A1a.5 Birds

A1a.5.1 Introduction

This section describes the distribution and ecology of birds species which make specific use of the UK's coast and marine environments. The UK and its surrounding seas are very important for birds. The extensive network of cliffs, sheltered bays, coastal wetlands, and estuarine areas, provide breeding and wintering grounds for nationally and internationally important numbers of individual bird species and assemblages. As a signatory to a number of international conservation conventions, the UK has a legal obligation to conserve bird species and their habitats.

The baseline provides a description of the main colonies and sites for seabirds and waterbirds in each of the Regional Sea areas, as well as a description of their distribution at sea. It has been compiled using a variety of resources, (see below) and draws data from recent surveys of seabird colonies where available and sites used by waterbirds during winter.

A1a.5.2 UK Context

Some twenty five species of seabird regularly breed in the UK and Ireland as do a number of other waterbird species (Table A1a.5.1). Waterbirds, a loosely defined category including seaducks, divers, herons waders, geese and swans, are a major feature of the coastal habitats of the UK, with resident, migratory and over-wintering populations present.

Table A1a.5.1: Seabird and waterbird[1] species breeding in the UK and Ireland

Family	Species
Seabirds	
Procellariidae	Northern fulmar (*Fulmarus glacialis*), Manx shearwater (*Puffinus puffinus*), European storm petrel (*Hydrobates pelagicus*), Leach's storm-petrel (*Oceanodroma leucorhoa*)
Phalacrocoracidae	Great cormorant (*Phalacrocorax carbo*), European shag (*Phalacrocorax aristotelis*)
Sulidae	Northern gannet (*Morus bassanus*)
Stercorariidae	Great skua (*Stercorarius skua*), Arctic skua (*Stercorarius parasiticus*)
Laridae	Herring gull (*Larus argentatus*), common gull (*Larus canus*), black-headed gull (*Larus ridibundus*), lesser black-backed gull (*Larus fuscus*), great black-backed gull (*Larus marinus*), Mediterranean gull (*Larus melanocephalus*), black-legged kittiwake (*Rissa tridactyla*)
Sternidae	Sandwich tern (*Sterna sandvicensis*), roseate tern (*Sterna dougallii*), common tern (*Sterna hirundo*), Arctic tern (*Sterna paradisaea*), little tern (*Sterna albifrons*)
Alcidae	Common guillemot (*Uria aalge*), razorbill (*Alca torda*), black guillemot (*Cepphus grylle*), puffin (*Fratercula arctica*)
Waterbirds	
Anatidae	Mute swan[2] (*Cygnus olor*), greylag goose[2] (*Anser anser*), Canada goose[2] (*Branta canadensis*), Egyptian goose[2] (*Alopochen aegyptiacus*), shelduck[2] (*Tadorna tadorna*), mandarin[2] (*Aix galericulata*), wigeon[2] (*Anas penelope*), gadwall[2] (*Anas strepera*), teal[2] (*Anas crecca*), mallard[2] (*Anas platyrhynchos*), pintail[2] (*Anas acuta*), garganey (*Anas querquedula*), shoveler[2] (*Anas clypeata*), pochard[2] (*Aythya farina*), tufted duck[2] (*Aythya fuligula*), eider[2] (*Somateria mollissima*), common scoter[2] (*Melanitta nigra*), goldeneye[2]

Family	Species
	(*Bucephala clangula*), red-breasted merganser[2] (*Mergus serrator*), goosander[2] (*Mergus merganser*), ruddy duck[2] (*Oxyura jamaicensis*)
Gaviidae	Red-throated diver[2] (*Gavia stellata*), black-throated diver[2] (*Gavia arctica*)
Podicipedidae	Little grebe[2] (*Tachybaptus ruficollis*), great crested grebe[2] (*Podiceps cristatus*), Slavonian grebe[2] (*Podiceps auritus*), black-necked grebe (*Podiceps nigricollis*)
Ardeidae	Bittern[2] (*Botaurus stellaris*), little egret[2] (*Egretta garzetta*), grey heron[2] (*Ardea cinerea*)
Rallidae	Coot[2] (*Fulica atra*)
Haematopodidae	Oystercatcher[2] (*Haematopus ostralegus*)
Recurvirostridae	Avocet[2] (*Recurvirostra avosetta*)
Charadriidae	Little ringed plover[2] (*Charadrius dubius*) ringed plover (*Charadrius hiaticula*), golden plover[2] (*Pluvialis apricaria*), lapwing[2] (*Vanellus vanellus*)
Scolopacidae	Dunlin[2] (*Calidris alpina*), ruff[2] (*Philomachus pugnax*), snipe[2] (*Gallinago gallinago*), black-tailed godwit[2] (*Limosa limosa*), whimbrel[2] (*Numenius phaeopus*), curlew[2] (*Numenius arquata*), common sandpiper[2] (*Actitis hypoleucos*), greenshank[2] (*Tringa nebularia*), redshank[2] (*Tringa totanus*), red-necked phalarope[2] (*Phalaropus lobatus*)

Notes: [1]Waterbirds included here are typically associated with estuarine, coastal and marine habitats, but also freshwater/terrestrial habitats during breeding, therefore not every member of the Family is listed [2]Waterbird species which also regularly overwinter/stage in the UK. Source: JNCC website, Hume (2002)

The UK lies on some of the major migratory flyways of the east Atlantic, with many species not only overwintering in the area, but also using the UK as a stopover during spring and autumn migrations (Table A1a.5.2 – see also species[1] from Table A1a.5.1). Birds do not use fixed migratory corridors, with migration instead (usually) a broad front. The estuaries, bays and other coastal areas of the UK are of great importance to wintering and passage wildfowl, as well as for breeding waders and other waterbirds.

Table A1a.5.2: Waterbirds which regularly overwinter/stage in the UK[1]

Family	Species
Anatidae	Whooper swan* (*Cygnus cygnus*), Bewick's swan (*Cygnus columbianus bewickii*), Taiga bean goose (*Anser fabalis*), Tundra bean goose (*Anser serrirostris*), pink-footed goose (*Anser brachyrhynchus*), (European) Greenland white-fronted goose (*Anser albifrons flavirostris*), Barnacle goose[2], (*Branta leucopsis*) (Svalbard and Greenland), dark-bellied Brent goose (*Branta bernicla bernicla*), light bellied) Brent goose, (*Branta bernicla hrota*) Scaup* (*Aythya marila*), long-tailed duck (*Clangula hyemalis*), velvet scoter (*Melanitta fusca*), smew (*Mergus albellus*)
Gaviidae	Great northern diver (*Gavia immer*)
Podicipedidae	Red-necked grebe* (*Podiceps grisegena*)
Charadriidae	Grey plover (*Pluvialis squatarola*)
Scolopacidae	Knot (*Calidris canutus*), sanderling (*Calidris alba*), little stint (*Calidris minuta*), curlew sandpiper (*Calidris ferruginea*), purple sandpiper (*Calidris maritima*), Jack snipe (*Lymnocryptes minimus*), bar-tailed godwit (*Limosa lapponica*), green sandpiper (*Tringa ochropus*), wood sandpiper (*Tringa glareola*), spotted redshank (*Tringa erythropus*)

Notes: Species marked with a * are known/suspected to be (rare) breeders in the UK [1]Wintering birds, which also breed in the UK, are shown in Table A1a.5.1 [2]There are two distinct populations of Barnacle goose known to winter in the UK, the Svalbard population which are known to winter principally at the Solway Firth, Lindisfarne and Loch of Strathbeg, and the Greenland population which principally winters in the Western Isles. There is also

an increasing naturalised Barnacle goose population which breeds in the UK. Sources: JNCC website http://jncc.defra.gov.uk/page-1419, Frost *et al.* (2021). BTO website

In the UK, Special Protection Areas (SPAs) are classified in compliance with the "Birds Directive" (Council Directive 2009/147/EC on the Conservation of Wild Birds) through the *Conservation of Habitats and Species Regulations 2017* (as amended) (the "Habitats Regulations") for onshore or in territorial seas and the *Conservation of Offshore Marine Habitats Species Regulations 2017* (the Offshore Habitats Regulations) for the UK Continental Shelf. UK SPAs are not just designated for seabird and waterbird/wader species/assemblages, with a number of other bird species, which utilise coastal and island habitats, qualifying, either for their breeding or wintering population. These SPAs contribute to the OSPAR Commission's network of marine protected areas (MPA) (https://www.ospar.org/work-areas/bdc/marine-protected-areas).

The terrestrial suite of SPAs is well established, and, although many SPAs in inshore waters have seaward extensions, there are few that extend into offshore waters beyond the territorial sea limit and work on SPAs with marine components[1] is ongoing. The work by Kober *et al*. (2010, 2012, (this revised in 2018)) (two JNCC reports that aimed to identify potential marine SPAs by looking at the numbers and distributions of seabirds within the British Fisheries Limit), identified four important multispecies regions: Outer Firth of Forth; the inner Firth of Forth; the Moray Firth and the north and west of the Shetland Islands. Other important areas, but for lower number of species included those off the north coast of Scotland, around St Kilda and to the west of Skomer and Skokholm (Kober *et al.* 2012). In 2017, the classified Skokholm and Skomer SPA was re-classified to the Skomer, Skokholm and Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro SPA, after seaward extensions to incorporate marine areas were added to the site boundary and in 2020, 12 new inshore and offshore SPAs were announced, two of which (Seas off St Kilda and Seas off Foula) being the first Scottish SPAs to be designated which are mostly in offshore waters. The other sites included inshore areas around Shetland, (Bluemull and Colgrave Sounds), the Moray Firth and the Outer Firth of Forth and Outer St Andrews Bay Complex. In 2022, two further sites were designated in/around Orkney: the Scapa Flow SPA and North Orkney SPA.

JNCC are responsible for advising the UK Government and devolved administrations on aspects of SPA classification, with the latest changes to the SPA network being available on their website (https://jncc.gov.uk/our-work/special-protection-areas-overview/).

A1a.5.3 Publications

Relevant publications or work undertaken contributing to the present baseline knowledge of UK bird species, from which final, or preliminary results have been used to inform the assessment (in Section 5 of the Environmental Report) of bird sensitivity to elements of this plan/programme are summarised below, with more detailed descriptions within the relevant Regional SEA areas.

Census, Annual and Regular reports, Databases and International Projects

A census of all 25 seabird species that regularly breed in Britain and Ireland has been carried out on three occasions: Operation Seafarer (1969-70, Cramp *et al*. 1974); the Seabird Colony

[1] These are designed to protect bird species listed on the Birds Directive that are *dependent on the marine environment for all or part of their life-cycle, where these species are found in association with intertidal or subtidal habitats within the site*. JNCC https://jncc.gov.uk/our-work/spas-with-marine-components/

Register (SCR) (1985-88, Lloyd *et al*. 1991) and Seabird 2000 (1998-2000, Mitchell *et al*. 2004). The SCR served as the foundation for future seabird population monitoring and facilitated the collection of colony information and also led to the initiation of the Seabird Monitoring Programme (SMP) which began in 1986. This involves the regular monitoring of seabird demographics such as population size and breeding success. The online output, Seabird Population Trends and Causes of Change, is updated annually and highlights notable changes in seabird numbers and breeding performance at each colony studied. Trend information is presented at the UK Level, and separately for England, Scotland, Wales, Northern Ireland, Republic of Ireland, all-Ireland, Channel Islands and Isle of Man, with interpretation of trends and reasons for change given largely at a UK level. A fourth seabird breeding census (Seabirds Count), commenced in 2015 and final year of data collection was to be 2020. However, survey activity was suspended due to the Covid-19 viral pandemic, resulting in the census period being extended, with final surveys now being undertaken in 2021.

A census of all seventeen breeding seabirds on the Isle of Man was carried out in 2017 (Hill *et al*. 2019), and builds on the work of the Manx Bird Atlas Survey undertaken in 1999 (Sharpe & Sapsford 1999) and the census of 1985-86 (Moore 1987). There are other annual reports with a focus on important seabird areas and colonies, including the Skokholm Seabird Report (Wildlife Trust 2020), the Skomer Island seabird monitoring (Zbijewska *et al*. 2020).

In 2013, a strategy for seabird monitoring in Northern Ireland was developed and is overseen by the British Trust for Ornithology (BTO) on behalf of the Northern Ireland Environment Agency (NIEA). The output from this, the annual Northern Ireland Seabird Report, provides details on breeding seabird numbers and productivity from sites across Northern Ireland (Booth Jones 2021).

In the UK and Ireland, seabird surveys are undertaken using standard survey guidelines for each species – see Table A1a.5.3 and these units have been used throughout the section where applicable.

Table A1a.5.3: Standard breeding seabird survey terminologies

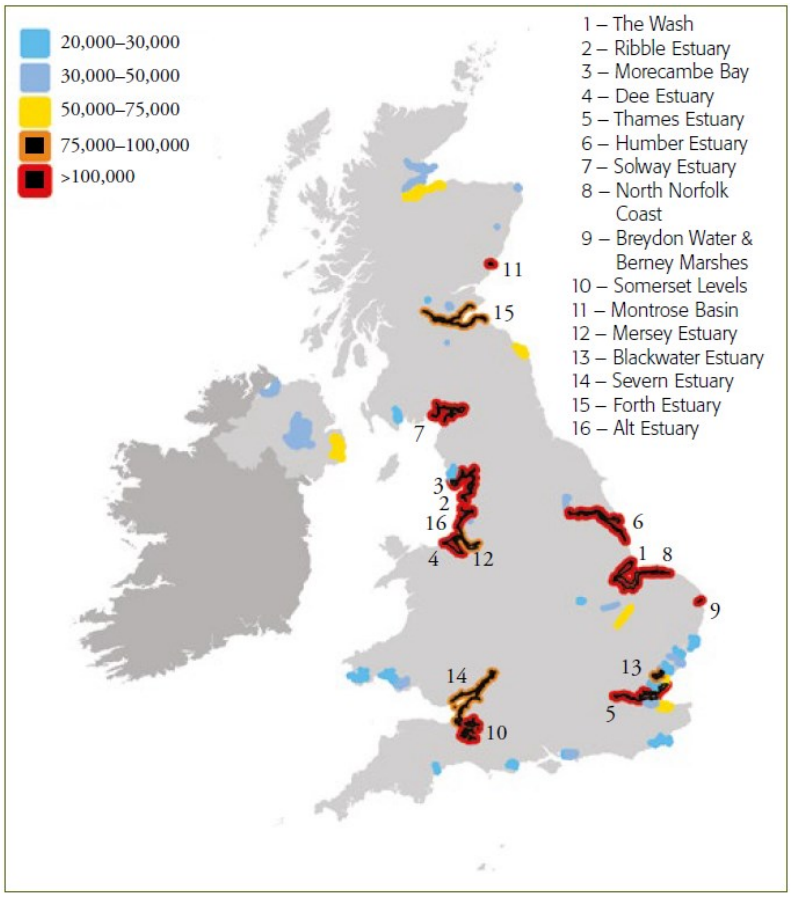
Unit	Abbreviation	Description
Apparently Occupied Nest	AON	An active nest occupied by a bird, pair of birds, or with eggs or chicks present
Apparently Occupied Site	AOS	An active site occupied by a bird, pair of birds, or with eggs or chicks present. Used for species without obvious nests.
Apparently Occupied Territory	AOT	An active nest, with eggs or chicks, apparently incubating or brooding adult, with adults distracting or alarm calling, with pairs/single bird in potential breeding habitat, apparently attached to the area.
Apparently Occupied Burrow	AOB	An apparently active and occupied burrow which may have a nest
Individuals	Ind	Individual birds

Source: Walsh *et al.* (1995), BTO (2015)

The annual Wetland Bird Survey (WeBS) is a partnership scheme of the BTO, WWT, RSPB and JNCC (Frost *et al*. 2021) and provides information on the population size, distribution and the most important sites for non-breeding waterbirds (i.e. wildfowl and waterfowl) in the UK. It aims to provide the principal data on which the conservation of populations and wetland

habitats is based. WeBS monitoring continues two long-running count schemes; synchronised 'Core Counts' conducted once per month year round, at a wide variety of coastal and wetland sites and 'Low Tide Counts' on selected estuaries with the aim of identifying key areas used principally by feeding birds. UK wetlands supporting the largest aggregations of wintering waterbirds (sites with a five year average of 20,000+ birds, based on data collected 2015/2016-2019/20) are shown in Figure A1a.5.1. Counts from 2019/2020 and the 5 year mean count from the top principal sites within each Regional Sea area are described within the relevant sections. A comprehensive list of all sites supporting more than 10,000 birds is available at www.bto.org/webs.

Figure A1a.5.1: Largest wintering waterbird aggregations in the UK



Notes: Wetlands supporting five-year average of 20,000+ waterbirds, with the top 16 sites labelled. Sources: Frost et al (2021)

The work of the Goose and Swan Monitoring Programme (https://monitoring.wwt.org.uk/our-work/goose-swan-monitoring-programme/), which is also referenced within the annual WeBS, is managed by the WWT and funded in partnership with the JNCC and NatureScot. This monitors a number of species, including pink-footed goose (*Anser brachyrhynchus*) and greylag goose (*Anser anser*) (Brides *et al.* 2021), Greenland white-fronted goose (*Anser albifrons*) (Fox *et al*. 2020) and Greenland barnacle goose (*Brent leucopsis*) (Mitchell & Hall 2020).

