ticked YES (entirely) and your data were collected **between 1980 and 2006 only**, you do not need to complete the rest of the questionnaire. However, please continue with the questionnaire using any ESAS data you may have collected in other years, or with any other seabird data / observations.*

Q3. *How did you make your observations/obtain these data?*

Chartered bird watching boat trips ☐

Standardised surveys onboard dedicated survey vessels ☐

Standardised surveys onboard vessels of opportunity ☐

Tracking Studies x

Aerial surveys ☐

Seawatching ☐

Other ☐

Please provide details:

PTTs and GPS loggers on gannets

Q4. *Have your observations previously been published in a format that could inform the identification of potential marine SPAs (e.g. distribution maps or as spatially referenced data)?*

YES (Entirely) – Please give details, you do not need to complete questions 5-9	☐
YES (Partially) – Please give details and continue with questions 5-9	x
NO – Please continue with questions 5-9	☐

If yes (partially or entirely), please give details here.

Hamer KC, Phillips RA, Wanless S, Harris MP & Wood AG (2000). Foraging ranges, diets and feeding locations of gannets in the North Sea: evidence from satellite telemetry. *Marine Ecology Progress Series* 200: 257-264.

Hamer KC, Phillips RA, Hill JK, Wanless S. & Wood AG (2001). Contrasting foraging strategies of gannets *Morus bassanus* at two North Atlantic colonies: foraging trip duration and foraging area fidelity. *Marine Ecology Progress Series* 224: 283-290

Hamer KC, Humphreys EM, Garthe S, Hennicke J, Peters G, Grémillet, D, Phillips RA, Harris MP & Wanless S (2007). Annual variation in diets, feeding locations and foraging behaviour of gannets in the North Sea: flexibility, consistency and constraint. *Marine Ecology Progress Series* 338: 295-305

Hamer KC, Humphreys EM, Magalhães MC, Garthe S, Hennicke J, Peters G, Grémillet D, Skov H, Wanless S. (2009) Fine-scale foraging behaviour of a medium-ranging marine predator. *Journal of Animal Ecology* 78: 880-889

Wakefield ED, Bodey TW, Bearhop S, Blackburn J, Davies R, Dwyer RG, Green J, Grémillet D, Jackson AL, Jessopp MJ, Kane A, Langston RHW, Lescroël A, Murray S, Le Nuz M, Patrick SC, Péron C, Soanes L, Wanless S, Votier SC, **Hamer KC** (2013) Space partitioning without territoriality in gannets. *Science* 341: 68-70

Q5. *On the map below, please identify:*

(a) The areas which you regularly visit; OR, if your evidence is based on tagged birds, the location(s) of your study colony(ies).

(b) Any areas which you feel regularly hold important numbers of a seabird species. (By "important numbers" we mean areas with higher densities than average of particular species. If your evidence is based on tagged birds, this could be an area where tagged birds spend a large proportion of time or are known foraging areas. An area can be important for one or several species).

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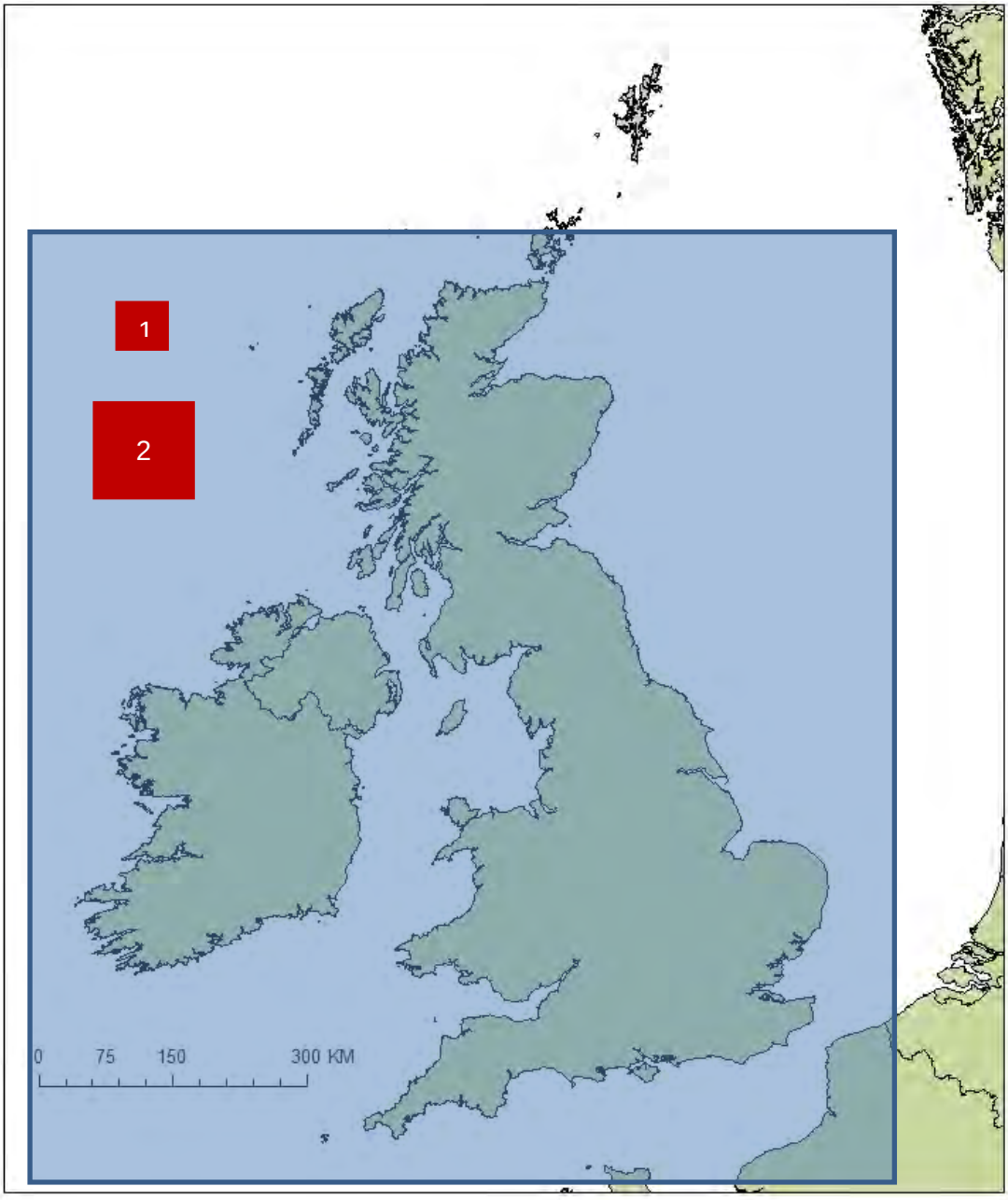
If the above option is not possible, please return annotated maps (use the blank map provided) either by fax or post, or by scanning images into your computer and returning by email.

Q6. *For each numbered red area (drawn in Q5), please indicate the species present in important numbers. Please also include the months when those species are most abundant within the area (add more rows if you need to)*

Red area number	***Species***	***Months when most abundant***
1 See Wakefield et al (2013) for core foraging areas at multiple colonies around UK and Ireland	Gannets	Only tracked in summer (geolocators covering two entire years but overwintering outside area of concern
2		
3		

Q7. *Are you able to supply any additional information about the birds using the areas you have identified? For example, do they tend to be used by immature/juvenile or adult birds (or both)? Is there evidence of foraging or rafting behaviour? (add more rows if you need to)*

Red area number	***Additional information***
1	
2	
3	



PLEASE ADJUST THE SHAPES ON THE MAP ABOVE TO SHOW THE EXTENT OF YOUR STUDY AREA AND TO MARK AREAS THAT YOU THINK HOLD IMPORTANT NUMBERS OF SEABIRDS

Full extent of the area that you have knowledge of (e.g. have visited or encompassed for seabird research)

Areas that you think regularly hold important numbers of seabirds

Q8. *Within which years and months were your observations/data recorded?*												
1970	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1971	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1972	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1973	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1974	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1975	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1976	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1977	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1978	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1979	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1980	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1981	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1982	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1983	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1984	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1985	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1986	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1987	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1988	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1989	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1990	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1991	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1992	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1993	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1994	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐
1995	Jan ☐	Feb ☐	Mar ☐	Apr ☐	May ☐	Jun ☐	Jul ☐	Aug ☐	Sep ☐	Oct ☐	Nov ☐	Dec ☐