The RSPB's annual publication *The State of the UKs Birds 2020* (Burns *et al.* 2020), pulls data from a range of sources, to provide an in-depth overview of the status of bird populations in the UK and its overseas territories and gives an update on trends. This report is a collaborative publication from the RSPB, BTO, WWT and the UK Government's statutory nature conservation agencies. A further partnership, this time between the BTO, JNCC and the RSPB, with fieldwork conducted by volunteers, produces The Breeding Bird Survey

(https://www.bto.org/our-science/projects/bbs) (Harris *et al* 2021). This describes the population trend of widespread UK breeding birds since 1994 and includes trends for waterbird species associated with this section, e.g. mute swan and shelduck.

In 2020, the fourth report by the Avian Population Estimates Panel (APEP 4) was published (Woodward *et al.* 2020[2]), the previous three having been published in 1997 (APEP 1, Stone *et al.* 1997), 2006 (APEP 2 Baker *et al.* 2006) and 2013 (APEP 3 Musgrove *et al.* 2013). APEP is a collaboration between the UK statutory conservation agencies and relevant non-government organisations, the role of which is to collate the best estimates of breeding/non-breeding bird populations in the UK; these present a consensus view of the best population size estimate (Woodward *et al*. 2020).

Other reports from a variety of different sources, e.g. Wildlife Trust publications, project specific ornithological surveys and journals (e.g. Ibis and Scottish Birds) are available and provide additional information on birds in specific areas of interest, around the UK. There are annual seabird reports issued for Skokholm and Skomer (Wildlife Trust 2020, Zbijewska *et al*. 2020), annual seabird monitoring programme surveys around Shetland, by the Shetland Oil Terminal Environmental Advisory Group (SOTEAG) (SOTEAG 2020), and regular seabird monitoring reports from the Flamborough and Filey Coast colonies (e.g. Aitken *et al*. 2018) for example.

Where new colony counts and waterbird numbers, since the publication of OESEA3 are available, these have been included within each Regional SEA area below.

There are a number of databases and tools which can be accessed/used for bird tracking and distribution information.

The RSPB Open Data Portal (https://opendata-rspb.opendata.arcgis.com/) provides access to their open geographical data, including bird tracking; data from the FAME (Future of the Atlantic Marine Environment) and STAR (Seabird Tracking and Research). These were used as building blocks to develop models to predict at-sea distributions of breeding seabirds (see also Wakefield *et al*. 2017, Cleasby *et al*. 2018).

Marine protected area management and monitoring (MarPAMM) is a cross border project (Ireland, Northern Ireland and western Scotland), with a multiple partner consortium comprising a mix of statutory organisations, academic institutions and non-governmental organisations (https://www.mpa-management.eu/). The aim of the project is to collect data on the abundance, distribution and movement of marine protected species and habitats and produce habitat maps and develop models for a range of species, including connectivity assessments for species; outputs will be a number of marine protected area (MPA) management plans. The project is expected to be completed by 2022.

Information from ESAS (European Seabirds at Sea), an international collaboration between organisations throughout north-west Europe, consists of a common database, maintained by the JNCC, of data from systematic seabird monitoring programmes conducted in British, Dutch, Belgian, German, Danish, Swedish and Norwegian waters, and is included in OBIS-SEAMAP (Ocean Biodiversity Information System Spatial Ecological Analysis of Megavertebrate Populations – see below). This was also used, along with data from visual aerial survey data collected by Wildfowl and Wetlands Trust (Consultancy) Ltd, under various contracts, to develop SeaMaST (Seabird Mapping and Sensitivity Tool) which aims to provide

[2] A summary can be found at https://www.bto.org/sites/default/files/publications/apep4-population-estimates-birds-great-britain-uk-2020.pdf with the full report in British Birds.

evidence of sea area use by seabirds and inshore waterbirds in English territorial waters, and mapping their sensitivity to offshore wind farms (Bradbury *et al*. 2014).

An industry-led, multi stakeholder forum, the Offshore Wind Strategic Monitoring Research Forum (OWSMRF [3]) and the Scottish Marine Energy Research (ScotMER[4]) programme, established by Marine Scotland, and having a focus on offshore renewable energy developments in Scottish waters aim to better understand the impacts of renewable energy developments on birds (the ScotMER programme also has a focus on other impact receptors including marine mammals, fish and benthic communities). Both have developed a framework of knowledge gaps with research programmes structured around these frameworks.

The Offshore Wind Evidence and Change Programme (OWEC[5]) is a five year programme by The Crown Estate, which commenced in 2020 and aims to create an enhanced evidence base, into a single source (the Marine Data Exchange) to facilitate the growth of the offshore wind sector, in such a way that best protects and enhances the environment. This is to be achieved by bringing together key stakeholders to gather and share evidence, including through the compilation of an offshore wind environmental evidence register (OWEER[6]) of data gaps and relevant research projects across four key areas, one of which is seabirds. Announcements of recent projects include: investigating seabird, marine mammal and fish behavioural changes in response to offshore wind development (PrePARED (Predators and Prey Around Renewable Energy Developments); a project trailing new tracking techniques (tags (on seabird leg rings) and receiver systems (on offshore turbines)), looking at seabird movements and survival in the North Sea and POSEIDON (Planning Offshore Wind Strategic Environmental Impact Decisions).

Internationally, OBIS-SEAMAP is a spatially referenced online database of observation data for a number of groups associated with the marine environment, including seabirds and marine mammals (http://seamap.env.duke.edu/), while the Birdlife International Seabird Tracking Database (http://www.seabirdtracking.org/), serves as a central store for seabird tracking data from around the world. In Ireland, the obSERVE programme was established in 2014 by the Department of Communications, Climate Action & Environment in partnership with the Department of Culture, Heritage and the Gaeltacht to improve knowledge and understanding of protected offshore species, including seabirds and sensitive habitats through a programme of data collection (e.g. aerial and acoustic surveys). The intention being, that information from these feed into sustainable management of offshore activities and marine conservation strategies. While, in Norway, the SEAPOP (SEAbird POPulations - http://www.seapop.no/en/about/) programme was established in 2005. This monitoring and mapping programme covers seabird populations in Norway, Svalbard and adjacent sea areas and maintains a baseline knowledge of seabirds in these areas for management of this marine environment. SEABIRD Tracking (https://seapop.no/seatrack/about-seatrack/) – has been a module to SEAPOP since 2014 and aims to produce distribution maps and population origin maps documenting areas used during the non-breeding season (i.e. moulting areas, migration routes and wintering areas).

[3] https://jncc.gov.uk/our-work/owsmrf/
[4] https://www.gov.scot/publications/ornithology-specialist-receptor-group/
[5] https://www.thecrownestate.co.uk/en-gb/what-we-do/on-the-seabed/offshore-wind-evidence-and-change-programme/
[6] https://beta.marinedataexchange.co.uk/details/3480/2021-jncc-offshore-wind-evidence-and-change-programme-offshore-wind-environmental-evidence-register-/summary

SEA programme research

A number of SEA-programme commissioned bird related studies have been carried out[7], with research ongoing in several areas (a selection of these are summarised here, and where relevant, (e.g. tagging studies) are described in detail within the Regional Sea areas below).

Since OESEA3 (2016), results from studies which examined the potential interaction of bird species with offshore wind farms have been published specifically looking at the ranging behaviour of gannets (Langston & Teuton 2018), and potential interaction between gannets and lesser black-backed gulls with OWFs (Lane *et al.* (2020, 2021), Clewley *et al*. (2022), Grecian *et al*. (2018), Thaxter *et al.* (2017, 2018, 2019), modelling flight heights of lesser black-backed gulls and great skuas (Ross-Smith *et al.* (2016), and the migratory movements of the common shelduck are being identified and a pilot tracking study completed to inform potential interactions with offshore wind farms in the North Sea (Green *et al.* 2021).

Studies are looking at the spatial and temporal variation in foraging of breeding red-throated diver (Duckworth *et al.* 2021), to improve knowledge around diver energetics and provide information on whether or not this species may face an energetic bottleneck during the non-breeding season, when they are more likely to be displaced from OWF areas (Duckworth *et al*. 2020, 2021).

With the increasing use of tags and the advancement of tagging technology, this is increasingly being used to track birds, with at-sea distribution previously, generally, derived from boat-based visual surveys. Chick rearing common guillemots and razorbills from the Shiant Islands were tagged, and GPS tracked, with simultaneous boat-based surveys carried out, in order to make a comparison of distributions between the two methods (Carroll *et al*. 2019).

Other SEA funded projects have been carried out/are ongoing, the aim of which is to provide a better understanding of bird distribution and behaviour, for spatial considerations for strategic assessment, consenting of offshore energy activities and monitoring programmes for consented projects (e.g. Cook *et al*. 2019). Through a review of habitats regulations assessments (HRAs) for 21 consented but not operational offshore wind farms, the project identified 16 species within 38 SPAs for which likely significant effects in relation to offshore wind farms could not be ruled out during HRA screening. Significant gaps in the monitoring of populations within SPAs for which HRA was carried out were identified. Limitations in the spatial and temporal coverage of existing monitoring mean that existing data typically lack sufficient statistical power to detect the changes that may be associated with the effects of offshore wind farms. The work highlighted the potential to improve both monitoring and analysis of data collected as part of monitoring, and a number of recommendations are made to suggest how current approaches could be enhanced to support monitoring the effects of offshore wind.

Other relevant research

There are a number of other sources of information and recent research/publications, including several recent papers, some of which are described below, have been investigating behaviours

[7] https://www.gov.uk/guidance/offshore-energy-strategic-environmental-assessment-sea-an-overview-of-the-sea-process#offshore-energy-sea-research-programme

and distributions of birds, that can go to improving seabird ecology knowledge, important for assessment purposes.

Survey data and reports collected during the planning, building and operating of offshore renewable energy projects, is provided by the Marine Data Exchange, with The Crown Estate acting as trustee for the data (http://www.marinedataexchange.co.uk/). Documents associated with renewable development applications, including ornithological information, can be found on the National Infrastructure Planning website (https://infrastructure.planninginspectorate.gov.uk/) while applications for marine projects in Scottish waters, can be found on Marine Scotland Information website (https://marine.gov.scot/marine-projects).

In 2015, JNCC published the assessment of the numbers and distributions of wintering red-throated diver, little gull and common scoter in the Greater Wash (Lawson *et al*. 2015), the results of five seasons of aerial survey data (2002/03, 2004/05, 2005/06, 2006/07 and 2007/08). The information from this was assessed against the UK SPA selection guideline threshold to inform possible SPA boundaries, with the Greater Wash designated a SPA in 2018. To identify and provide evidence of, inshore aggregations of seaduck, divers and grebes, JNCC also published (in 2015, with a revised edition in 2018), results from (winter season) data collected over a 10 year period (2000-2010). This report presented the numbers of inshore wintering aggregations of waterbirds in 21 areas of search around Scotland and indicated where species exceeded UK SPA Selection Guidelines thresholds.

In 2012, Thaxter *et al*. published a review of representative breeding season foraging ranges; which, with other data, could be a preliminary tool for identifying possible Marine Protected Areas. With the advancement of tracking technology and the increase in number of studies, a further review of data were undertaken to identify where foraging ranges could be updated (Woodward *et al*. 2019). Table A1a.5.4 summarises the mean maximum foraging distances and an indication of confidence level (highest, moderate, low, uncertain, poor) from Thaxter *et al*. (2012b), with updated values from Woodward *et al.* (2019).

Table A1a.5.4: Representative breeding season foraging ranges of some seabird species, update from Thaxter *et al*. (2012)

Species	Thaxter *et al* (2012)		Woodward *et al.* (2019)	
	Mean Maximum foraging ranges km (±SD)	Confidence of assessment	Mean Maximum foraging range km (±SD)[1]	Confidence of assessment
Common eider	80	Poor	21.5	Poor
Red-throated diver	9	Low	9	Low
Northern fulmar	400 (±245.8)	Moderate	542.3 (±657.9)	Good
Manx shearwater	>300	Moderate	1,346.8 (±1,018.7)	Moderate
European storm petrel	-	Poor	336	Poor
Leach's storm petrel	91.7 (±27.5)	Poor	N/A	Moderate
Northern gannet	229.4 (±124.3)	Highest	315.2 (±194.2)	Highest
Great cormorant	25 (±10)	Moderate	25.6 (±8.3)	Moderate

Species	Thaxter *et al* (2012)		Woodward *et al.* (2019)	
	Mean Maximum foraging ranges km (±SD)	Confidence of assessment	Mean Maximum foraging range km (±SD)[1]	Confidence of assessment
European shag	14.5 (±3.5)	Moderate	13.2 (±10.5)	Highest
Arctic skua	62.5 (±17.7)	Uncertain	N/A	Poor
Great skua	86.4	Moderate, Low	443.3 (±487.9)	Uncertain
Black-headed gull	25.5 (±20.5)	Uncertain	18.5	Uncertain
Common gull	50	Poor	50	Poor
Mediterranean gull	20	Uncertain	20	Uncertain
Herring gull	61.1 (±44)	Moderate	58.8 (±26.8)	Good
Great black-backed gull	N/A		73	Low
Lesser black-backed gull	141 (±50.8)	Moderate	127 (±109)	Highest
Black-legged kittiwake	60 (±23.3)	Highest	156.1 (±144.5)	Good
Sandwich tern	49 (±7.1)	Moderate	34.3 (±23.2)	Moderate
Roseate tern	16.6 (±11.6)	Low	12.6 (±10.6)	Moderate
Common tern	15.2 (±11.2)	Moderate	18.0 (±8.9)	Good
Arctic tern	24.2 (±6.3)	Moderate	25.7 (±14.8)	Good
Little tern	6.3 (±2.4)	Low	5	Moderate
Common guillemot	84.2 (±50.1)	Highest	73.2 (±80.5)	Highest
Razorbill	48.5 (±35)	Moderate	88.7 (±75.9)	Good
Black guillemot	N/A	N/A	4.8 (±4.3)	Moderate
Atlantic puffin	105.4 (±46)	Low	137.1 (±128.3)	Good

Notes: 1. Typically, for assessments, e.g. environmental impact assessments, the mean maximum foraging range +1SD is used. Source: Thaxter *et al.* (2012b), Woodward *et al.* (2019)

Studies have also looked at northern gannets from the breeding colony at Grassholm (Wales), to investigate rafting behaviours in waters adjacent to the colony (Carter *et al*. 2016) and to look at foraging strategies and to investigate the influence of shelf-sea-fronts on the distribution and characteristics of northern gannet dives (Cox *et al*. 2016). While seabird (black-legged kittiwake, European shag, common guillemot and razorbill) tagging at multiple colonies is being used to estimate at-sea distribution, and identify the factors affecting these (Wakefield *et al.* 2017, see also Cleasby *et al*. 2018, 2020), and work has been undertaken to try and identify foraging distributions for breeding storm petrels (e.g. Bolton 2021) and the identification of foraging areas and quantify diet variability, during annual moult in auks (common guillemot, razorbill and Atlantic puffin) (St John Glew *et al*. 2018). This work continues to build on that previously undertaken, particularly in trying to understand important at-sea areas for birds, including during the non-breeding season (e.g. Kober *et al*. 2010, 2012).

A1a.5.4 International context of seabird populations

The importance of British and Irish seabird populations can be considered in global and biogeographical contexts. The latter is of particular importance in terms of the EU Directive on the Conservation of Wild Birds (EC/79/409), as under Article 4, member states are required to classify SPAs for important populations of birds. A biogeographical population is defined as a group of birds which breed in a particular location (or group of locations), breed freely within the group, and rarely breed or exchange individuals with other groups (Lloyd *et al*. 1991).

A1a.5.5 Ecological context

Seabirds have a variety of feeding methods and are able to exploit most marine food sources. Diverse feeding strategies are also seen between species. Gulls are very opportunistic and are adaptable; equally at home feeding on fishing boat discards, foraging on estuarine mudflats, rocky shores or inland on newly ploughed fields. Gulls and skuas also steal food from other birds or directly predate other seabirds' eggs and chicks, occasionally killing adult birds. Some species, e.g. petrels and black-legged kittiwake, are surface feeders or feed at shallow depths on fish, plankton and crustaceans. Other seabirds can exploit deeper waters, either plunge diving to relatively shallow depths, and greater depths by those species that can swim under water. Terns plunge for fish and crustaceans, such as sandeels, sprats and aquatic invertebrates, while the northern gannet can plunge-dive deeper than terns and exploit a deeper prey source including herring, sprat, sandeels and mackerel. Several species, including the great cormorant, European shag, divers and the auks, can dive and swim to collect deeper water and demersal species, including flatfish, saithe, whiting, sprat and sandeels.

Waterbirds with short beaks, e.g. dunlin, prey on species at the sediment surface while species with long slender bills can forage for deeper burrowed prey. Slender billed species tend not to overturn stones in search of prey as seen in the turnstone. Oystercatchers and other birds with similar beak structure probe mud- and sandflats for prey such as bivalve molluscs.

Due to the wide range of habitats which they exploit and their high position in the food chain, birds can provide good indicators of the state of the environment. Changes at lower trophic levels, particularly those affecting the abundance of their prey species, may result in marked effects on birds populations. For example, the decline in breeding success at many seabird colonies has been attributed to low food availability, particularly of sandeels - a major food source for many species. Additionally, changes in the levels of discarded fish from commercial fishing vessels will alter the availability of food for species which scavenge on this resource.

A1a.5.6 Features of Regional Sea 1

Regional Sea 1 extends along the east coast of Shetland and follows the east coast of Britain from Duncansby Head to Flamborough Head, and encompasses the inshore and offshore areas of the northern North Sea. For the purposes of this section, the whole of Shetland will be described, not just the east coast, with the whole of Orkney, including an offshore area to the east of the Islands described in Regional Sea 8.

Some areas of this region are extremely important for seabirds and coastal waterbirds, with much of the cliffed coastline colonised by seabirds and the region is used throughout the year by species (for breeding, wintering or on migration). The area also includes many important offshore areas which seabirds depend upon for prey and for large proportions of the year, their habitat, e.g. some species of seabird spend the winter at sea. Important areas include the cliff and island habitats and the many firths, including Cromarty, Dornoch, Tay and Firth of Forth

and an area that straddles the border of Regional Sea 1 and 2, Flamborough Head and Bempton Cliffs. The description of this site has been included in the Regional Sea 2 area.

Sites referred to or described in this section are listed geographically north to south where possible. Where colony counts are available these have been included for the individual species along with the year of count (See JNCC https://app.bto.org/seabirds/public/data.jsp). For overall population change of species (2000-2019), see Section A1a5.49 below.

A1a.5.7 Seabird species and distribution

Of the seabird species currently breeding in the UK, only the Mediterranean gull is not recorded as breeding in Regional Sea 1. Coastal areas here support thousands of breeding seabirds and a summary of the most important breeding seabird colonies, all of which are designated as SPAs, are shown in Table A1a.5.6. For full details of SPAs and other sites designated for birds, see Appendix 1j – Conservation.

Table A1a.5.6: Important breeding seabird colonies in Regional Sea 1

Site	Species (designated feature)
Ronas Hill - North Roe and Tingon	Great skua (also designated for breeding red-throated diver)
Hermaness, Saxa Vord and Valla Field	Northern gannet, northern fulmar, European shag, black-legged kittiwake, common guillemot, Atlantic puffin, great skua (also designated for breeding red throated diver) **Seabird Assemblage**
Fetlar	Northern fulmar, Arctic tern, great skua, Arctic skua **Seabird Assemblage**
Ramna Stacks and Gruney	Leach's storm petrel
Papa Stour	Arctic tern
Noss	Northern gannet, great skua, common guillemot, northern fulmar, black-legged kittiwake, Atlantic puffin **Seabird Assemblage**
Mousa	Arctic tern, European storm petrel
Sumburgh Head	Northern fulmar, black-legged kittiwake, Arctic tern, common guillemot **Seabird Assemblage**
Fair Isle	Arctic tern, common guillemot, northern fulmar, northern gannet, European shag, Arctic skua, black-legged kittiwake, razorbill, Atlantic puffin, great skua **Seabird Assemblage**
East Caithness Cliffs	Northern fulmar, great cormorant, common guillemot, herring gull, black-legged kittiwake, razorbill, European shag, great black-backed gull **Seabird Assemblage**
Cromarty Firth	Common tern
Inner Moray Firth	Common tern (wintering great cormorant also a feature)
Troup, Pennan & Lion's Head	Northern fulmar, herring gull, black-legged kittiwake, common guillemot, razorbill **Seabird Assemblage**
Loch of Strathbeg	Sandwich tern

Site	Species (designated feature)
Buchan Ness to Collieston Coast	Herring gull, northern fulmar, European shag, black-legged kittiwake, common guillemot **Seabird Assemblage**
Ythan Estuary, Sands of Forvie & Meikle Loch	Common tern, little tern, sandwich tern
Fowlsheugh	Northern fulmar, herring gull, common guillemot, black-legged kittiwake, razorbill **Seabird Assemblage**
Firth of Tay & Eden Estuary	Little tern (wintering great cormorant also a feature)
Forth Islands	Arctic tern, common tern, roseate tern, sandwich tern, northern gannet, lesser black-backed gull, Atlantic puffin, European shag, great cormorant, herring gull, black-legged kittiwake, common guillemot, razorbill, (wintering great cormorant also a feature) **Seabird Assemblage**
Imperial Dock Lock, Leith	Common tern
St Abbs Head to Fast Castle	European shag, herring gull, black-legged kittiwake, common guillemot, razorbill **Seabird Assemblage**
Lindisfarne	Little tern, Roseate tern
Farne Island	Arctic tern, common tern, roseate tern, sandwich tern, common guillemot **Seabird Assemblage**
Northumbria Coast	Little tern, Arctic tern
Northumberland Marine	Sandwich tern, Roseate tern, common tern, Arctic tern, little tern, common guillemot, Atlantic puffin **Seabird Assemblage**
Coquet Island	Arctic tern, common tern, roseate tern, sandwich tern **Seabird Assemblage**
Teesmouth & Cleveland Coast	Little tern (also designated for concentrations of sandwich tern), common tern added in 2020 (wintering great cormorant also a feature)

Notes: Sites in bold are designated as Seabird Assemblages of International Importance, (qualifying level is 20,000 birds). Source: JNCC (2020) JNCC (seabird monitoring programme) website https://app.bto.org/seabirds/public/data.jsp, JNCC Special Protection Areas https://jncc.gov.uk/our-work/list-of-spas/

Between Seabird 2000 and counts since OESEA3 (>2016) reductions in seabird numbers (e.g. northern fulmar (13,958 AOS compared to 12,228, representing a -12% change) and common guillemot (10,439 IND compared to 5,808, a -44% change), have been evident at Hermaness, with northern fulmar also declining at Fowsleugh (-55% change (2018); common guillemot has fared better here, with an increase (62,330 IND compared to 69,828, a +12% change, count as at 2018) over the same period. Figures from 2019 (4,211 AON/AOS) has shown a 125% increase in northern gannet at Fair Isle since the Seabird 2000 count (1,875 AON/AOS), with an even greater increase (212% change) at Troup Head, where numbers recorded in 2019 were 4,825 AON/AOS (compared to 1,547 AON/AOS); all northern gannet colonies monitored in Regional Sea 1 showed an increase since Seabird 2000, the greatest difference being at Noup Head and Sule Skerry (Orkney) (JNCC 2021) colonies where numbers have grown significantly.

Declines have continued to be recorded for European shag, across colonies monitored: Buchan Ness to Collieston Coast (-10%, count in 2019); Forth Island (-73%, 2019); St Abbs Head (-61%, 2019) and Farne Island (-63%, 2019) (JNCC 2021). A continuing decline has also been seen in black-legged kittiwake numbers across the colonies in this Regional Sea area: Noss (-97%, 2019); Marwick Head (-84%, 2018); Troup, Pennan and Lion's Head (-43%, 2017); Fowlsheugh (-25%, 2018); Forth Island (-47%, 2018) and St Abbs Head (-58%, 2019) (JNCC 2021).

Although not a designated feature of the SPA, northern gannet appears to be establishing a presence at St Abb's (on Foul Carr), after first attempting to breed there in 2016. With space becoming a premium at the Bass Rock gannetry just to the north, birds may be prospecting other areas in the region for suitable nest sites; the potential impact of nesting northern gannet for common guillemot, which favour the stack as a breeding area, remain to be seen and these may be out-competed for space if northern gannet numbers continue to increase here.

Shetland and the north-east coast of Scotland have a number of seabird colonies, the boundaries between which are often indistinct. Many of these colonies are regarded as of international importance for seabirds and are amongst the most important areas for offshore seabirds in Europe.

With the exception of sites on the west coast of Scotland and Orkney, Shetland is the only other place in Britain where Arctic and great skua breed, with breeding sites located throughout the archipelago; no birds have been recorded breeding in England or Wales and only the great skua is a recent breeder in Northern Ireland (see Regional SEA 6). It is thought that Arctic skuas have probably declined more than any other seabird in the period between 1986 and 2019, with the 2017 population index estimated to be the lowest at 83% lower than in 1986 (JNCC 2021). There has been a marked decline in the species numbers and work is needed to fully understand the scale and causes of the decline. Contributory causes are thought to include reduced food availability (sandeels) and competing for nesting territories with and predation by great skuas (numbers of which have markedly increased) (JNCC 2021).

After first being identified on the island in 2019, European storm petrels were confirmed breeding on the Isle of May in 2021 for the first time (NatureScot website). Atlantic puffins on the Isle of May showed an increase in numbers between Seabird 2000 (42,000 AOB) and 2003 (69,300 AOB) but had decreased to 39,200 AOB in 2017 (JNCC 2021).

The Firth of Forth used to be a stronghold in Scotland for the roseate tern, the rarest breeding seabird in Britain (RSPB website), however, these have seen a variable, but steady decline since the late 1980s; competition with herring gulls for nesting habitat is thought to be a significant factor in the decline of the species at the Forth Islands.

Along the English coast, between Berwick-upon-Tweed and just north of Flamborough Head, are two of the most important seabird breeding sites at Farne Island and Coquet Island, with other colonies present including Holy Island and Long Nanny, Marsden Bay, South Gare and Filey North Cliffs. In contrast to numbers in the Firth of Forth, Coquet Island supports one of the largest breeding colonies of roseate terns, with 122 AON recorded in 2019, compared to 94 AON in 2006, this population, while fluctuating, showing an overall increase. The increase has been attributed to a programme of conservation including the creation of shingle terraces and the introduction of nest boxes but this may be to the detriment of other colonies, with the birds abandoning them in favour of Coquet (JNCC 2014).

Coquet Island also supports one of the two largest colonies of Atlantic puffins in England, the other is Farne Island, also in Regional Sea 1, which between them, held 95% of England's

Atlantic puffins during the last census. In the intervening period, the population has fluctuated, showing a decrease of around one third immediately after Seabird 2000, with some recovery by 2008, a decline in 2013, but an increase in 2019 (25,029 AOB). The Farne Island colony, a larger colony than Coquet, has also fluctuated with the most recent count (2019) recording 43,753 AOB, a decrease of 21% since Seabird 2000.

A1a.5.8 Seabird distribution at sea

Seabird distribution and abundance in the northern and central North Sea varies throughout the year, with offshore areas, in general, containing peak numbers of birds following the breeding season and through winter. Seabirds are distributed closer inshore during the breeding season, foraging closer to coastal breeding colonies in spring and early summer (see Table A1a.5.7).

Table A1a.5.7: General seabird distribution at sea in the Regional Sea 1 area

Month	General distribution
January	Common guillemot and razorbill are abundant in the Moray Firth and close to the coasts of eastern Scotland and northern England. Common guillemots return to Shetland waters. Herring and great black-backed gulls most frequently seen in the Moray Firth and off the eastern coast of Britain. Glaucous gulls reach an annual peak in the northern North Sea. Although commonest off Shetland, fulmars are present in high numbers, in most offshore areas of the northern and central North Sea, with spring migration in January in most years. Breeding birds can attend nest sites from early winter, but as this species can forage vast distances, nest attendance during this time may be sporadic. .
February	Main concentrations of common guillemots present in Moray Firth and Firth of Forth, birds also around the southern half of Shetland. Important numbers present off most of Scottish coast and Silver Pit. Atlantic puffins present in large numbers and widely distributed in northern North Sea. Adult northern gannets returning, with the areas off south east Scotland and north-east England important at this time. Herring and great black-backed gulls most common off east coast of England. Spring migration of Manx shearwater (Feb-Mar).
March	Common guillemots and Atlantic puffins return to the vicinity of their colonies. Razorbills present in Outer Silver Pit area. Main concentrations of black-legged kittiwakes in northern North Sea, off Orkney and Shetland, and more northern gannets return. Highest densities of northern fulmar present off main breeding areas, but many also present in central North Sea. Herring and great black-backed gulls from Norway return north-eastwards, fewer birds seen off the east coast of England. Gulls remaining in area are breeding birds and the Moray Firth remains important.
April	Breeding season for some seabirds begins at the end of the month. Many birds returning to colonies and pre-breeding feeding, both close to colonies and further offshore. Black-legged kittiwakes remain widely distributed particularly in north near main breeding areas. Large numbers of northern gannets found near colonies. Many immature northern gannets attend at colonies during summer (for shorter times than breeding adults). Great skuas return to breeding grounds in Shetland. Terns return in greatest numbers.
May	Start of breeding season for most seabirds, birds away from colonies likely to be immature. Areas including Shetland, Caithness, Aberdeenshire, Firth of Forth and Farne Islands, the most important for auk species. Birds still forage at distances further from the colonies than during chick rearing. Manx shearwater, European storm petrels and Arctic skua start arriving back in the northern North Sea.
June	Peak of breeding season. Majority of seabirds in coastal areas. Majority of the common guillemots in Shetland & Moray Firth, with important concentrations also found further south. Most breeding common guillemots do not feed further than 30km from their breeding site. At end of month, common guillemot chicks start to leave colonies & disperse into northern North Sea. Breeding razorbills feed closer to shore than common guillemots. Some adult northern gannets forage great distances from breeding sites, with many staying much closer, with immatures still present. Black-legged kittiwakes forage in similar areas as common

Month	General distribution
	guillemots, razorbill and Atlantic puffin. Breeding Arctic and great skua feed close to colonies.
July	The nesting season for many species of seabird ends in late June/early July, and adult and juvenile birds start to move south to wintering grounds or move to areas where they form moulting flocks. The area of the Shetland Basin, over some of the banks of the central North Sea and off the Moray Firth and Aberdeenshire coasts support large concentrations of birds than at any other time of the year. Birds widely dispersed so many areas of the North Sea hold vulnerable populations.
August	The highest number of auks occurs off east coast of Scotland and northern England. Black guillemots moult at this time and are found at specific moult sites concentrated in sheltered inshore waters around Shetland. Atlantic puffins disperse rapidly from colonies. Young northern gannets start to leave and are flightless for a short period with areas close to colonies containing vulnerable concentrations. Fledglings ringed on sea below colony at Noss moved on average 60km/day during the first 10-16 days. Autumn migration of Manx shearwater.
September	Distribution of auks spreads outwards into North Sea. Inshore areas off the east coast of Scotland and north-east England remain important for birds, but the width of the area away from the coast is greater than in August. The sea off the Scottish and north-east English coast between Moray Firth and Barmade Bank of importance to guillemot. Largest concentrations of razorbills found off Moray Firth (and the inner area of the Firth also important for Manx shearwaters) and east of the Forth and Tay, these areas are also important for Atlantic puffins. Great skuas become widespread in North Sea as they leave their breeding sites and move south. Great black-backed gulls move across the North Sea from Norway and found off east coast of England. Northern fulmar numerous and widespread across most of northern and central North Sea. Peak autumn migration of northern gannet.
October	Southward shift in guillemot and razorbill populations, however the inshore band off Scotland and northern England still hold the largest numbers. Atlantic puffins found in offshore areas, with areas in central North Sea holding the most birds. Black-legged kittiwake distribution moves south and large numbers of birds found off Yorkshire and the Moray Firth. Small numbers of little auks arrive in northern North Sea. Northern fulmars remain common throughout most of the northern North Sea.
November	Areas off eastern coast of Britain remain important for guillemots and razorbills. The east coast of Scotland holds relatively few birds compared to other times of the year, with the exception of the Firth of Forth and its approaches. Another important area is off north-eastern England, stretching east to the Dogger Bank and south to the Outer Silver Pit. Flocks of black-legged kittiwake found around fishing fleets in the Fladen Ground and several winter visitors become more common in northern North Sea: an obvious change is the arrival of gulls in offshore waters, with herring gulls from Norway moving south-west across the North Sea to areas including the Fladen Ground.
December	Large numbers of guillemots close to coasts, with the most important area being the southern shore of the Moray Firth. Main area for Atlantic puffins is Outer Silver Pit, but also present in central North Sea, off the north-east and east coasts of England and Scotland. Considerable numbers of little auk present in areas including the Dogger Bank and inshore towards Yorkshire. Northern fulmars commonest in northern North Sea.