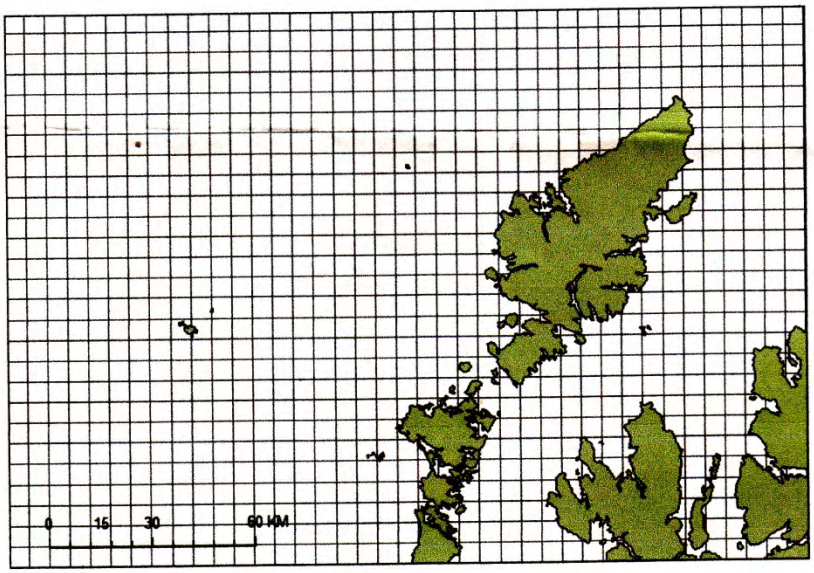
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1996	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1997	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1998	☐	☐	☐	☐	☐	☐	Jul x	Aug x	☐	☐	☐	☐
1999	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2000	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2001	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2002	☐	☐	☐	☐	☐	Jun x	Jul x	Aug x	☐	☐	☐	☐
2003	☐	☐	☐	☐	☐	Jun x	Jul x	Aug x	☐	☐	☐	☐
2004	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2005	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2006	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2007	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2008	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2009	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2010	☐	☐	☐	☐	☐	Jun x	Jul x	Aug x	☐	☐	☐	☐
2011	☐	☐	☐	☐	☐	Jun x	Jul x	Aug x	☐	☐	☐	☐
2012	☐	☐	☐	☐	☐	Jun x	Jul x	Aug x	☐	☐	☐	☐
2013	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

If earlier, please give details:

Q9. *Please, briefly, describe your experience (e.g. as a researcher/boat handler/warden etc.).*

Seabird researcher

BTO Seabirds at Sea Questionnaire: Hebrides



Q1. *Have you made observations or obtained data on seabirds within the area of sea shown on the map above?*

(Yes) – *please continue with the questionnaire*

No – please do not complete the questionnaire and return

Q2. *Have your observations / data been sent to the JNCC European Seabirds at Sea (ESAS) group?*

~~*YES (entirely)*~~

YES (partially)

(NO)

If you have ticked YES (entirely) and your data were collected ***between 1980 and 2006 only****, you do not need to complete the rest of the questionnaire. However, please continue with the questionnaire using any ESAS data you may have collected in other years, or with any other seabird data / observations.*

Q3. *How did you make your observations/obtain these data?*

Chartered bird watching boat trips

Standardised surveys onboard dedicated survey vessels

Standardised surveys onboard vessels of opportunity

Tracking Studies

Aerial surveys

Seawatching

Other

Please provide details:
(Fulmar chicks)
Counts from cliffs + casual boat trips
Common Gull colony NRC

Q4. *Have your observations previously been published in a format that could inform the identification of potential marine SPAs (e.g. distribution maps or as spatially referenced data)?*

YES (Entirely) – Please give details, you do not need to complete questions 5-9

YES (Partially) – Please give details and continue with questions 5-9

(NO) – Please continue with questions 5-9

If yes (partially or entirely), please give details here.

Q5. *On the map below, please identify:*

(a) *The areas which you regularly visit; OR, if your evidence is based on tagged birds, the location(s) of your study colony(ies).*

(b) *Any areas which you feel regularly hold important numbers of a seabird species. (By "important numbers" we mean areas with higher densities than average of particular species. If your evidence is based on tagged birds, this could be an area where tagged birds spend a large proportion of time or are known foraging areas. An area can be important for one or several species).*

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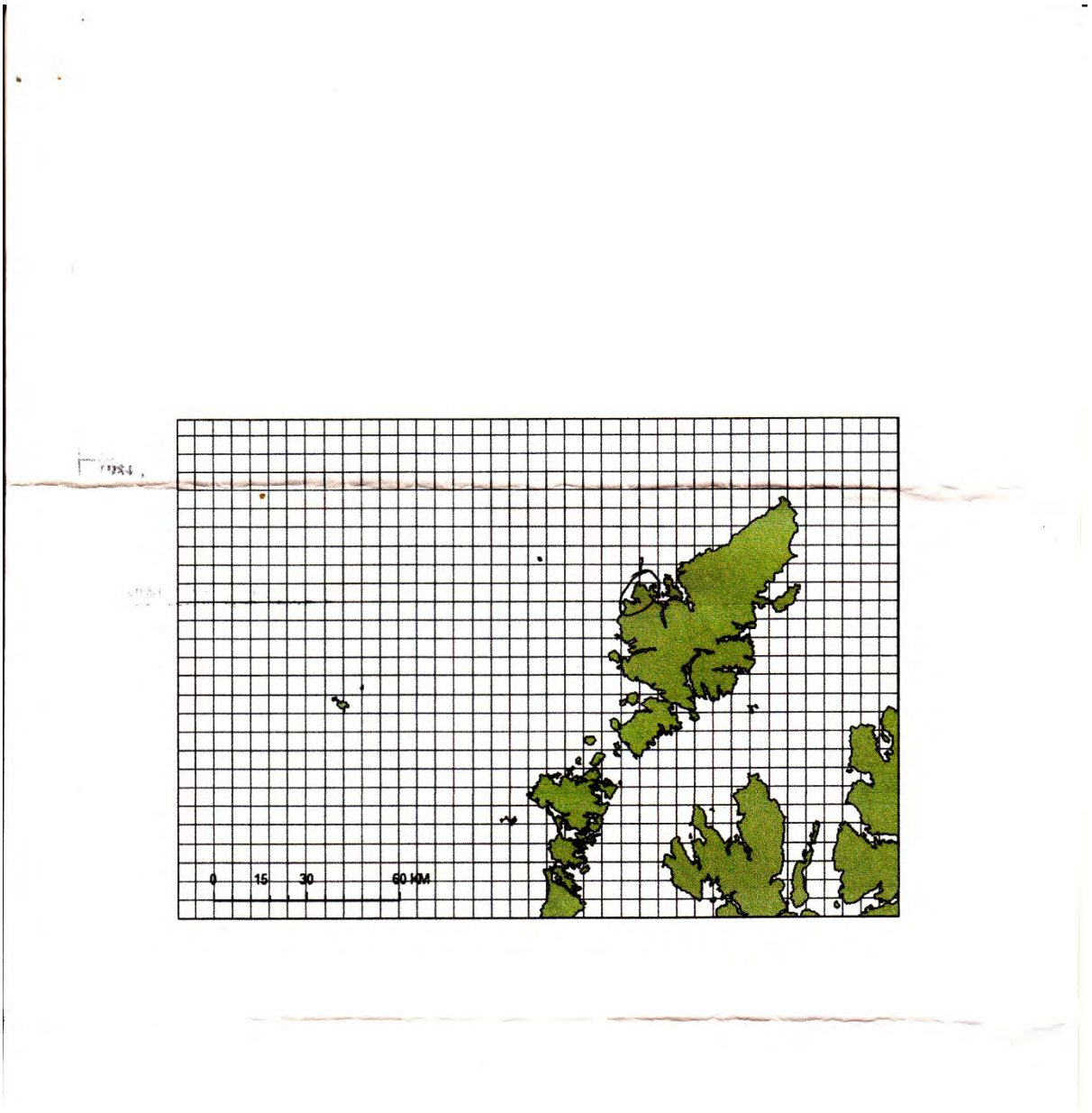
If the above option is not possible, please return annotated maps (use the blank map provided) either by fax or post, or by scanning images into your computer and returning by email.

Q6. *For each numbered red area (drawn in Q5), please indicate the species present in important numbers. Please also include the months when those species are most abundant within the area (add more rows if you need to)*

Red area number	***Species***	***Months when most abundant***
1	Fulmar	
2		
3		

Q7. *Are you able to supply any additional information about the birds using the areas you have identified? For example, do they tend to be used by immature/juvenile or adult birds (or both)? Is there evidence of foraging or rafting behaviour? (add more rows if you need to)*

Red area number	***Additional information***
1	
2	
3	



***Q8.** Within which years and months were your observations/data recorded?*

1970	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1971	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1972	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1973	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1974	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1975	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1977	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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1981	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1982	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1983	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1984	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1986	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1987	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1988	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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2002	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2007	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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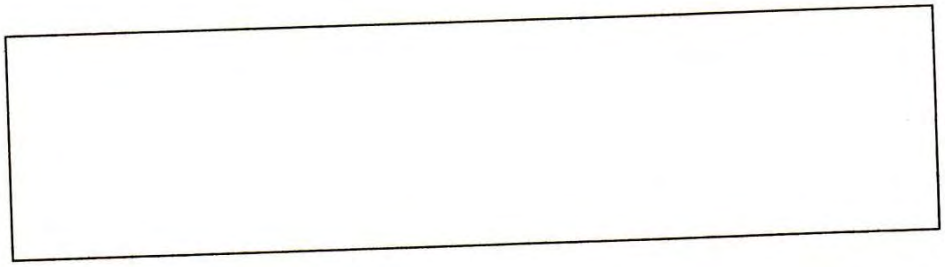
2009	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

If earlier, please give details:

Q9. *Please, briefly, describe your experience (e.g. as a researcher/boat handler/warden etc.).*



I also visit/observe a number of nesting colonies of Common gulls and Herring gulls at various place on the island

C. M. Reynolds

11 Reef
Isle of Lewis
HS2 9HU

01851 672 376

April — mid Nov

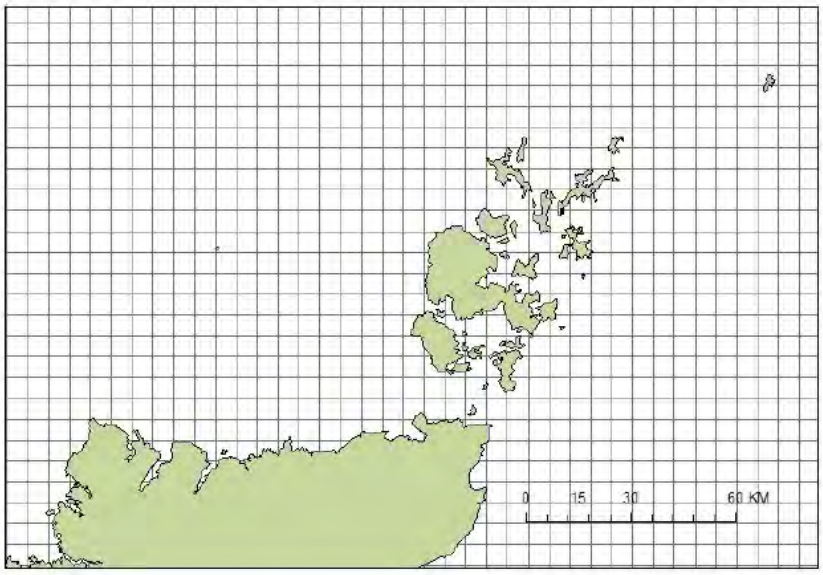
or

44 Coppice Avenue
Ferndown
Dorset
BH24 9PX

01202 854 629

mid Nov — mid March

BTO Seabirds at Sea Questionnaire: Northern Scotland



Grid cells are 6 km x 6 km

Q1. *Have you made observations or obtained data on seabirds within the area of sea shown on the map above?*

Yes – please continue with the questionnaire x☐

No – please do not complete the questionnaire and return ☐

Q2. *Have your observations / data been sent to the JNCC European Seabirds at Sea (ESAS) group?*

YES (entirely) ☐

YES (partially) ☐

NO x☐

*If you have ticked YES (entirely) and your data were collected **between 1980 and 2006 only**, you do not need to complete the rest of the questionnaire. However, please continue with the questionnaire using any ESAS data you may have collected in other years, or with any other seabird data / observations.*

Q3. *How did you make your observations/obtain these data?*

Chartered bird watching boat trips ☐

Standardised surveys onboard dedicated survey vessels ☐

Standardised surveys onboard vessels of opportunity ☐

Tracking Studies ☐

Aerial surveys ☐

Seawatching ☐

Other x☐

Please provide details:
As a countryside ranger, I often lead guided walks along the cliff tops. In the summer, the breeding seabird colonies are of great interest to members of the public.

Q4. *Have your observations previously been published in a format that could inform the identification of potential marine SPAs (e.g. distribution maps or as spatially referenced data)?*

YES (Entirely) – Please give details, you do not need to complete questions 5-9	☐
YES (Partially) – Please give details and continue with questions 5-9	☐
NO – Please continue with questions 5-9	x☐

If yes (partially or entirely), please give details here.

Q5. *On the map below, please identify:*

(a) The areas which you regularly visit; OR, if your evidence is based on tagged birds, the location(s) of your study colony(ies).

(b) Any areas which you feel regularly hold important numbers of a seabird species. (By "important numbers" we mean areas with higher densities than average of particular species. If your evidence is based on tagged birds, this could be an area where tagged birds spend a large proportion of time or are known foraging areas. An area can be important for one or several species).

The best way to identify areas on the map, if using Microsoft Word, is to adjust the shapes on the map below. Each shape can be copied to indicate multiple areas. Use the blue transparent shape to show the area(s) you regularly visit and use the red shape to indicate the area(s) you feel regularly hold important numbers of seabirds. Place a number in each box for reference. It may be best to then save your completed questionnaire as a pdf to ensure that the shape does not move if opened in a different version of Microsoft Word.

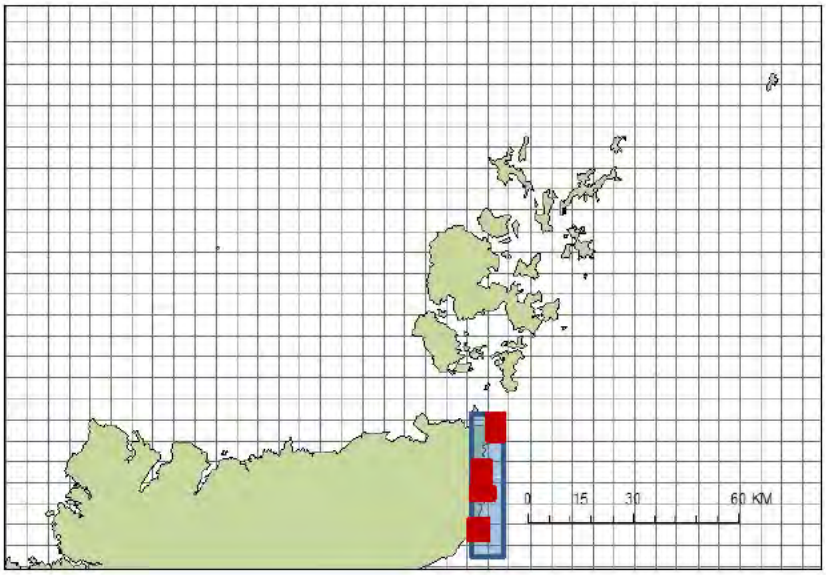
If the above option is not possible, please return annotated maps (use the blank map provided) either by fax or post, or by scanning images into your computer and returning by email.

Q6. *For each numbered red area (drawn in Q5), please indicate the species present in important numbers. Please also include the months when those species are most abundant within the area (add more rows if you need to)*

Red area number	*Species*	*Months when most abundant*
1	Puffin, shag, fulmar, razor bill, guillemot, kittiwake	April-July
2	Puffin, shag, fulmar, razor bill, guillemot, kittiwake	April-July
3	Puffin, shag, fulmar, razor bill, guillemot, kittiwake	April-July
4	Long tailed duck	Dec-Feb

Q7. *Are you able to supply any additional information about the birds using the areas you have identified? For example, do they tend to be used by immature/juvenile or adult birds (or both)? Is there evidence of foraging or rafting behaviour? (add more rows if you need to)*

Red area number	*Additional information*
1	
2	
3	



PLEASE ADJUST THE SHAPES ON THE MAP ABOVE TO SHOW THE EXTENT OF YOUR STUDY AREA AND TO MARK AREAS THAT YOU THINK HOLD IMPORTANT NUMBERS OF SEABIRDS

Full extent of the area that you have knowledge of (e.g. have visited or encompassed for seabird research)

Areas that you think regularly hold important numbers of seabirds

***Q8**. Within which years and months were your observations/data recorded?*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1971	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1972	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1973	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1974	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1975	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1976	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1977	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1978	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1979	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1980	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1981	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1982	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1983	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1984	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1985	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1986	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1987	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1988	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1989	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1990	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1991	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1992	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1993	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1994	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1995	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1996	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1997	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