Sources: Tasker & Pienkowski (1987), Skov *et al.* (1995), Furness (2015)

An understanding of the abundance and distribution of birds not only at colonies, but also within the marine environment, is important in assessing any potential interaction with offshore activities, that could then lead to an impact on that species (see Section 5.6 of the Environmental Report). Details of results from SEA-programme research, along with other

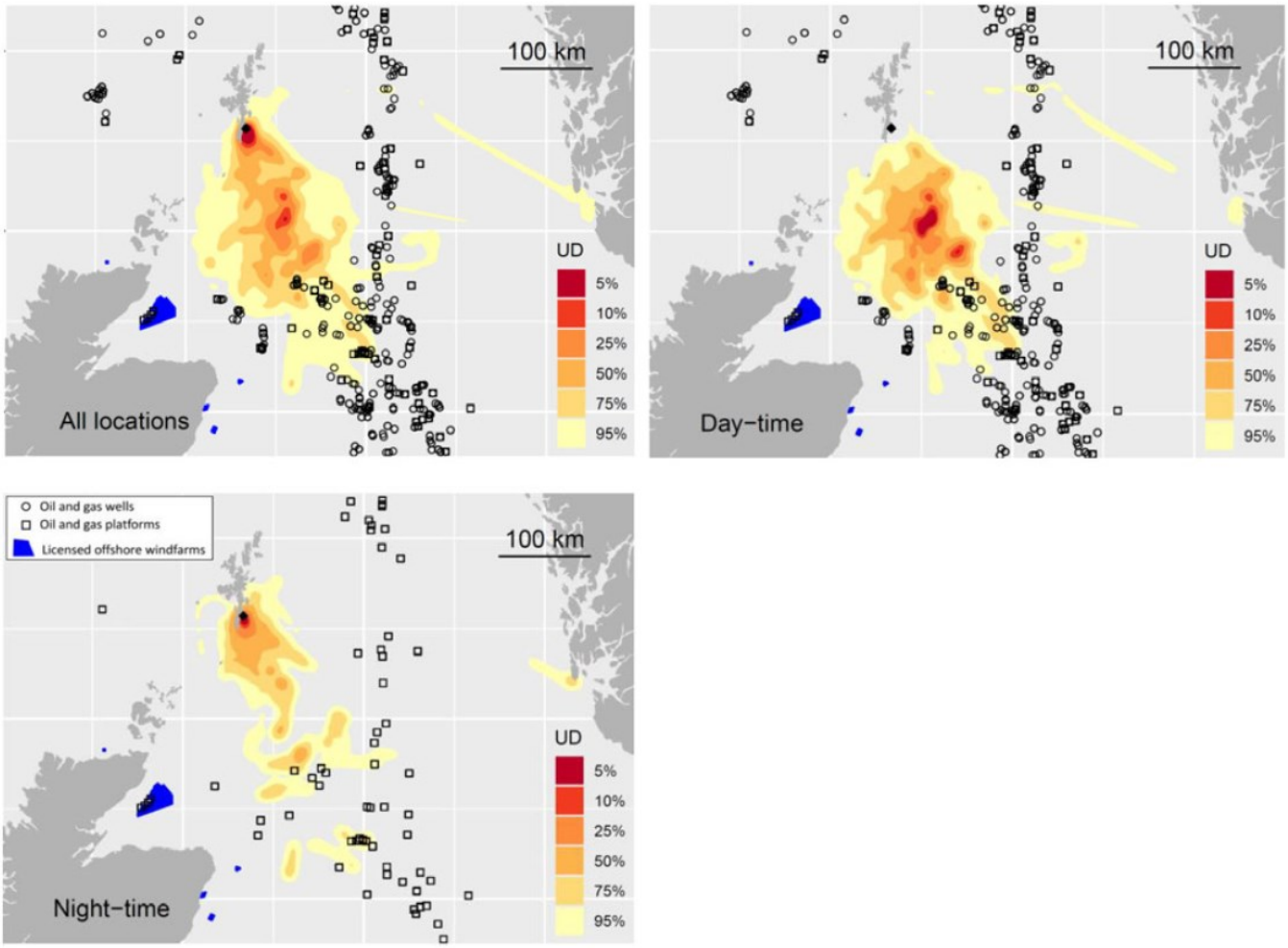
studies collecting data on bird distributions are described here, with details of other applicable research provided in other Regional Sea areas.

European storm petrels are, logistically challenging to monitor at colonies as is obtaining information on the distribution of this specie at sea. Forty-two birds were successfully tagged, over four breeding seasons (2014-2017), at their colony at Mousa, Shetland, their largest UK breeding colony (Bolton 2020). Birds were found to have a highly consistent usage of a relatively small area of continental shelf waters to the south of the colony (Figure A1a.52), in all breeding stages and in all years of the study. A further area located approximately 110km to the south of the colony also appeared particularly important during the brooding period. The median foraging range calculated across all breeding stages (159 km) greatly exceeded the previous estimate for the species by Thaxter *et al*, (2012) (65 km), but within the updated range by Woodward *et al*. (2019) (337km (mean max + SD)). Storm petrels from Mousa regularly ranged up to 300 km from the colony (Bolton 2020).

The consistent utilisation of shelf waters to the south of the colony was an unexpected result, as this represented a relatively small proportion of potential foraging area available, and while the drivers for this were out with the remit of the study, the author suggested the use of shallow seas may reflect avoidance of competition from conspecifics from colonies in the north-west UK and the Faroe Islands (e.g. Wakefield *et al.* 2017). It was further suggested that the foraging distribution may reflect the predictable distribution of certain abundant prey types, as the waters are seasonally stratified, with the area of highest usage centred over the “110 Miles Hole”, a trench that descends steeply to 243m and this feature likely to be associated with mixing of the water column (e.g. Neilsen & St John 2001, Scott *et al*. 2013 as cited inn Bolton 2020). It is therefore important to understand the diet and seasonal shift in prey choice and prey distribution in order to understand the distribution pattern observed in birds, this having implications for seasonal and longer-term shifts in distribution (Bolton 2020).

A limitation of the study was that, although the species has a protracted breeding season (birds attend the colony from late May to November), no information of marine distribution before mid-July or from the start of September was available (Bolton 2021).

Figure A1a.5.2: Marine distribution of European storm petrels

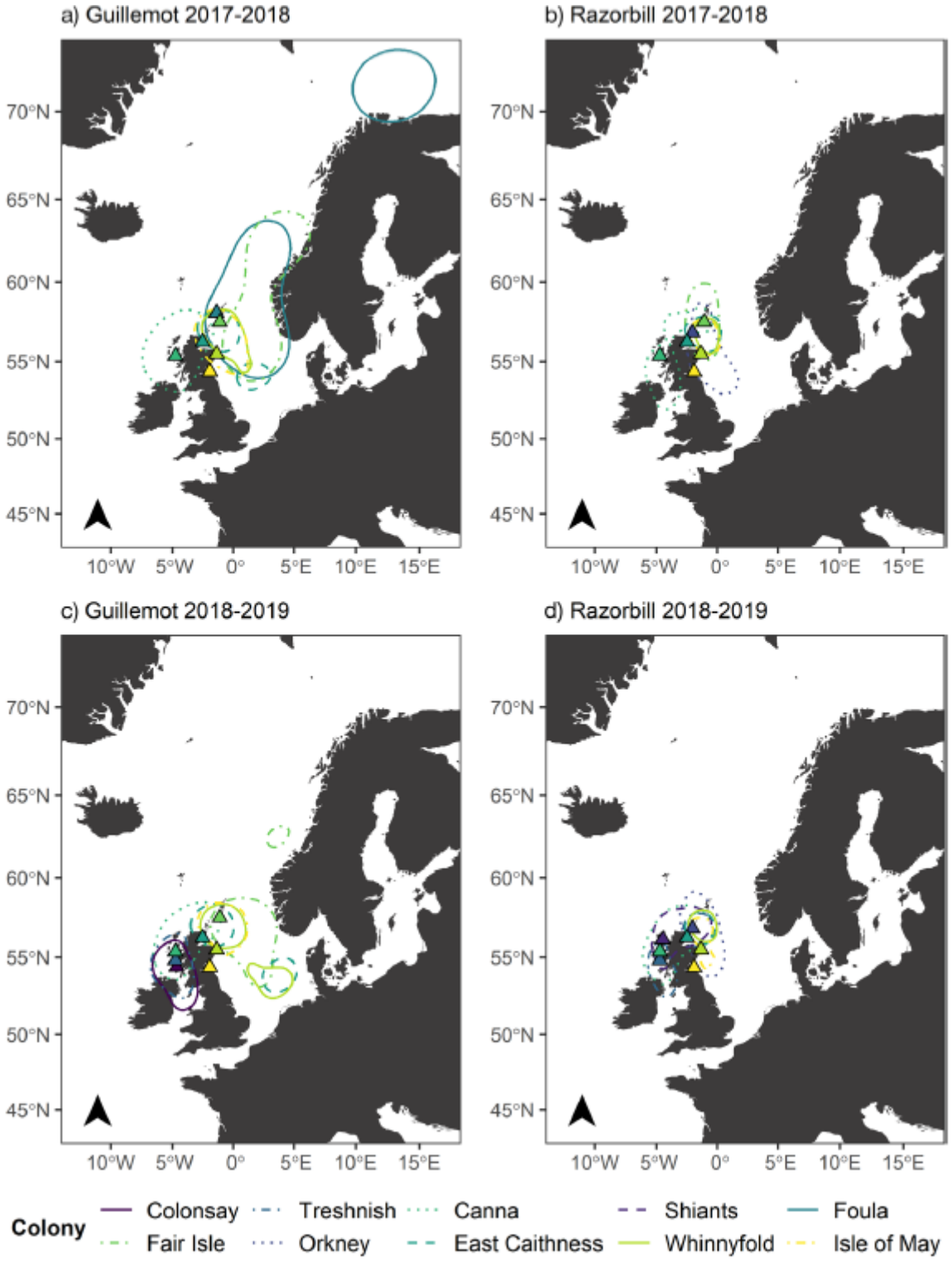


Notes: Distribution over an entire 24-hr cycle (upper left panel), during daylight hours (upper right panel) and at night (lower left panel), active (drilling or operating) oil and gas wells (circles – the close proximity of some wells does not allow visual separation of all wells at the plotted scale), platforms (squares) and licensed offshore windfarms (note, Scotwind information not shown here). The breeding colony is shown as a black diamond.
Sources: Bolton (2020)

There has been recent research on the movements of auks (guillemot, and razorbill) during the non-breeding season (Buckingham *et al*. 2022) (see Figure A1a.5.3 and A1a.5.4); tags have been deployed over three years (2017-2019) at a number of colonies throughout the UK and showed relatively short distance movements during this period. Guillemots showed generally high levels of segregation among breeding colonies. During moult, two areas (off the north coast and off the west coast) were commonly used by multiple colonies with the north coast populated by birds from the northern and eastern colonies (Fair Isle, Foula and East Caithness, Whinnyfold and Isle of May respectively) and the west coast populated by the birds from the western colonies (Colonsay, Treshnish and Canna) (Buckingham *et al.* 2022).

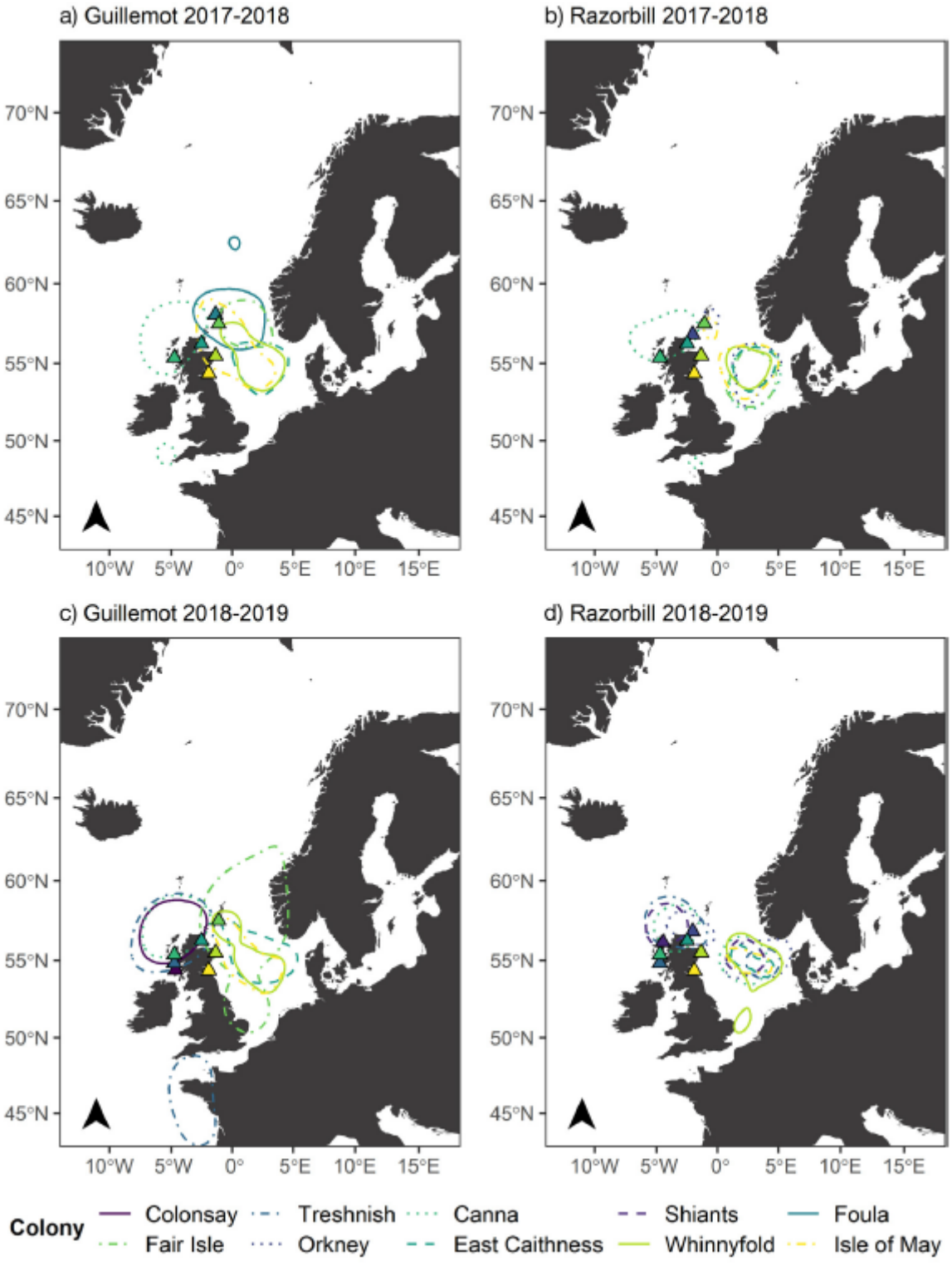
During mid-winter, guillemot core colony distributions were located around the coasts of Scotland, throughout the North Sea, off the south-west coast of England and in the Norwegian Sea. Only a small number of individuals appear to have carried out a moult migration, indicated by longer distance movements to higher latitudes, before returning south for the winter.

Figure A1a.5.3: 50% kernel density contour outlines of common guillemot and razorbill during post-breeding moult - 2017-2019



Notes: Post breeding moult period was 16th Aug – 15th Sept. Colony locations are depicted by triangles, with colours matching the distribution. Source: Buckingham *et al*. (2022)

Figure A1a.5.4: 50% kernel density contours of common guillemot and razorbills during mid-winter – 2017-2019



Notes: Mid winter was defined as 6th Dec-5th Jan, colony locations depicted by triangles with colours marching the distribution. Source: Buckingham *et al*. (2022)

The post-breeding moult distribution for razorbill was more contracted that that of guillemot and razorbill showed more mixing among breeding colonies. Core colony distributions were located throughout the coastline of mainland Scotland, around Orkney and into the central North Sea with two commonly used areas identified: one, located in the northern North Sea,

was used by birds from all tracked colonies with the second located off the west coast of Scotland, this used by birds from west coast colonies (Buckingham *et al.* 2022). Core colony distributions in mid-winter were located off the north coast of Scotland, in the central North Sea and in the English Channel with two commonly used areas, one off the north coast of Scotland and one in the central North Sea. They generally showed less individual variation in moult migration than that seen in guillemot, instead tending to migrate to their wintering grounds (Buckingham 2022)

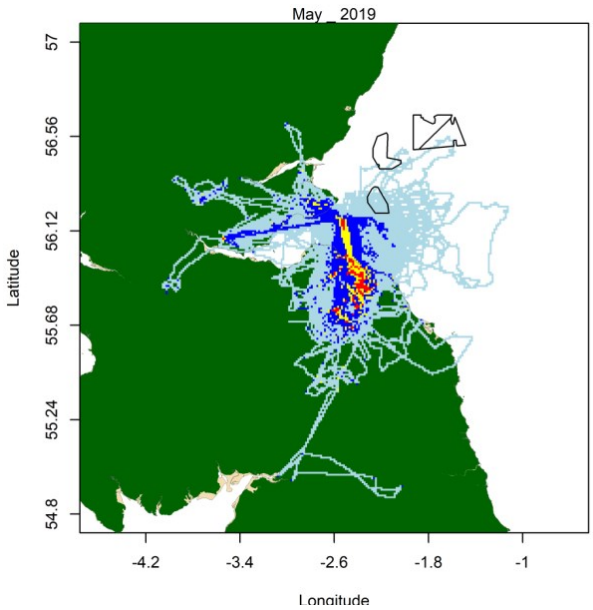
As part of the SEA-programme of research, a study was initiated in 2019 to tag and track lesser black-backed gulls from three breeding sites within the Forth Islands SPA (Isle of May, Fidra and Graigleith) in order to understand the distribution of this species throughout the area, which could result in potential interaction with offshore wind farms (Clewley *et al*. 2022). Data analysis focused on movements of birds in the breeding season, however, data was also available out with this season; due to the global pandemic, the project has been extended to include data collection during the 2022 breeding season, with final analysis and a final report to be issued thereafter. Tagged birds (along with a control group of untagged birds) were also fitted with colour-rings for subsequent field identification.