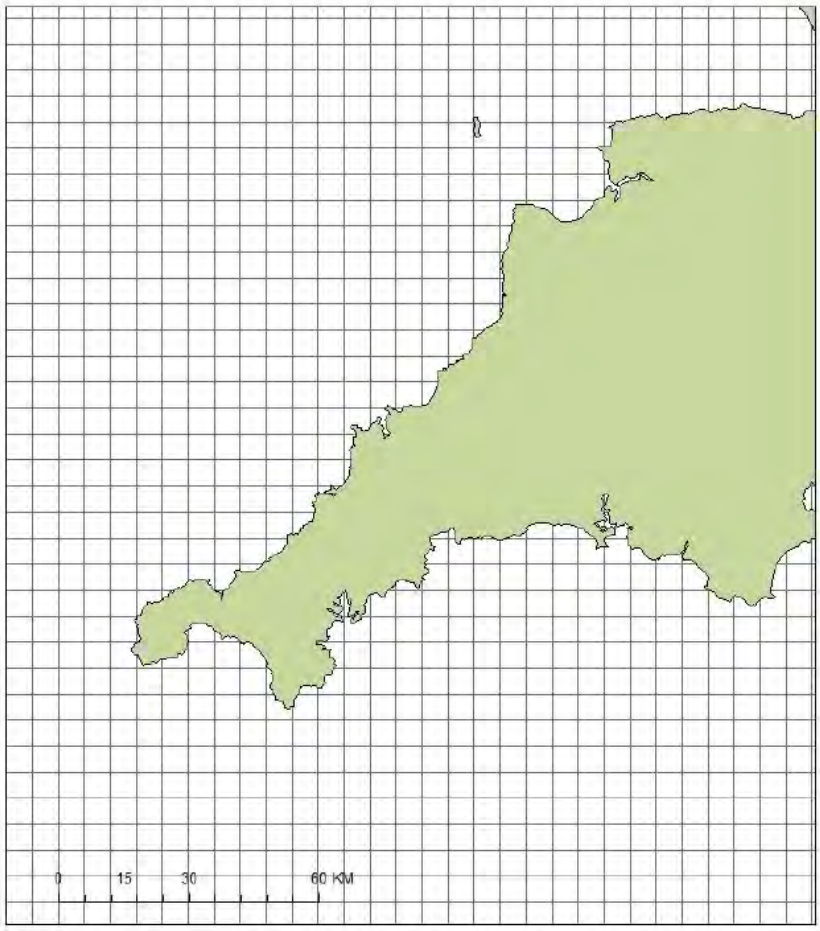
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1998	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May		Jul	Aug	Sep	Oct	Nov	Dec
2002	☐	☐	☐	☐	☐x	Jun x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2007	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2009	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	☐	☐	☐	☐	☐x	☐x	☐	☐	☐	☐	☐	☐

If earlier, please give details:

Q9. *Please, briefly, describe your experience (e.g. as a researcher/boat handler/warden etc.).*

I work as a countryside ranger for HC. I conduct guided walks along the sea cliffs during the summer months often visiting seabird colonies such as Duncansby stacks, Hemriggs stack (near Castle of Old Wick) and the colonies North of Corbigoe. I have been working in this area since 1999.

BTO Seabirds at Sea Questionnaire: South West



Grid cells are 6 km x 6 km

Q1. *Have you made observations or obtained data on seabirds within the area of sea shown on the map above?*

Yes – please continue with the questionnaire	x
No – please do not complete the questionnaire and return	☐

Q2. *Have your observations / data been sent to the JNCC European Seabirds at Sea (ESAS) group?*

YES (entirely)	☐
YES (partially)	☐
NO	x

If you have ticked YES (entirely) and your data were collected ***between 1980 and 2006 only****, you do not need to complete the rest of the questionnaire. However, please continue with the questionnaire using any ESAS data you may have collected in other years, or with any other seabird data / observations.*

Q3. *How did you make your observations/obtain these data?*

Chartered bird watching boat trips	x
Standardised surveys onboard dedicated survey vessels	☐
Standardised surveys onboard vessels of opportunity	☐
Tracking Studies	☐
Aerial surveys	☐
Seawatching	x
Other	☐

Please provide details:
We operate birdwatching boat trips

Q4. *Have your observations previously been published in a format that could inform the identification of potential marine SPAs (e.g. distribution maps or as spatially referenced data)?*

YES (Entirely) – Please give details, you do not need to complete questions 5-9	☐
YES (Partially) – Please give details and continue with questions 5-9	☐
NO – Please continue with questions 5-9	x

If yes (partially or entirely), please give details here.

Q5. *On the map below, please identify:*

(a) The areas which you regularly visit; OR, if your evidence is based on tagged birds, the location(s) of your study colony(ies).

(b) Any areas which you feel regularly hold important numbers of a seabird species. (By "important numbers" we mean areas with higher densities than average of particular species. If your evidence is based on tagged birds, this could be an area where tagged birds spend a large proportion of time or are known foraging areas. An area can be important for one or several species).

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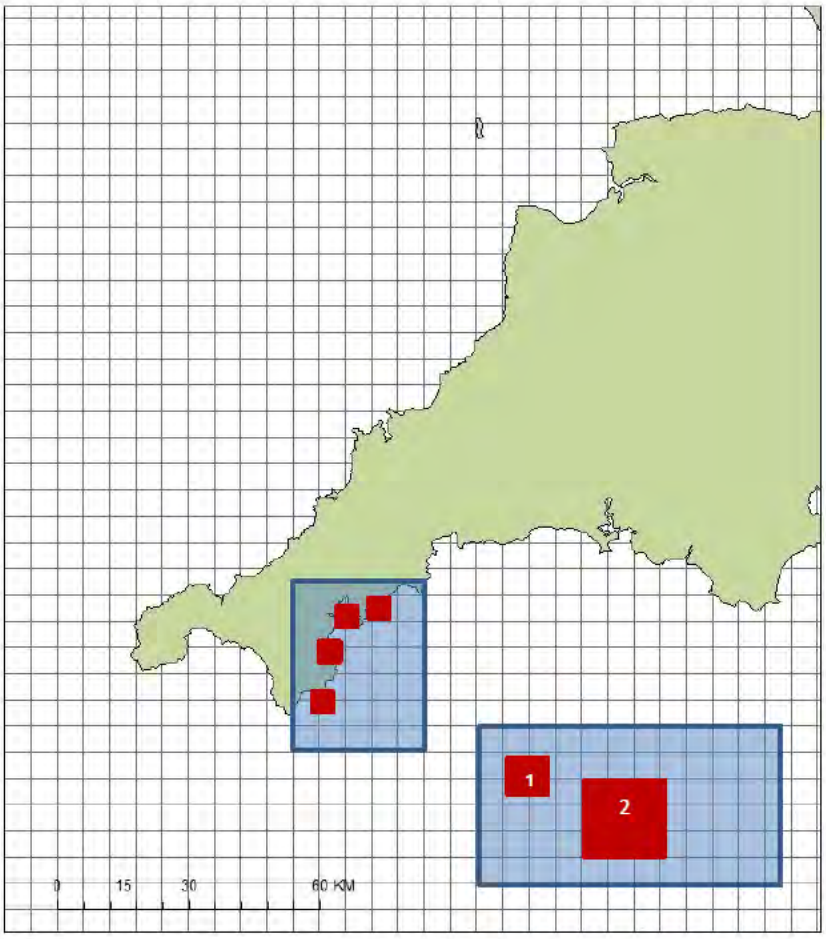
Q6. *For each numbered red area (drawn in Q5), please indicate the species present in important numbers. Please also include the months when those species are most abundant within the area (add more rows if you need to)*

Red area number	***Species***	***Months when most abundant***
1 – bottom left	Great skua, arctic skua, guillemot, razorbill, puffin, gannet, Balearic shearwater, Manx shearwater, sooty shearwater, European storm petrel, sandwich tern, little tern, common tern, Arctic tern.	High levels of avian traffic passing throughout.
2 – middle right	Common scoter, eider, great northern diver, black throated diver, black necked grebe, slavonian grebe, red breasted merganser.	October - April
3 – top right	Razorbill, Guillemot (inc. bridled) (gull Rock) – great northern diver, black throated diver, red throated diver, red necked grebe, Mediterranean gulls and Larus gulls (gerrans bay).	February – June at Gull rock auk nests. October – April Gerrans Bay
4 – middle left	Lesser black backed gulls, great black backed gulls, herring gulls, black headed gulls, little gull, Iceland gull	May-July (breeding) but birds present year round.

Q7. *Are you able to supply any additional information about the birds using the areas you have identified? For example, do they tend to be used by immature/juvenile or adult birds (or both)? Is*

there evidence of foraging or rafting behaviour? (add more rows if you need to)	
Red area number	***Additional information***
1	*We observe a high density of seabirds using this area to fly though, in particular the Manacles Reef which sees the greatest number of species.*
2	*Fal estuary, particularly the Eastern side, has a lot of wintering birds, particularly ducks and grebes.*
3	*Gull Rock had up to 500 breeding auks on there alongside great black backed gulls, herring gulls, cormorants and shags.* *Gerrans bay holds many divers and grebes in the winter.*
4	*Very good natural gull roost and breeding site.*



PLEASE ADJUST THE SHAPES ON THE MAP ABOVE TO SHOW THE EXTENT OF YOUR STUDY AREA AND TO MARK AREAS THAT YOU THINK HOLD IMPORTANT NUMBERS OF SEABIRDS

Full extent of the area that you have knowledge of (e.g. have visited or encompassed for seabird research)

Areas that you think regularly hold important numbers of seabirds

***Q8.** Within which years and months were your observations/data recorded?*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1971	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1972	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1973	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1974	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1975	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1976	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1977	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1978	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1979	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1980	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1981	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1982	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1983	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1984	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1985	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1986	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1987	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1988	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1989	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1990	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1991	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1992	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1993	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1994	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1995	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1996	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1997	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

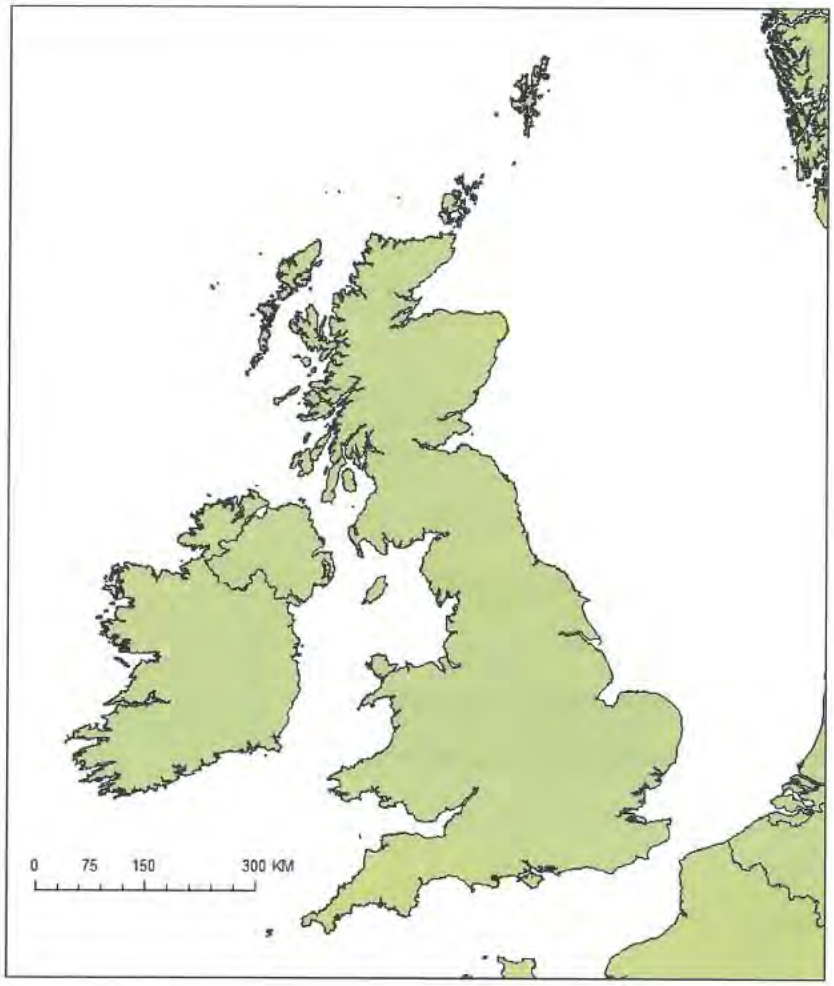
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1998	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1999	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2002	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2004	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2005	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2006	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2007	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2009	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2011	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	■	■
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	■	■	■	■	■	■	■	■	■	■	■	■

If earlier, please give details:

Q9. *Please, briefly, describe your experience (e.g. as a researcher/boat handler/warden etc.).*

AK Wildlife cruises as a team have years worth of experience as a wildlife tour operator. I am a zoology graduate and have assisted in work on seabirds with RSPB and MARINElife before and completed my dissertation on gull behaviour. Our work runs year round and we explore a large area regularly in a number of different conditions.

BTO Seabirds at Sea Questionnaire: UK



Q1. *Have you made observations or obtained data on seabirds within the area of sea shown on the map above?*

Yes – please continue with the questionnaire ☒

No – please do not complete the questionnaire and return ☐

Q2. *Have your observations / data been sent to the JNCC European Seabirds at Sea (ESAS) group?*

YES (entirely) ☐

YES (partially) ☒

NO ☐

If you have ticked YES (entirely) and your data were collected ***between 1980 and 2006 only****, you do not need to complete the rest of the questionnaire. However, please continue with the questionnaire using any ESAS data you may have collected in other years, or with any other seabird data / observations.*

Q3. *How did you make your observations/obtain these data?*

Chartered bird watching boat trips ☐

Standardised surveys onboard dedicated survey vessels ☐

Standardised surveys onboard vessels of opportunity ☐

Tracking Studies ☒

Aerial surveys ☐

Seawatching ☐

Other ☐

Please provide details:

Q4. *Have your observations previously been published in a format that could inform the identification of potential marine SPAs (e.g. distribution maps or as spatially referenced data)?*

YES (Entirely) – Please give details, you do not need to complete questions 5-9	☐
YES (Partially) – Please give details and continue with questions 5-9	☒
NO – Please continue with questions 5-9	☐

If yes (partially or entirely), please give details here.

The tracking data collected in the UK by RSPB as part of the FAME and STAR seabird tracking projects have been made available to JNCC for the purposes of potential marine SPA identification.

Tracking data collected as part of the FAME project is also available for public download at www.RSPB.org.uk/FAME (currently being updated to include recent data) *and publically viewable online at www.FAMEproject.eu.*

Q5. *On the map below, please identify:*

(a) The areas which you regularly visit; OR, if your evidence is based on tagged birds, the location(s) of your study colony(ies).

(b) Any areas which you feel regularly hold important numbers of a seabird species. (By "important numbers" we mean areas with higher densities than average of particular species. If your evidence is based on tagged birds, this could be an area where tagged birds spend a large proportion of time or are known foraging areas. An area can be important for one or several species).

The best way to identify areas on the map, if using Microsoft Word, is to adjust the shapes on the map below. Each shape can be copied to indicate multiple areas. Use the blue transparent shape to show the area(s) you regularly visit and use the red shape to indicate the area(s) you feel regularly hold important numbers of seabirds. Place a number in each box for reference. It may be best to then save your completed questionnaire as a pdf to ensure that the shape does not move if opened in a different version of Microsoft Word.

If the above option is not possible, please return annotated maps (use the blank map provided) either by fax or post, or by scanning images into your computer and returning by email.

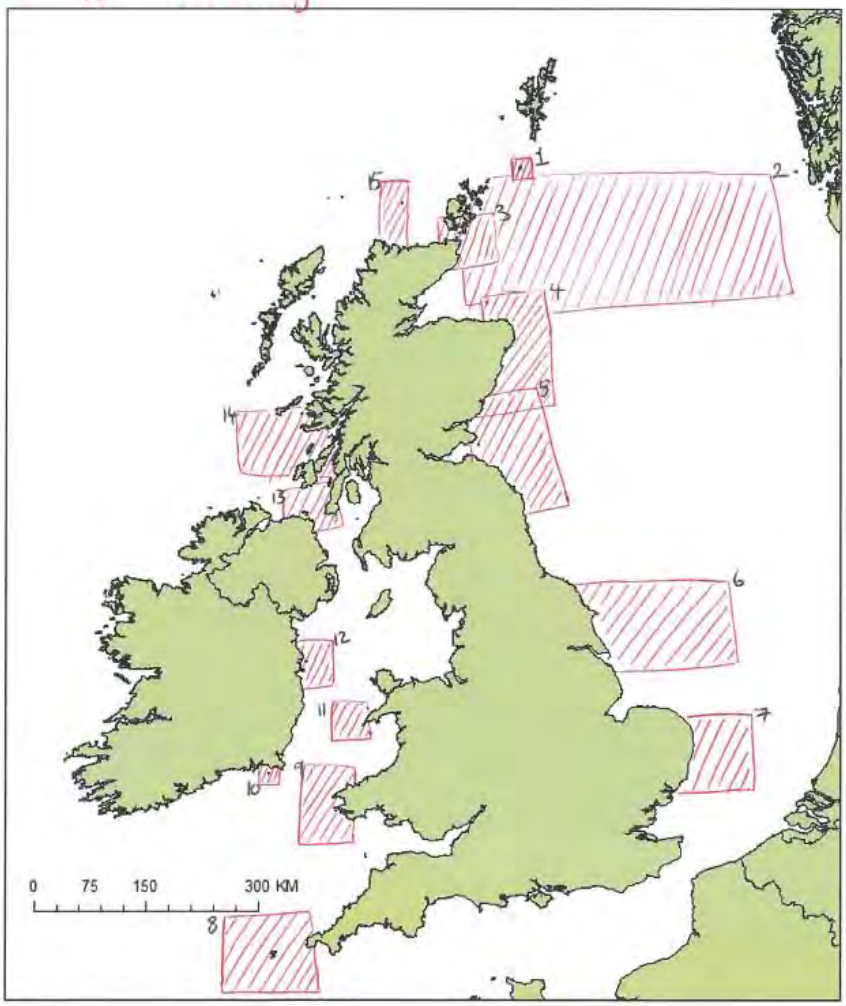
Q6. *For each numbered red area (drawn in Q5), please indicate the species present in important numbers. Please also include the months when those species are most abundant within the area (add more rows if you need to)*