In 2021, and similar to that seen in 2019 and 2020, birds tracked from within the Firth of Forth SPA, predominantly used onshore sites to forage with a mean (±SD) foraging trip duration in 2021 of 10.9 ± 12.9 hours and the mean foraging range of 32.3 ± 15.3 km, lower than 2020 and comparable to 2019. Utilisation distributions (UD) were calculated for all individuals and each site using a time-in-area (TIA) approach which calculates cumulative time spent in each 1 km grid cell across the tracked areas. The overlaps between core (50%) and total (95% and 100%) UDs and OWF boundaries were assessed. Thirteen individuals from the Isle of May interacted with at least one of the OWFs and total spatial overlap for the 100% UD was 2.1%; the bird from Craigleith did not show any interaction with any OWF in 2021. The UDs over the study period are shown in Figure A1a5.5 below.

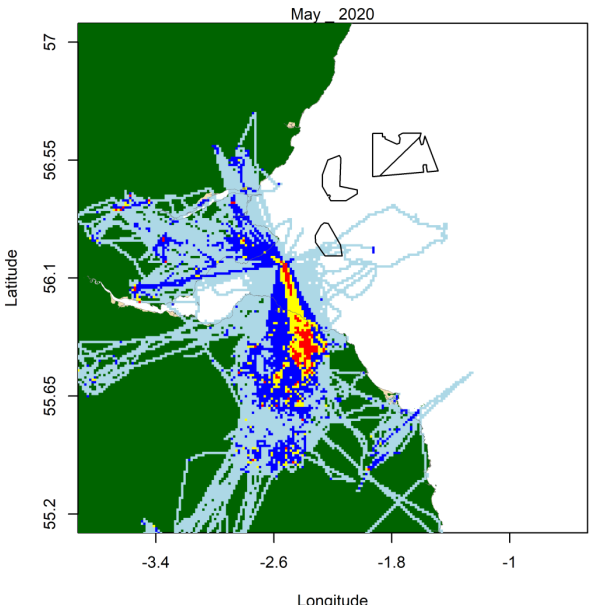
Although tracks showed a southerly bias to onshore areas, there was considerable variation between individuals from the Isle of May in preferred foraging locations and movements (Clewley *et al*. 2022). In 2021, offshore areas were used more compared with 2020; 13 of the 20 individuals tracked interacted with the areas of the OWFs through the breeding season. It is reported that Lesser Black-backed Gulls spend more time foraging offshore during chick provisioning (Camphuysen 1995, Thaxter *et al*. 2015) and therefore offshore use may be influenced by breeding success. Although to a lesser extent than 2020, it is also possible that food resources were still atypical inland during 2021 due to altered human behaviour during the Covid-19 pandemic (Rutz *et al*. 2020) which may have led to a change in resource availability and to individuals using novel resources; lesser black-backed gulls and other gulls have been shown to utilise terrestrial foraging, particularly during periods of the breeding season (e.g. Gyimesi *et al*. 2016, Isaksson *et al*. 2016). It will be important to consider both the inland habitats and resources being utilised and the breeding success of individuals to provide context to annual differences in the use of offshore areas in studies final report (Clewley *et al*. 2022).

Figure A1a.5.5: Utilisation distribution (UD) for all lesser black-backed gulls tracked from the Isle of May (Forth Island group) during 2019-2021

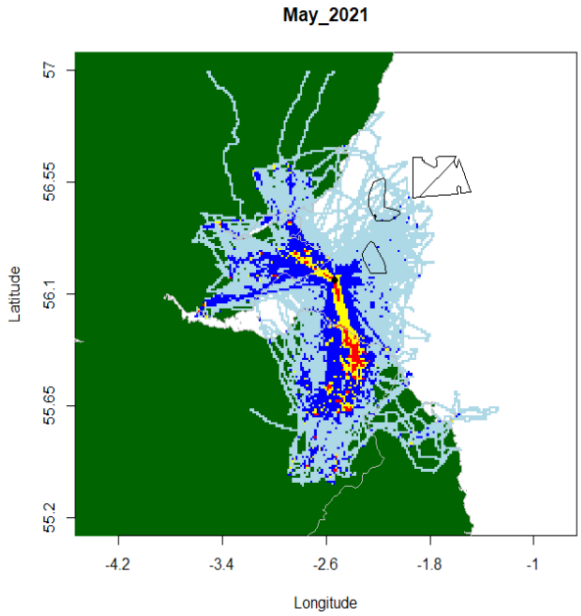
a)



b)



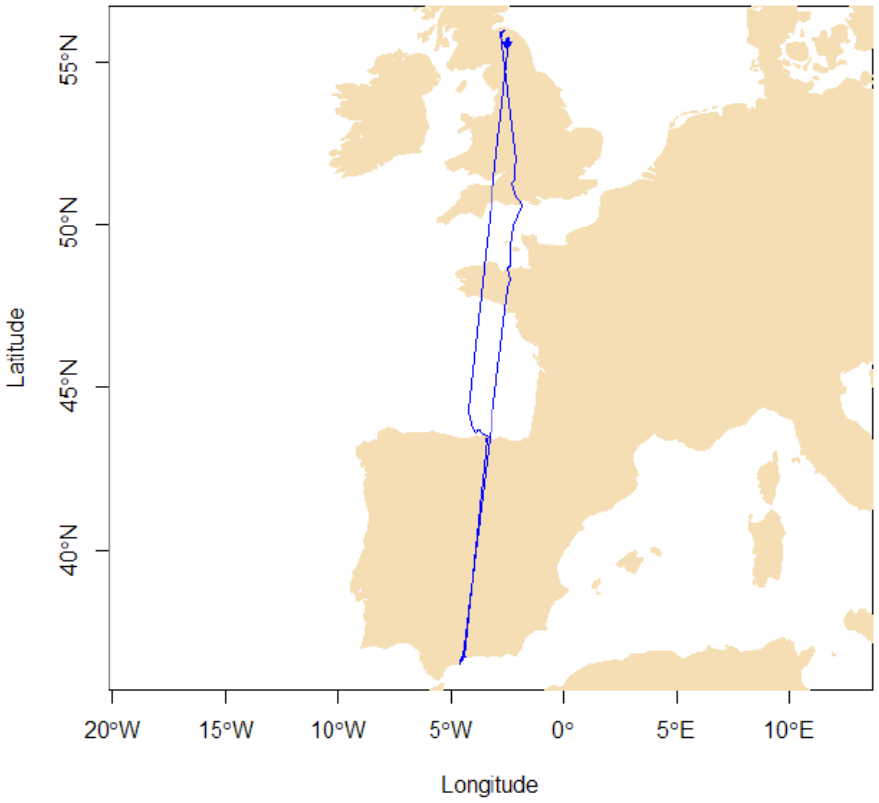
c)



Notes: UDs for lesser black-backed gull during 2019 a), 2020 b) and 2021 c). Offshore windfarm areas of interest are shown in black. Light blue = 100% UD, dark blue = 95%, yellow = 75% and red = 50%. Source: Clewley et al (2022).

After the 2020 breeding season, individuals showed a broad front migration into Europe, with their final wintering destinations varying between Northern Europe to Senegal in West Africa. The majority of individuals wintered in Southern Europe or North Africa (n = 11); routes taken were overland from the Firth of Forth, south through England and existing the UK through the western area of the English Channel (Figure A1a.5.6) and not south through the North Sea (Clewley *et al*. 2022).

Figure A1a.5.6: Movement of lesser black-backed full from Craigleith during the 2020/21 non-breeding period



Source: Clewley et al (2022).

Work has been undertaken to try and quantify species-specific foraging, diet and moult locations for three auk species (common guillemot, razorbill and Atlantic puffin) from the breeding populations on the Isle of May (St John Glew *et al.* 2018). Guillemots are known to undergo a complete post-breeding moult soon after leaving the breeding colony in July, at which time they are flightless for between 25 and 80 days (Thompson *et al*. 1998); regrowth is complete by the end of September. Birds from the Isle of May also start a partial pre-breeding moult in October, back into summer plumage, which is completed by the end of December; the birds are not flightless during this time, as it is just the head and cheek feathers that are replaced. Razorbill moult is similar, although the post-breeding moult starts earlier than guillemot and the pre-breeding moult starts later; adults spend several months longer in winter plumage compared to guillemots (Harris & Wanless 1990, Wernham *et al.* 2002). Atlantic puffins also undergo a complete replacement of the flight feathers, when they are flightless, however, the timing of this appears to be more variable compared to guillemot and razorbill, occurring any time between September and March (Harris *et al*. 2014); the partial pre-breeding moult where the black feathers of the winter face are replaced by white ones, occurs immediately prior to the birds returning to the breeding colony in March.

Many studies on bird distribution focus on the breeding season, when birds are limited to some extent in the distances they forage, having to return to the nest. It is however, also important to understand distribution outside of the breeding season, with areas of moult particularly important as this is when birds are flightless. Using a combination of techniques (bird-borne data loggers and isoscape assignment geolocation – which have limitations and associated errors, see St. John Glew *et al*. 2018 for detail), it was suggested guillemots likely underwent a moult within the southern North Sea, Atlantic puffins off the east coast of Scotland and razorbill along the east coast of England (during the post-breeding body and secondary feather growth) and into the southern North Sea (pre-breeding cheek feather growth), this suggesting a shift in foraging locations during different feather moults (St. John Glew *et al*. 2018). In terms of diets

during the moult, the results from this study suggested that the three auk specie have different winter diets, during different feather moult periods, suggesting trophic level segregation could be a mechanism to reduce interspecific competition outside the breeding season (St. John Glew *et al*. 2018). Understanding individual differences and flexibility in foraging behaviour and diet during the moult, can lead to the identification of important regions, information that can inform marine spatial planning and conservation strategies (St. John Glew *et al*. 2018).

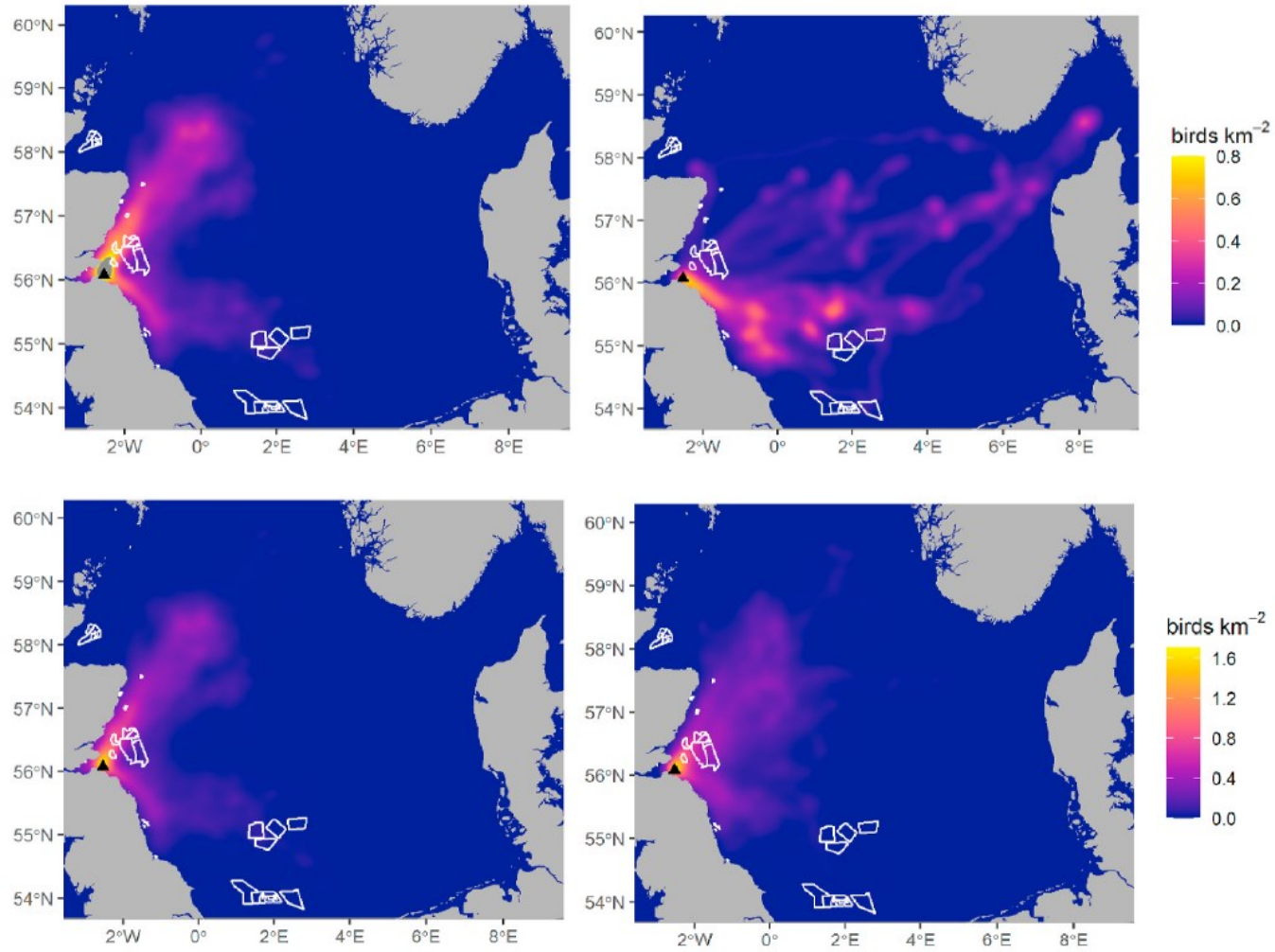
There has been several SEA-programme funded research projects on the northern gannets from Bass Rock, the most recent of these looking at the breeding season distribution of both male and female birds and the migration movements of adults and juveniles after the breeding season (Lane *et al*. 2020, 2021, Pollock *et al*. 2021).

Examination of data from gannets tagged at Bass Rock from the pre-egg laying period (April, years 2017-2019) and while attending chicks (June-August, 2015-2019) found birds made significantly longer (up to 2.5 times longer on average) and further (1.5 times longer on average) foraging trips during pre-hatching periods than chick rearing. Females also made significantly longer trips than males and while both sexes flew higher when actively foraging than when commuting, females were found to be flying higher than males during these activities (Lane *et al*. 2020). Irrespective of sex, the distribution of birds in flight at sea was much more diffuse during the pre-hatching period than during chick-rearing. This resulted in much higher peak densities of birds in flight around the Bass Rock during chick-rearing than pre-hatching (Figure A1a.5.6) and in addition, densities were highest along the coast to the south east of the colony during the pre-hatching period and to the north-east of the colony during chick-rearing; this resulted in higher densities of birds within the proposed wind farm sites in the outer Firth of Forth during chick-rearing compared to pre-hatching, particularly females. Although within the mean max (+1SD) breeding season foraging range of northern gannets (509km, Woodward *et al*. 2019), densities of both sexes were relatively low at other offshore wind farm sites in the region (Figure A1a.5.7).

A sex-difference in colony attendance was also evident; females were found to spend a greater proportion of time at sea than males, particular prior to chick-hatching, (new and additional nest material was solely provided by males, and males had a greater role in defending the nest site) and made consistently longer foraging trips than males in terms of duration and distance travelled. Males were found to forage in more mixed waters, whilst females foraged in more stratified waters (Lane *et al*. 2020, Cleaseby *et al*. 2015b) diving to greater depths than males. Females were found to fly at greater heights than males, particularly during periods of active foraging; additional height would provide additional dive momentum, to attain depth, penetrating further beneath the water surface (Lewis *et al*. 2002 Garthe *et al*. 2014, Cleasby *et al*. 2015).

There is a general lack of data on movements during the non-breeding season (there needs to be effective long term attachment of tagging device to encompass period of moult for example, but which will not affect the fitness of the bird), and generally studies focus on adult birds, with data lacking on movement of juvenile birds. As part of the work at the Bass Rock, juveniles were also tagged in order to look at post-fledgling movements and migration of juveniles (Lane *et al*. 2021) and to look at both adult and juvenile migration movements (Pollock *et al*. 2021).

Figure A1a.5.7: Estimated density of male and female northern gannets in flight, tracked from Bass Rock



Notes: Left = Male, Right = Female, northern gannets in flight (birds km^{-2}) tracked from Bass Rock (black triangle) during (top) pre-hatching and (bottom) chick rearing stages of the breeding season. Wind farms are outlined in white. Note different scales for densities pre-and post hatching. Source: Lane *et al*. (2022).