Red area number	***Species***	***Months when most abundant***
1	Shag, kittiwake, guillemot, razorbill, fulmar	April to August
2	Kittiwake, guillemot, razorbill, fulmar	April to August
3	Shag, kittiwake, guillemot, razorbill, fulmar	April to August
4	Shag, kittiwake, guillemot, razorbill, Fulmar	April to August
5	Shag, kittiwake, guillemot, razorbill, Fulmar	April to August
6	kittiwake, gannet	April to September
7	Herring and lesser black-backed gulls	April to August
8	Shag, kittiwake, Fulmar	April to August
9	guillemot, razorbill	April to August

10	Shag	April to August
11	kittiwake, razorbill	April to August
12	Shag, kittiwake, guillemot, razorbill,	April to August
13	kittiwake, razorbill	April to August
14	Shag, kittiwake, guillemot, razorbill	April to August
15	kittiwake	April to August

Q7. *Are you able to supply any additional information about the birds using the areas you have identified? For example, do they tend to be used by immature/juvenile or adult birds (or both)? Is there evidence of foraging or rafting behaviour? (add more rows if you need to)*

Red area number	***Additional information***
All areas	*Evidence of foraging*

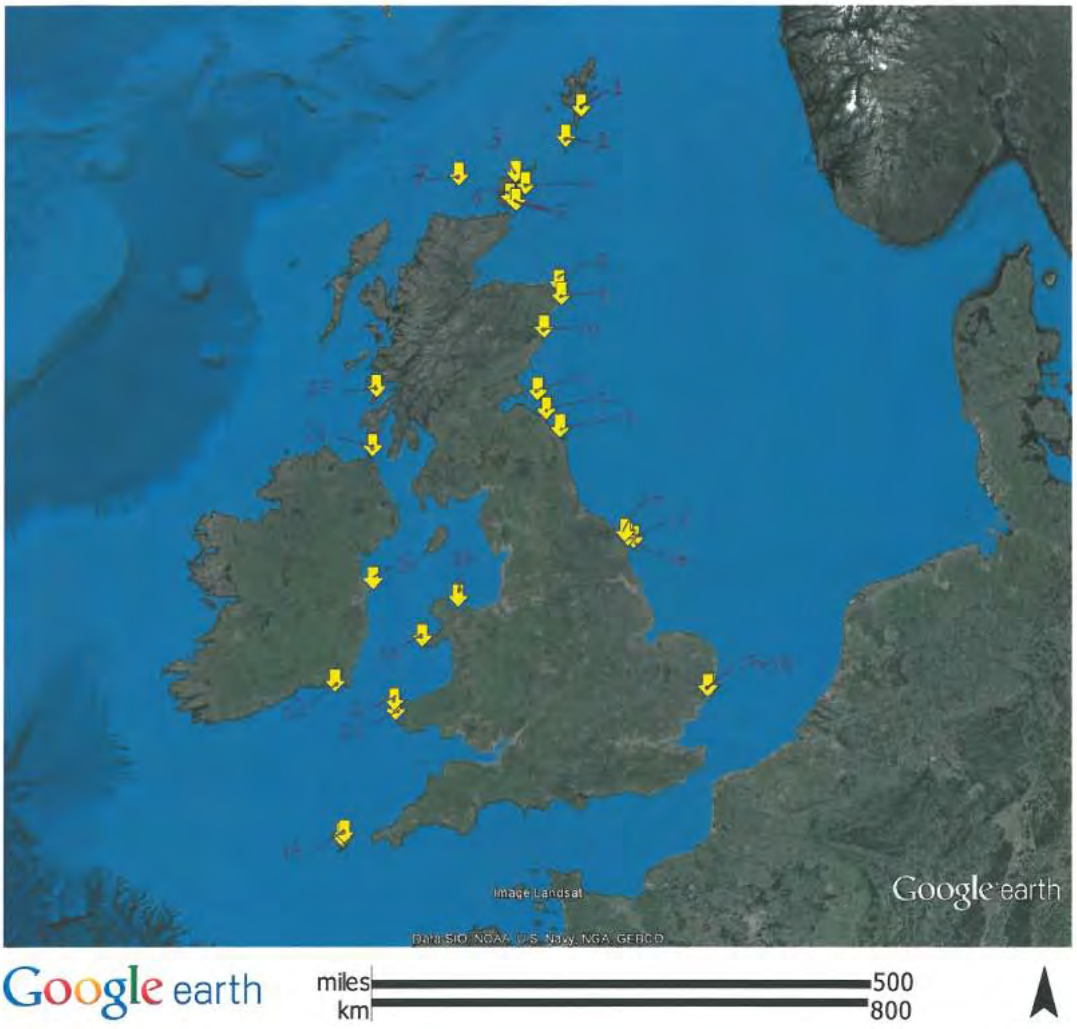


PLEASE ADJUST THE SHAPES ON THE MAP ABOVE TO SHOW THE EXTENT OF YOUR STUDY AREA AND TO MARK AREAS THAT YOU THINK HOLD IMPORTANT NUMBERS OF SEABIRDS

Full extent of the area that you have knowledge of (e.g. have visited or encompassed for seabird research)
(Marked on map overleaf.)

Areas that you think regularly hold important numbers of seabirds

Colony Location for which I am familiar with the tracking data:



Q8. Within which years and months were your observations/data recorded?

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1971	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1972	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1973	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1974	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1975	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1976	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1977	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1978	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1979	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1980	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1981	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1982	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1983	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1984	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1985	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1986	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1987	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1988	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1989	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1990	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1991	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1992	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1993	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1994	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1995	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1996	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1997	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1998	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1999	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2000	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2001	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2002	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2003	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2004	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2005	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2006	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2007	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2008	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2009	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2010	☐	☐	☐	☒	☒	☒	☒	☒	☐	☐	☐	☐
2011	☐	☐	☐	☒	☒	☒	☒	☒	☐	☐	☐	☐
2012	☐	☐	☐	☒	☒	☒	☒	☒	☐	☐	☐	☐
2013	☐	☐	☐	☒	☒	☒	☒	☒	☐	☐	☐	☐

If earlier, please give details:

Q9. *Please, briefly, describe your experience (e.g. as a researcher/boat handler/warden etc.).*
I am a researcher in RSPB's Conservation Science department. With colleagues, I have managed the RSPB's tracking of UK seabirds since 2010.

Appendix 5

Maps of various environmental variables that may provide ecological explanations for the presence of seabird aggregations. The 25 seabird aggregations being considered in this report are also shown on each map.

Figure A5.1 The 25 seabird aggregation areas with underlying 1 second resolution bathymetry.

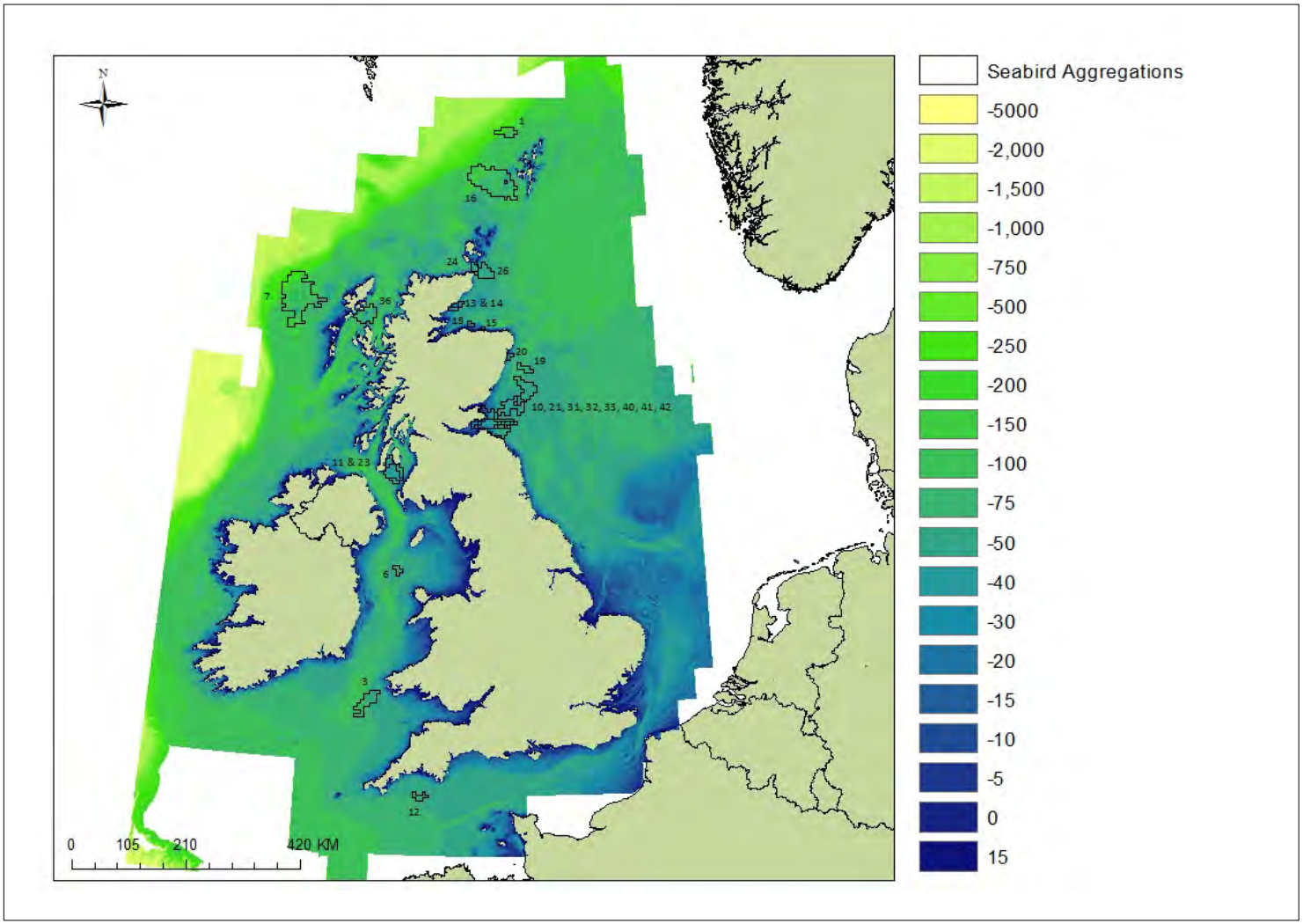


Figure A5.2 The 25 seabird aggregation areas with underlying substrate type.

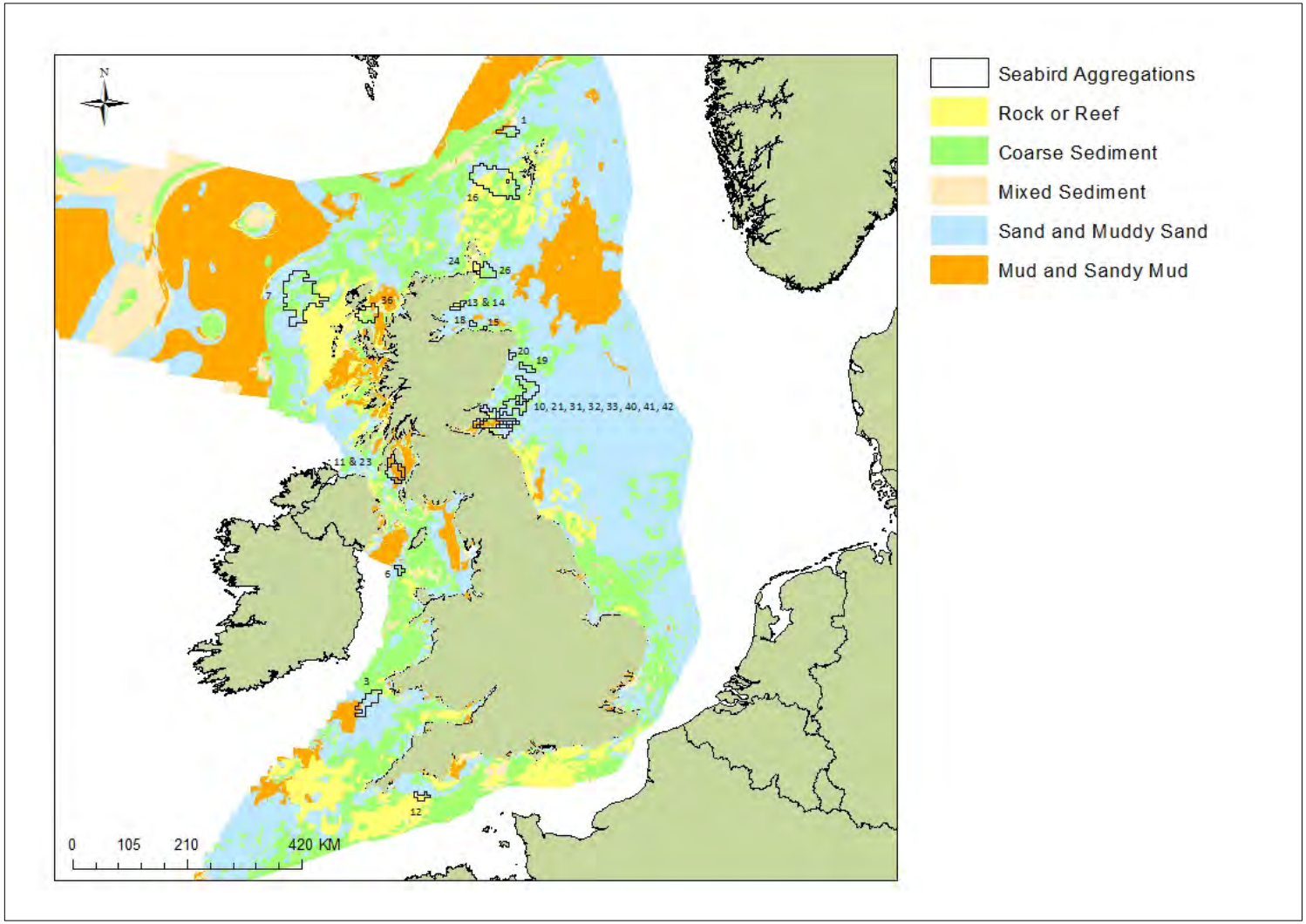


Figure A5.3 The 25 seabird aggregation areas with a seasonal frequent front map, indicating the percentage of summer time a strong front was observed at each location.

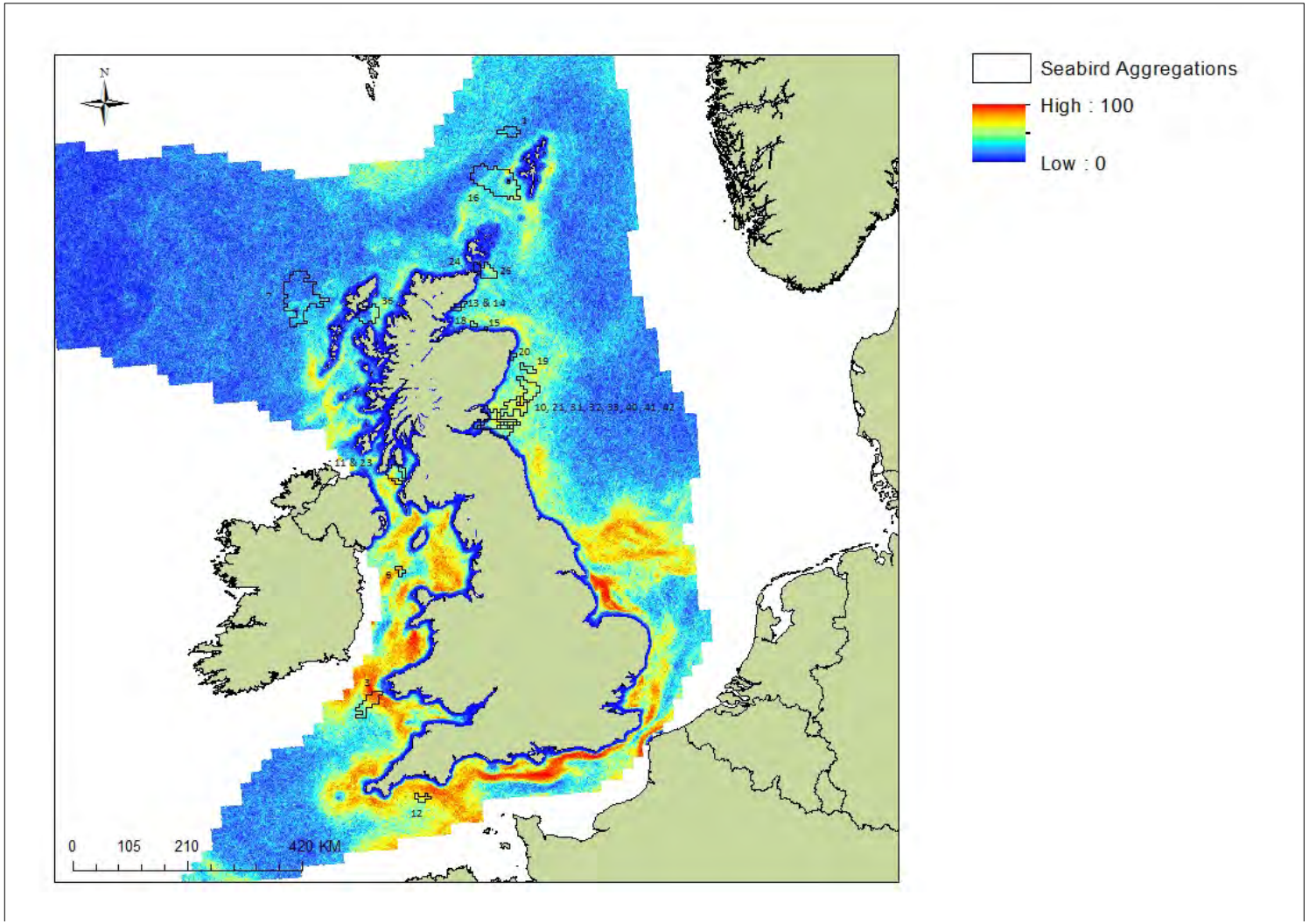


Figure A5.4 The 25 seabird aggregation areas with potential Annex I sandbanks.