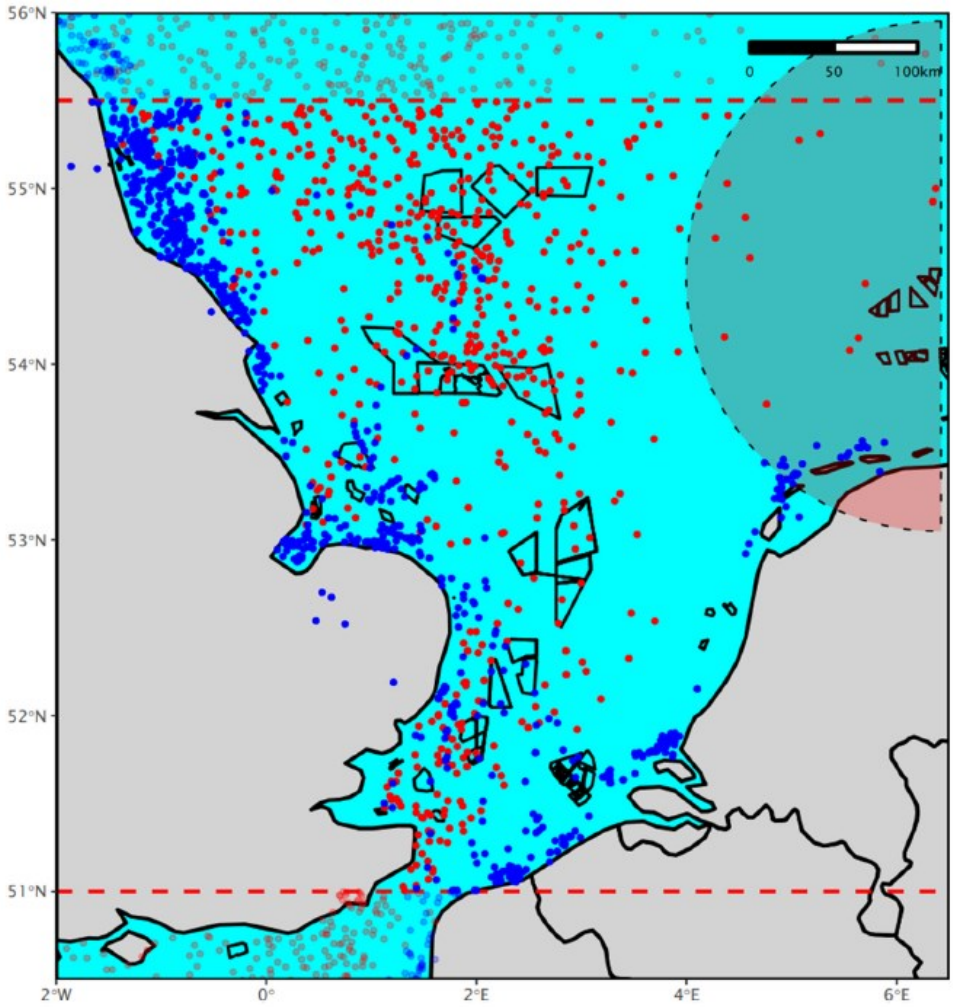
About 60% of gannets die within their first year at sea (Wanless *et al*. 2006), data from the juveniles tagged at Bass Rock suggested a high proportion of this mortality occurs within a short period after fledging (almost one-third of juveniles died within 2 months of leaving the colony and over half of this (60%) occurred close to the colony within the first few days at sea; juvenile mortality was often associated with uncertainties in migration, with abrupt, often repeated changes in bearing within the north sea evident and there was no evidence of juveniles following adults (Lane *et al*. 2021). The Canary Current Large Marine Ecosystem[8] (CCLME) off the Atlantic coast of West Africa was the destination of both juveniles and adults. Juveniles reached the area taking a more direct route, staying close to the coast throughout most of their migration. In contrast, adults spent additional long periods over areas further offshore.

Focusing on the distribution of birds in southern North Sea, Pollock *et al*. (2021) analysed the data from the juvenile and adults tagged at Bass Rock. The authors applied a “high risk area” in the southern North Sea, defined as between 55.5ºN and 51.0ºN since, as many northern

[8] The CCLME is a highly productive upwelling area (the mixing of nutrient-rich cool water with warm surface layers fuelling primary production) and supports communities of upper trophic-level consumers, resulting in it being a hotspot for migratory seabirds. The area also attracts some of the highest fishing effort (Grecian *et al.* 2016).

gannets migrate south through the Strait of Dover on autumn migration and the any has a number of operational and proposed OWF. The upper limit of the high risk area was far enough from the colony that bird that entered could be assumed to be on migration and the area was large enough (~500km between upper and lower limit) that differences between age classes could be detected (Pollock *et al*. 2021). Adults were found to have a much more offshore distribution compared to juveniles, being almost four times further away (i.e. adult = 106±61.5km, juvenile = 21.5km±22.4km) and, as a consequence, 11% of adult locations inside the high risk area appeared to fall inside OWF sites, compared to only 1% for juveniles (Figure A1.a.5.8). Comparing their findings with those from aerial surveys undertaken for OWF applications and ESAS data, pulses of gannet numbers appeared evident, with breeding birds from colonies such as the Bass Rock, and Bempton (e.g. Wakefield *et al*. 2013), along with birds from colonies further north, including Norway, wintering in (e.g. Furness *et al*. 2018) and migrating through, the North Sea, emphasising the southern North Sea's importance as a migratory bottle-neck for gannets, particularly during autumn (Pollock *et al*. 2021).

Figure A1a.5.8: Location estimates of adult and juvenile northern gannets during autumn migration



Notes: Adults (red, n individuals = 27), Juveniles (blue, n individuals = 11). Red dashed line indicates upper and lower limits of the designated high risk area, OWF sites indicated by black polygons. Translucent semicircle with black dashed outline shows the mean estimated error (167km) for adult GLS locations, whereas the error associated with GPS-PTT for juveniles (<1500m) does not exceed the size of the plotted blue points. Source: Pollock *et al*. (2021).

The natural nesting habitat of black-legged kittiwake is normally narrow ledges on steep nearshore cliffs (Cramp & Simmons 1983), but it also appears to utilise man-made structures such as buildings and bridges (Turner 2002; Coulson 2011). In Norway for example, there is an increasing urbanisation of the species, and in the UK, the "Tyne Kittiwakes" are a well known feature of the Tyne Bridge, and there is an estimated 120 pairs nesting on the kittiwake tower at Gateshead, an artificial nest site purpose built for the birds in an attempt to relocate them away from buildings that were being redeveloped. There is also evidence that black-legged kittiwakes, are nesting on offshore installations[9] in the UK, Norwegian and Dutch sectors of the North Sea (e.g. Camphuysen & Leopold 2007, Geelhoed *et al*. 2011, Chistensen-Dalsgaard *et al*. 2019 - see also JNCC advice note, Thompson 2021) however, the full extent of this and the numbers of birds involved, is unknown. As central place foragers during the breeding season, black-legged kittiwakes are restricted in their foraging ranges, limited by the need to return to the nest; nesting on offshore installations can therefore give them access to different foraging areas, and can reduce predation pressure they may be exposed to at the coastal colony. In a study conducted in the Norwegian and Barents Sea in 2019, the birds were found to inhabit variety of surfaces on offshore installations, including ledges and the tops of shafts, (Figure A1.a.5.9) and nesting material comprised mainly dried kelp and pieces of plastic debris (Christensen-Dalsgaard *et al*. 2019).

Figure A1a.5.9: Example of black-legged kittiwake breeding locations on offshore installations

Source: Christensen-Dalsgaard *et al*. (2019).

A1a.5.9 Seabird vulnerability to pollution

The vulnerability of seabird species to oil pollution at sea is dependent on a number of factors and varies considerably throughout the year. The Offshore Vulnerability Index (OVI) was

[9] When production ceases and the production facilities are being decommissioned, unless the facilities are a candidate for derogation (see OSPAR Decision https://www.ospar.org/documents?v=6875, and BEIS (2018) guidance https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/760560/Decom_Guidance_Notes_November_2018.pdf) then there is a requirement to completely remove these from the seabed/marine environment

developed by JNCC and was used to assess the vulnerability of bird species to surface pollution. This index considered four factors: amount of time spent on the water; total biogeographical population; reliance on the marine environment; and potential rate of population recovery (Williams *et al*. 1994, see JNCC 1999). In 2015 work was undertaken to develop a revised index, published as the as the Seabird Oil Sensitivity Index (SOSI) (Webb *et al*. 2016).

The SOSI was developed based on previous indices by Williams *et al*. (1994) and method refining according to Certain *et al*. (2015) using seabird survey data collected from 1995-2015 from a variety of survey techniques (boat-based, visual aerial and digital video aerial). This survey data was combined with an individual seabird species sensitivity index value, these values being based on a number of factors considered to contribute towards a species sensitivity to oil pollution such as habitat flexibility (a species ability to locate to alternative feeding sites), adult survival rate and potential annual productivity. The SOSI is presented as a series of monthly UKCS block gridded maps, with each block containing a score on a scale of low to extremely high; these scores indicate where the highest seabird sensitivities might lie, if there were to be a pollution incident.

For some months, data may not be available and data availability is highlighted by Webb *et al.* (2016) as a wider issue for the index which requires extended data coverage to be improved. JNCC devised guidance to help reduce coverage gaps (JNCC 2017), the first step of which is to utilise data from adjacent months, and, if data cannot be supplemented by using Step 1, Step 2 looks to use data from adjoining blocks. If neither step can be used to populate blocks which lack coverage, then these should be highlighted to denote no coverage.

Figures A1a.5.10a and b below shows the monthly seabird vulnerability for the Regional SEA 1 area and each of the Regional SEA areas have their respective seabird vulnerability maps.

Regional Sea 1 has a number of areas with extremely and very high bird sensitivity to oil pollution, some areas being highly sensitive for most months of the year, e.g. Moray Firth, Firth of Forth and areas down the eastern coast of Scotland. Highest sensitivity occurs in coastal waters during the breeding season, May-July, when the adults have returned to colonies and utilise coastal waters for foraging. Birds that winter in the UK and do not migrate can return to colonies throughout the year, with numbers augmented by birds that breed elsewhere and winter in the UK, represented here by higher sensitivities during December; breeding birds can also start returning to nest sites as early as March and April. For several months of the year, there are extensive data gaps.

Figure A1a.5.10a: Monthly seabird oil sensitivity index scores for Regional SEA 1 (Jan-Jun)

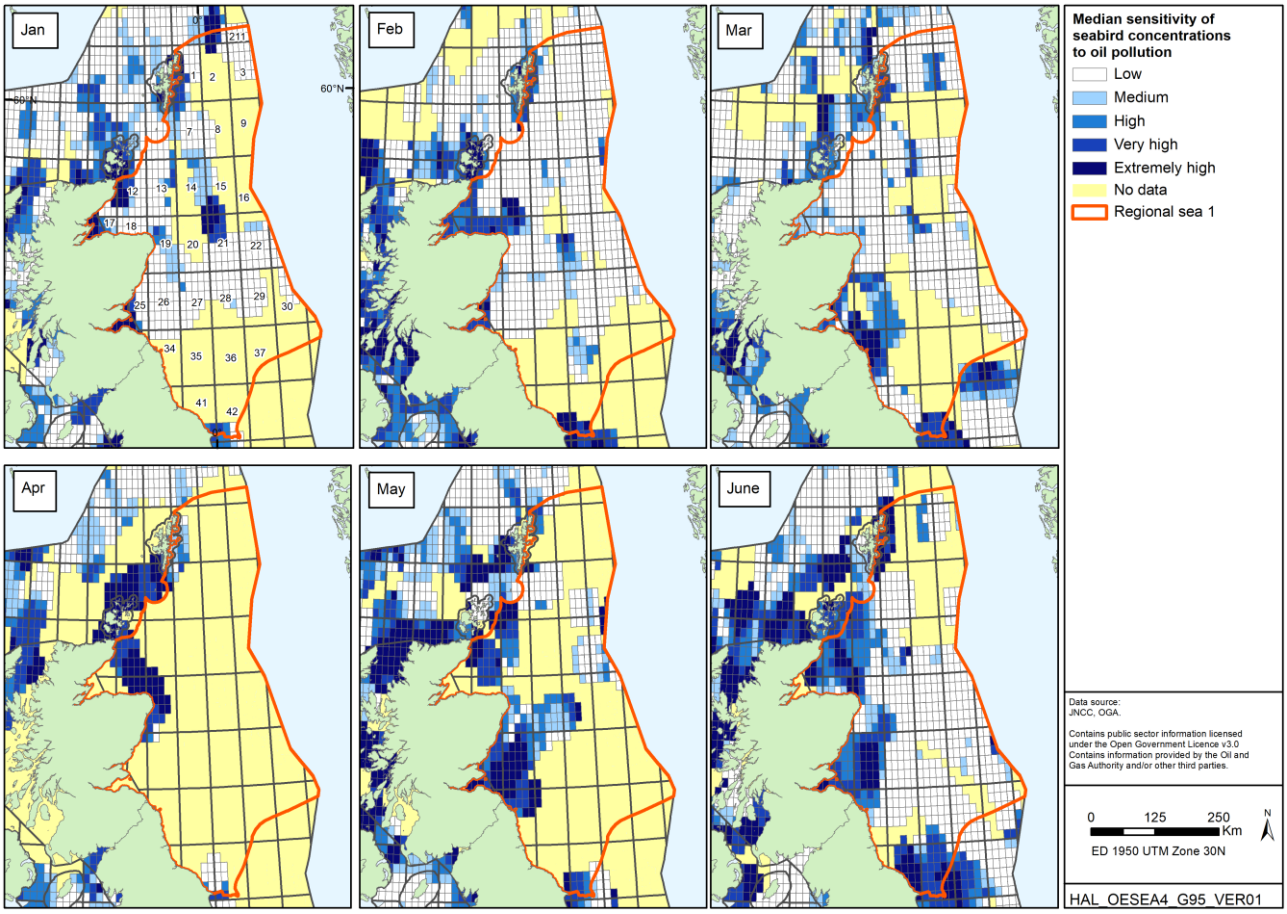
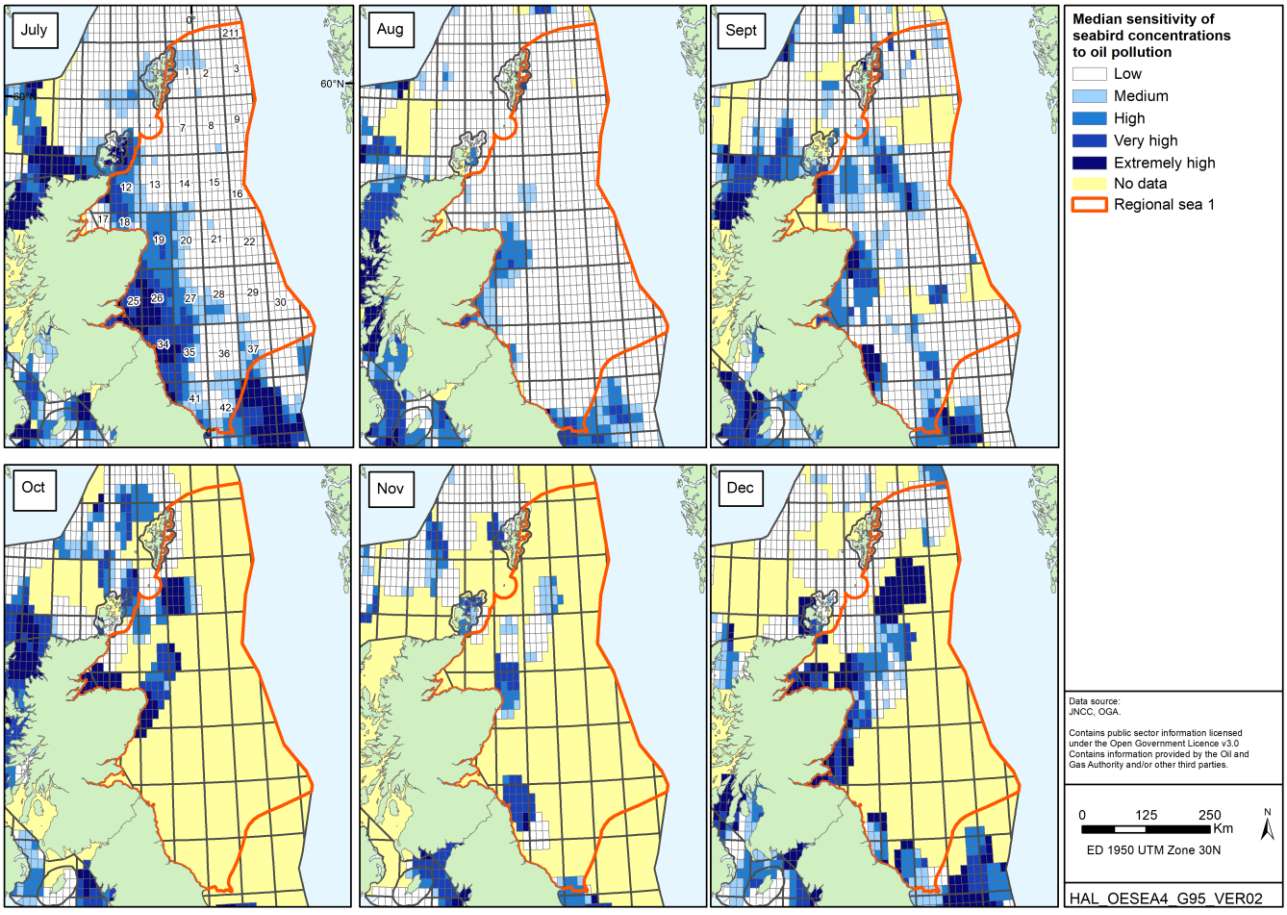


Figure A1a.5.10b: Monthly seabird oil sensitivity index scores for Regional SEA 1 (Jul-Dec)



A1a.5.10 Waterbird species and distribution (breeding, wintering and migratory)

There is a diverse array of habitats throughout Shetland, the eastern coast of Scotland, including its many firths and the north-east coast of England, including wet grassland, shingle, sand dune, saltmarsh and intertidal mud and sand flats, which support breeding and wintering populations of waterbirds; some areas support bird species and assemblages in internationally important numbers.