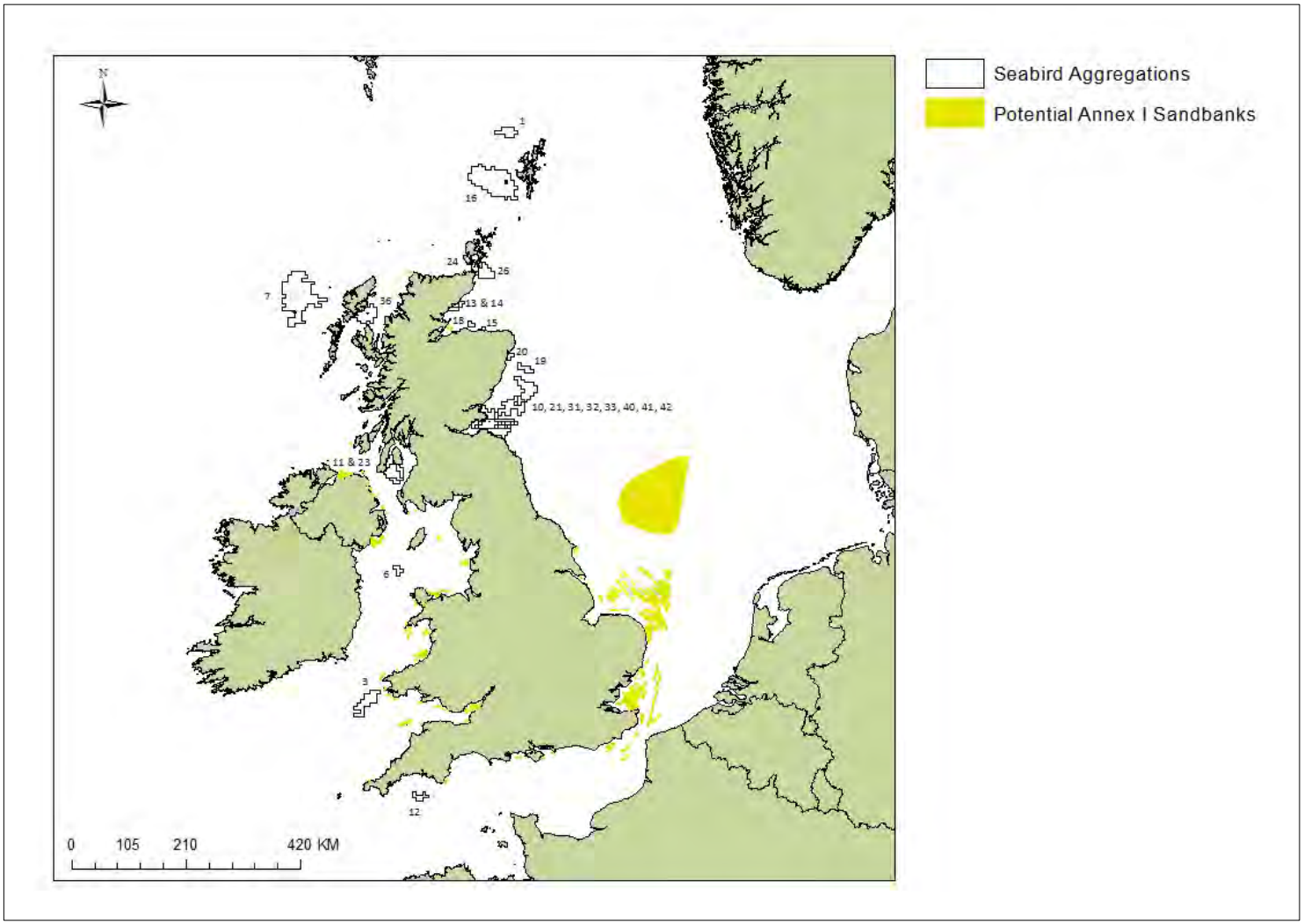


Figure A5.5 The 25 seabird aggregation areas with potential Annex I reefs.

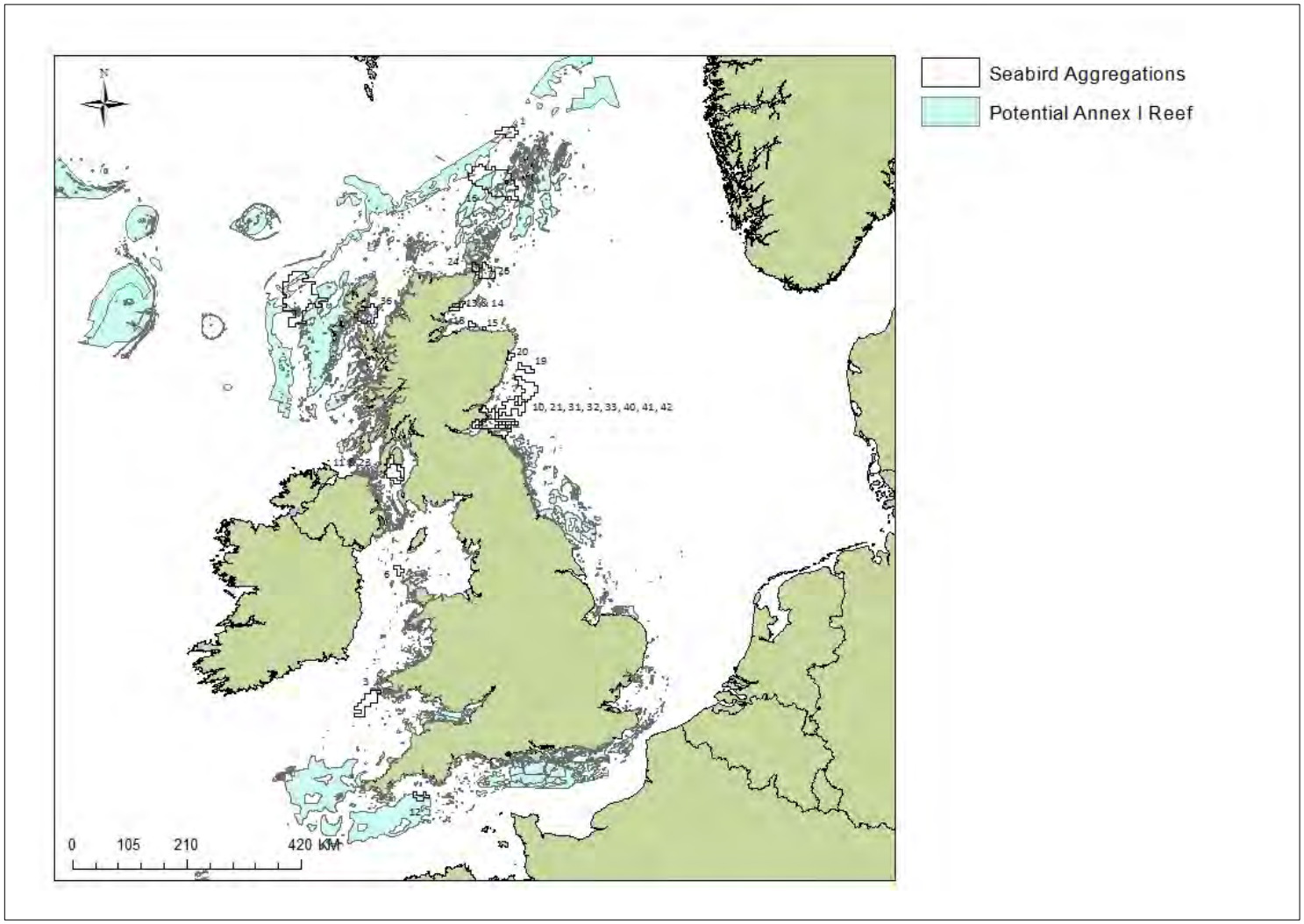


Figure A5.6 The 25 seabird aggregation areas with known Annex I submarine structures and fluid seeps.