Of the important coastal locations of this Regional Sea designated as SPAs with waterbirds are designated features, the majority of sites are designated for over-wintering birds rather than breeding waterbirds, with a small number of exceptions, e.g. the Hermaness, Saxa Vord and Valla Field SPA includes breeding red-throated diver and Fetlar, which includes breeding dunlin and whimbrel. Table A1a.5.8 describes principal sites in this region for non-breeding waterbirds, all of which are designated as SPAs (for passage and wintering birds) and Wetlands of International Importance[10] (see Appendix 1j Conservation for details).

Table A1a.5.8: Important sites[1] for non-breeding waterbirds in Regional Sea 1

Site	Site total[2] (2019/2020)	5-year average[2]	Species (designated feature)
Dornoch Firth and Loch Fleet (numbers for Dornoch Firth)	25,712 (↓)	30,886	Greylag goose, wigeon, teal, greater scaup, oystercatcher, bar-tailed godwit, redshank, dunlin, curlew **Waterbird assemblage**
Cromarty Firth	38,769 (↓)	44,328	Whooper swan, greylag goose, wigeon, northern pintail greater scaup, red-breasted merganser, oystercatcher, bar-tailed godwit, curlew, redshank, knot, dunlin **Waterbird assemblage**
Inner Moray Firth (numbers for Inner Moray and Beauly Firths)	81,475 (↑)	70,014	Greylag goose, wigeon, teal, greater scaup, goldeneye, red-breasted merganser, goosander, oystercatcher, curlew, redshank **Waterbird assemblage**
Moray and Nairn Coast (numbers for Moray Coast)	3,905 (↓)	4,046	Pink-footed goose, greylag goose, wigeon, red-breasted merganser, oystercatcher, bar-tailed godwit, redshank, dunlin **Waterbird assemblage**
Loch of Strathbeg	23,908 (↑)	30,342	Whooper swan, pink-footed goose, greylag goose, (Svalbard) barnacle goose, teal, goldeneye **Waterbird assemblage**
Ythan Estuary, Sands of Forvie and Meikle loch (numbers for Ythan Estuary)	14,180 (↑)	11,124	Pink-footed goose **Waterfowl assemblage**
Montrose Basin	87,695 (↓)	98,470	Pink-footed goose, greylag goose, shelduck, wigeon, common eider, oystercatcher, redshank, red knot, dunlin **Waterbird assemblage**
Firth of Tay and Eden Estuary (numbers for Tay Estuary and separately for Eden Estuary)	16,514 (↑) 12,557 (↓)	18,360 14,470	Pink-footed goose, greylag goose, shelduck, eider, long-tailed duck, common scoter, velvet scoter, goldeneye, red-breasted merganser, goosander, oystercatcher, grey plover, sanderling, bar-tailed godwit, redshank, black-tailed godwit, dunlin **Waterbird assemblage**

[10] https://www.ramsar.org/about/wetlands-of-international-importance-ramsar-sites

Site	Site total[2] (2019/2020)	5-year average[2]	Species (designated feature)
Firth of Forth (numbers for Forth Estuary)	73,851 (↑)	80,372	Great crested grebe, Slavonian grebe, pink-footed goose, shelduck, wigeon, mallard, greater scuap, common eider, long-tailed duck, common scoter, velvet scoter, goldeneye, red-breasted merganser, oystercatcher, ringed plover, golden plover, grey plover, lapwing, red knot, bar-tailed godwit, curlew, redshank, ruddy turnstone dunlin, red throated diver **Waterbird assemblage**
Lindisfarne	72,542 (↑)	52,528	Whooper swan, greylag goose, shelduck, wigeon, common eider, long-tailed duck, common scoter, red-breasted merganser, ringed plover, golden plover, grey plover, sanderling, bar-tailed godwit, redshank, dunlin, light-bellied brent goose
Northumbria Coast	-	-	Purple sandpiper, turnstone
Teesmouth and Cleveland Coast (numbers for Tee Estuary)	18,197 (↓)	19,832	Shelduck, teal, northern shoveler, red knot, sandering, redshank, ruff added to site in 2020, along with breeding avocet **Waterfowl assemblage**

Notes: [1]Sites for non-breeding waterbirds in the UK as described in the WeBS annual publication and the JNCC SPA website, designated features as described in JNCC UK Natura 2000 spreadsheet, version dated 2019-10-31, and latest changes to sites webpage. [2]Site total and 5-yr average from WeBS report online (site total tab), https://app.bto.org/webs-reporting/principal.jsp, ↓↑ denotes decrease or increase from previous years site total
Source: Frost *et al.* (2021), https://www.bto.org/our-science/projects/wetland-bird-survey/publications

Much of the coastline between Berwick and Filey Bay in the south is rocky with relatively little marsh close to intertidal areas, although some sites support populations of national and international importance. Being on the major migratory flyway of the east Atlantic, the estuaries of Shetland and the rest of this coastline are important during spring and autumn migration with many birds stopping and staging here as they move to and from wintering and breeding areas. At times of severe cold in mainland Europe estuarine and inter-tidal areas of the UK (especially on the west) can become more important as cold weather refuges. The variation in waterbird abundance and distribution throughout the year is described in Table A1a.5.9.

Waters off this region's coastline are very important for several species of wintering seaduck, including eiders off the Aberdeenshire coast and scoter (common and velvet), shelduck and long-tailed duck off the Moray Firth, Tay, Firth of Forth and Lindisfarne.

Table A1a.5.9: General waterbird distribution in the Regional Sea 1 area

Month	General distribution
January	Large flocks of eider in waters off eastern Scotland. Firth of Forth supports winter peaks of shelduck, large concentrations of common scoter present in Dornoch/Moray Firth. Large flocks of goldeneye present in waters off the Tweed, the Forth, Cromarty and Moray Firths. Moray Firth also supports large flocks of long-tailed duck, as does Scapa Flow. Great northern diver and black guillemot present in waters round Northern Isles with the latter species concentrated in shallow, sheltered waters.
February	Eiders remain in large numbers in waters off eastern Scotland. Peak numbers of long-tailed duck in Scapa Flow and large concentrations still present in Moray Firth. Moray Firth supports large concentrations of common scoter, velvet scoter, goosander and red-breasted merganser. Peak numbers of bar-tailed godwit in Forth along with important flocks of knot and redshank.

Month	General distribution
March	Marks start of return of many species to breeding grounds, intertidal areas become less important. Numbers of wading birds on estuaries decline. High Arctic nesting species, e.g. bar-tailed godwit, remain in UK sites later than more temperate species and important numbers remain at sites including Lindisfarne and Firth of Forth. Eiders move back towards breeding grounds and high numbers recorded on the Forth
April	Estuaries used by birds on passage from southern wintering grounds to northern breeding grounds. There are fewer feeding waders in terms of absolute numbers on British estuaries between April and June, although number of birds on passage is thought to be underestimated. Eiders continue to return to breeding grounds near the Tay, on Lindisfarne, on the Ythan and Shetland. Large numbers of brent geese still on wintering grounds.
May	Wildfowl and other waterbirds that have wintered on sites on this coastline return to breeding sites. Numbers of dark-bellied brent geese peak in May, before rapid departure. Migration of divers continues through the North Sea.
June	June is peak of breeding season, most migrant birds that spend winter on/pass through coasts of North Sea have returned to breeding grounds. Eiders, the only seaduck that breeds in any great numbers around the North Sea, are found at main colonies in Shetland, Aberdeenshire and Firth of Forth. There are few waders at estuaries compared to numbers that use these sites outwith the breeding season
July	Some species move to moulting sites after breeding, large concentrations of moulting shelduck found in south-eastern sector of North Sea, smaller concentrations found in Firth of Forth. Common scoter also undergo moulting migration. Largest concentrations found out with Regional Sea 1 but smaller concentrations found off Aberdeenshire, and north-east England. Flocks of moulting eider also found off Aberdeenshire, in Scapa Flow, Wyre Sound and off various areas around Shetland. After breeding, some species of waders return to estuaries and mudflats.
August	Start of main influx of wading birds and ducks into North Sea. Some may remain in area for winter, or stop to moult and/or feed before onward migration southwards. High numbers of redshank found at various sites, including Forth, Tay and Montrose Basin. Lindisfarne and Cromarty Firth hold large populations of bar-tailed godwit, high numbers of eider remain in Forth, off Aberdeenshire, in the Tay and around Lindisfarne. Common scoter numbers off Aberdeenshire peak during this month
September	Peak month for usage of North Sea estuaries. Lindisfarne supports large numbers of wigeon, eider and bar-tailed godwit. Eider present in important numbers in the Forth, Tay, off Aberdeenshire, and large migration of common scoter into Moray and Dornoch Firths. Firth of Forth important for bar-tailed godwit, curlew, redshank and great crested grebe. Large numbers of red-throated divers undergo wing-moult off Aberdeenshire coast and southern Moray Firth.
October	Firth of Forth holds large numbers of ringed plover, bar-tailed godwit and redshank. Large numbers of red-throated divers in wing moult present in Firths of Forth, Tay and off north-east Scotland. Influx of common and velvet scoters, and goldeneye. Large numbers of common scoter found in Dornoch/Moray Firth – and have velvet scoters associated with them (albeit in lower numbers). Firths of Forth and Tay and waters off north-east Scotland support large numbers of red throated divers. Area off the Tay holds large numbers of red-breasted merganser.
November	Some light-bellied brent geese move across from Wadden Sea to Lindisfarne. Knot also move westward to Lindisfarne and the Firth of Forth (and other areas on the south-east coast of England, e.g. the Wash). Immigration by more wading birds. Important flocks of turnstone appear on Shetland and Aberdeenshire coasts, while important sites for purple sandpipers include Shetland, Orkney, Aberdeenshire and the outer Firth of Forth. Large flocks of eider on the Tay, and concentrations found in Scapa Flow and goldeneye found in the Forth and Moray/Cromarty Firths. Long-tailed duck arrive in important numbers to the Moray Firth, but often feed offshore. This species also roosts offshore.

Month	General distribution
December	Lindisfarne and the Firth of Forth of importance to knot, important flocks of turnstone on coast of Shetland and Aberdeenshire, and of purple sandpipers around Shetland, Aberdeenshire and the outer Firth of Forth. Large flocks of eider on the Tay, Scapa Flow, goldeneye in the Forth and Moray/Cromarty Firth. Long-tailed duck continue to arrive in important numbers to the Moray Firth from breeding areas.

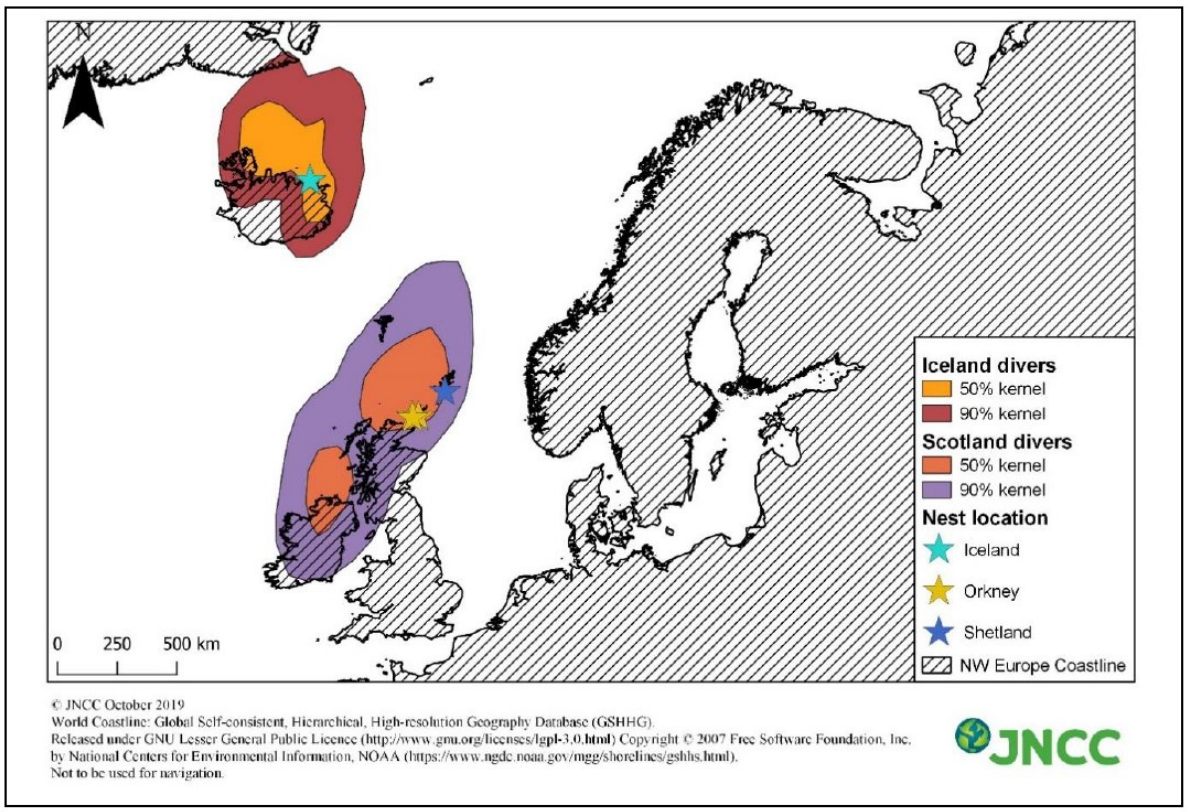
Source: Tasker & Pienkowski (1987), Skov *et al.* (1995)

Studies are looking at the spatial and temporal variation in foraging of breeding red-throated diver (Duckworth *et al.* 2021) (JNCC Red-Throated Diver Energetics Project, Duckworth *et al*. 2020, 2021). Breeding birds in Scotland, Finland and Iceland were tagged during the 2018 breeding seasons, the subsequent work seasons focusing on data tag retrieval, feather sampling, and data analyses. In Finland, the distance of the nests from the coast was greater (>10km) than birds from Scotland and Iceland (<10km); it is noted that many of the local acidic lochans nearby to Scottish sites were devoid of prey. Results from the project indicated birds breeding in Scotland (n=5) and Iceland (n=7) foraged in saltwater, while Finnish birds (n=7) foraged nearly exclusively in freshwater; a single Finnish bird whose nest was >15km from the coast, did forage in the marine environment at the start of the study period before returning to an entirely freshwater habitat for the remainder of the breeding season, although the reasons for this change were unknown. The maximum dive depth observed across all sites was 29.3m (Icelandic bird) with dives of *ca*. 24m and 27m recorded for Scottish and Finnish birds respectively; the majority of dives were typically shallow (94% of foraging dives recorded were <15m) (Duckworth *et al*. 2021). Finnish birds were also found to dive for longer, during longer bouts with more dives, than Scottish and Icelandic birds.

Animals foraging through the breeding season are thought to adapt their foraging effort to meet the increasing demands of the growing young, however, at all three sites, foraging effort did not change through the breeding season but prey selection did (the foraging time did not change, but proportion of benthic dives decreased as the breeding season progressed), suggesting the divers adapted their foraging strategy via prey selection, rather than increasing foraging trips/foraging intensity (Duckworth *et al*. 2021). Although results demonstrated that local environments could have an effect on foraging behaviour, in the absence of knowing precise foraging locations, linking foraging behaviour to such environmental influences/conditions such as tidal cycles, hydrographic features etc. could not be made. The authors also acknowledged the overall small sample size in the study limited their ability to make true large scale comparisons across the sites (Duckworth *et al.* 2021).

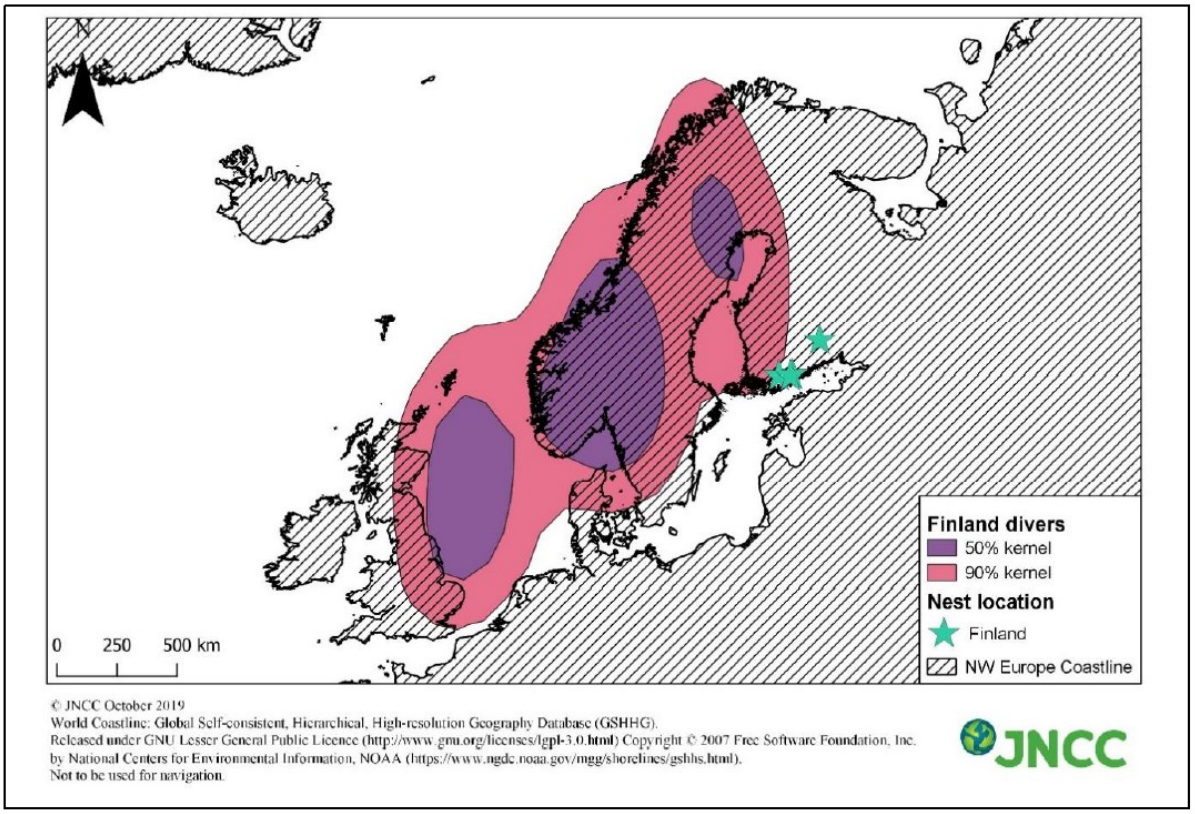
Data from ring recoveries (Duckworth *et al*. 2020), found Scottish and Icelandic birds remain close to their breeding grounds, wintering in north western Scotland/Ireland and northern Iceland respectively; ringing recoveries and GLS data suggests Scottish divers are not using Liverpool Bay (Duckworth *et al*. 2020) (Figure A1a.5.11). In contrast, birds tagged from Finland (n=4) moved westwards from the Baltic Sea, to Denmark, with two individuals moving into the North Sea (Figure A1a.5.12). Whilst a maximum dive depth (MDD) of 41m was recorded during the breeding season, most frequently MDD was only 2-6m and there was individual variation seen in the MDD (mean MDD remained relatively constant for Icelandic birds, but increased for Finnish and Scottish tagged birds), suggesting that individual birds may have different strategies and/or preferred foraging areas during the non-breeding season.

Figure A1a.5.11: Non-breeding season core area density and home range for Scotland and Iceland-tagged red-throated diver



Notes: Non breeding season (October 2018 to February 2019). Core use area (50% density distribution kernel) and home range (90% density distribution kernel). Scotland (n=4), Iceland (n=7). Source: Duckworth (2020)

Figure A1a.5.12: Non-breeding season core use area and home range for Finland tagged red-throated diver

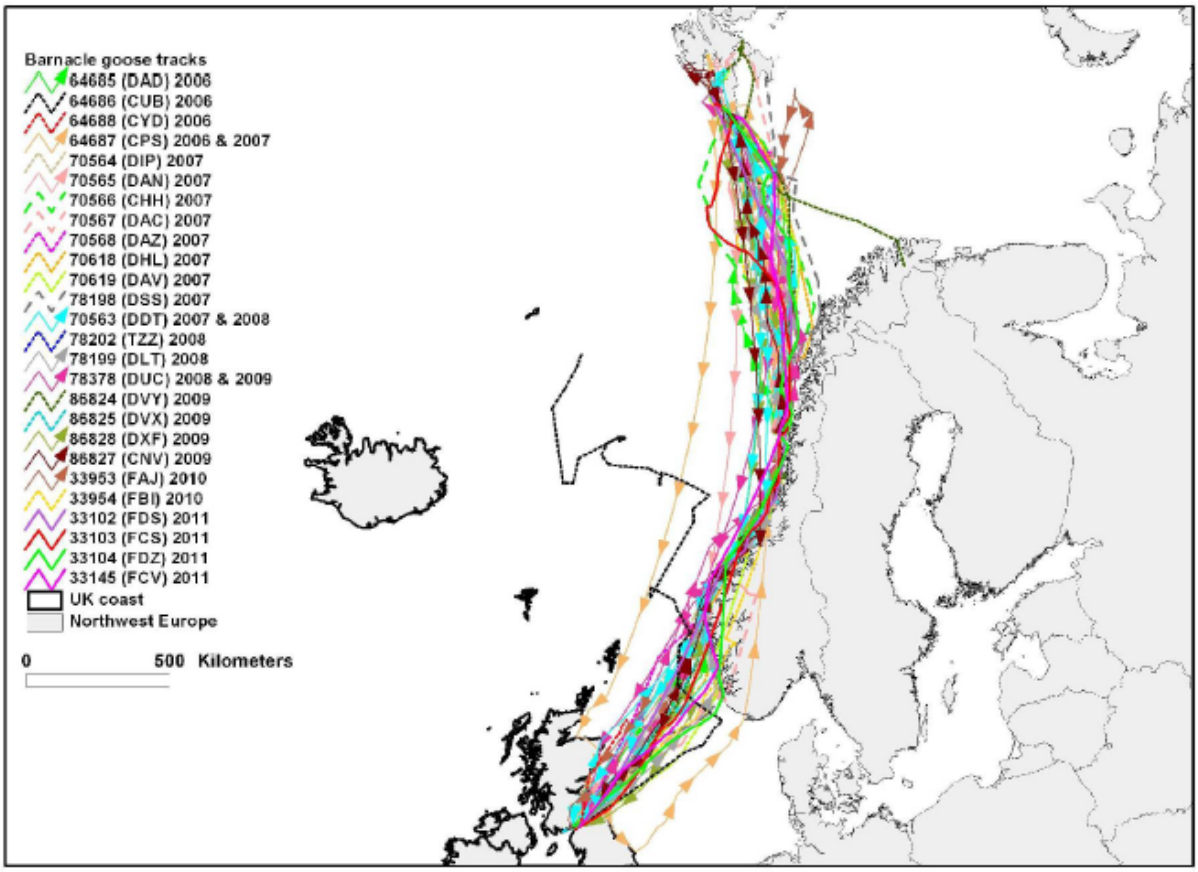


Notes: Non-breeding season (October 2018 to February 2019) core use area (50% density distribution kernel) and home range (90% density distribution kernel) for Finland-tagged birds (n=4). The true location of the birds is likely to be further south than indicated by these kernels; closer examination of the GLS data showed these divers

to move westwards as the non-breeding season progressed, likely starting in the Gulf of Bothnia in the Baltic Sea, then to Denmark, and in late winter, two of the birds moved into the southern North Sea, and 1 remained around the coast of Denmark. Source: Duckworth *et al.* (2020)

Birds present on the east coast of the UK and in the North Sea can originate from sites and areas on the west coast. Between 2006 and 2011, Griffin *et al*. (2011) looked at the migratory tracks of 26 individual Svalbard barnacle geese (barnacle geese) from and to the Solway Firth during winter and spring migrations. Birds were found to migrate in a north-easterly direction, after first flying 100-110km overland and then exiting the UK from the east coast between North Berwick and Lindisfarne/Holy Island; since about 2010, there has been an increasing tendency for large numbers of Barnacle geese to remain at the autumn staging site around Budle Bay/Lindisfarne, until later in the winter, or into the following spring, depending on the east coast weather (Griffin 2019). The migratory front is thought to be broad across the North Sea, narrowing along the coast of Norway (Figures A1a.5.13 (Griffin *et al.* 2011)).

Figure A1a.5.13: Overview of the migration route of 26 Svalbard barnacle geese between 2006 and 2011



Note: Geese were tracked from and to the Solway Firth on the west (Regional Sea 6) between 2006 and 2011. The migratory front was broadest across the North Sea and across the Barents Sea; the migratory corridor was very narrow along the Norwegian coast in spring. The autumn routes (indicated by southbound arrows) are likely to be inaccurate due to extrapolations between GPS fixes that are often >12 hours and large distances apart, due to the reduced frequency of fixes in lower light levels. Source: Griffin *et al.* (2011).

Four of the birds tagged in 2011 were fitted with tags that took positions every hour throughout the night in order to determine the night time overland route taken by these birds and if they used the Firth of Forth area (i.e. to rest) or if they passed straight through it; based on speeds recorded and distances between consecutive fixes, it was determined that these birds did not stop on the sea in the Firth of Forth overnight (Griffin *et al*. 2011). However, the cohort of geese in the tagged group did not leave the Solway Firth until late May (later than is typical)

and three of the four tagged birds did not stop again during the migration (usually birds have staging stops on-route); leading the authors to suggest the migratory behaviour of this cohort was not representative of the broader population as a whole (Griffin *et al*. 2011).

A1a.5.11 Features of Regional Sea 2

The coast of Regional Sea 2 runs from Flamborough Head in the north to approximately Deal on the Kent coast in south-east England. This area includes a number of areas suitable for cliff nesting seabirds and some of the most important sites for wintering and passage waterbirds, including the Wash and Thames Estuary. Sites referred to or described in this section are listed geographically north to south where possible.

A1a.5.12 Seabird species and distribution

Only a small number of the seabird species breeding in the UK are not listed in Mitchell *et al*. (2004) as breeding within Regional Sea 2 (for example Manx shearwater, European storm petrel, Leach's storm petrel, Arctic skua, great skua and black guillemot). The counties along the east and south-east of England support an array of breeding seabirds, some of importance in a national and international context. The most important seabird breeding colonies in Regional Sea 2 (listed in geographical order, from north to south) are indicated in Table A1a.5.10 below.

Table A1a.5.10: Important breeding seabird colonies in Regional Sea 2

Site	Species (designated feature)
Flamborough and Filey Coast	Black-legged kittiwake, common guillemot, razorbill, northern gannet **Seabird Assemblage**
Humber Estuary	Little tern
Gibraltar Point	Little tern
The Wash	Common tern, little tern
Greater Wash	Sandwich tern, common tern little tern
North Norfolk Coast	Common tern, little tern, sandwich tern
Great Yarmouth North Denes	Little tern
Breydon Water	Common tern
Benacre to Easton Bavents	Little tern
Minsmere – Walberswick	Little tern
Alde-Ore Estuary	Little tern, sandwich tern, lesser black-backed gull
Hamford Water	Little tern
Colne Estuary (Mid-Essex Coast Phase 2)	Little tern
Abberton Reservoir[1]	Great cormorant
Blackwater Estuary (Mid-Essex Coast Phase 4)	Little tern
Foulness (Mid-Essex Coast Phase 5)	Common tern, little tern, sandwich tern
Outer Thames Estuary	Common tern, little tern

Site	Species (designated feature)
Medway Estuary and Marshes	Little tern, common tern

Note: Sites designated as Seabird Assemblages of International Importance are shown in bold (qualifying level is 20,000 birds). [1]Abberton Reservoir is included as although the reservoir is located a few kilometres inland, many of the birds feed in nearby estuaries. Source: JNCC (2020) JNCC (seabird monitoring programme) website https://app.bto.org/seabirds/public/data.jsp, JNCC Special Protection Areas https://jncc.gov.uk/our-work/list-of-spas/

During the breeding season, colonies at Filey, Flamborough Head and Bempton Cliffs, regularly support tens of thousands of individual seabirds, while the lack of suitable cliff habitat south of these areas results in fewer nesting seabirds, other than terns and gulls, with most colonies on saltmarshes, remote beaches or offshore sandbanks (Tasker 1998).

The only northern gannet colony in England is at Bempton Cliffs and since the 1960s, the colony has been increasing steadily, with a rapid escalation in numbers in recent years (JNCC 2014). With the exception of a dip in 2005, a steep increase in numbers has been recorded between counts in 2004 and 2012; the most recent count at the colony (2017), recorded 13,392 AON/AOS), representing a +240% change since Seabird 2000 (JNCC 2021).

Further along the coast, Blakeney Point and Scolt Head are important for sandwich tern supporting almost half of the English population. These sites can show contrasting breeding seasons, for example, between 2015 and 2019, Scolt Head Island had four very successful breeding seasons, while Blakeney Point faired less favourably; a similar situation happened in 2000, when all nests at Blakeney Point failed whilst Scolt Head recorded the highest productivity values since monitoring began in 1986 (JNCC 2021). Fox predation is thought to have an impact on the Sandwich tern at Blakeney Point, this also affecting black-headed gull and little tern numbers too.

A1a.5.13 Seabird distribution at sea

Seabird distribution and abundance in the southern North Sea varies throughout the year, with offshore areas in general, containing peak numbers of birds following the breeding season and through winter (Table A1a.5.11). Zones where water masses meet, hydrographic fronts, can have enhanced primary productivity and aggregations of other marine organisms, including birds. A year round frontal system off the coast of Flamborough Head – the Flamborough Front – an important hydrographic feature close to the boundary between Regional Seas 1 and 2. forms the boundary between Regional Seas 1 and 2. The Outer Silver Pit and the Brown Ridge off the Suffolk coast are also important for seabird foraging, resulting in birds being present in these areas. This notwithstanding, numbers of seabirds at sea are generally lower in Regional Sea 2 compared with waters further north, with greatest concentrations offshore occurring outside the breeding period.

Table A1a.5.11: General seabird distribution at sea in the Regional Sea 2 area

Month	General distribution
January	Auks (common guillemots and razorbills) present in large numbers throughout the southern North Sea, particularly over the Outer Silver Pit area.
February	High numbers of auk present off the coast of Flamborough Head and also over the Outer Silver Pit area. Moderate numbers of other seabirds, particularly black-legged kittiwake, present over the Silver Pit area and off the Norfolk and Suffolk coast. Return of some adult northern gannets to the North Sea.

Month	General distribution
March	The Outer Silver Pit area is important for immature and adult razorbills and Atlantic puffins are returning to their breeding colonies, including those at Flamborough Head. Some fulmars present in the southern North Sea. High concentrations of common guillemots found off Flamborough Head.
April	Breeding season for some seabirds begins at the end of the month, with birds re-establishing/ establishing/defending territories at colonies. Many seabirds, particularly females, feeding to improve body condition; some may feed close to colonies but others may be further offshore. Common guillemots off Flamborough Head can forage up to 100km from colony to feed on sandeels. High numbers of sandwich terns associated with colonies at Scolt Head, continues through May, with birds feeding close to colonies during summer.
May	Start of breeding season for most seabirds, laying and incubating eggs. Predominantly immature birds located away from colonies, some birds, e.g. black-legged kittiwake, have been found to travel up to 120km away (off Flamborough Head). Large numbers of sandwich and little terns found at breeding sites in southern North Sea.
June	Peak of breeding season. Majority of seabirds in coastal areas, but numbers not large in this area compared to central northern parts of the North Sea. Most migrant birds that winter on North Sea coasts have returned to their breeding grounds.
July	Moulting season for inshore and coastal birds, with some auks flightless at this time. Massive movement of birds from breeding colonies into offshore areas of the North Sea during this month. Aggregations of birds present in coastal waters off the coast of Flamborough Head and Great Yarmouth.
August	Moderate numbers of flightless auks in offshore waters off the coast of Flamborough Head. Higher densities of northern fulmar also found in this area. Concentrations of sandwich tern are coastal, although some birds feed offshore, and most widely distributed after the breeding season
September	Few auks in offshore area at this time, with concentrations further north in the central and northern North Sea. Great black-backed gulls present, frequently found around trawlers off the east coast of England. Northern fulmar remains numerous.
October	Southward shift of common guillemot and razorbill populations with high concentrations of auks offshore, particularly in the area of southern gas fields off Norfolk and Lincolnshire. Prominent movement of northern gannet during autumn from the North Sea to the Channel. The North Sea is largely abandoned by lesser black-backed gulls during winter.
November	Few auks present offshore, but not in great numbers. Razorbills from more southerly and westerly colonies fly into southern wintering grounds, including southern North Sea. Northern fulmar densities similar to those seen in Aug-Oct, but eastern shift in distribution, further into North Sea. Moderate densities of northern gannet seen over Dogger Bank area, higher densities off Flamborough Head, as dispersion from breeding sites is at maximum. Black-legged kittiwakes distributed over large areas of the North Sea, in winter numbers double and areas, including the Silver Pit support large numbers.
December	High concentrations of auks and other seabird species in offshore areas in the southern North Sea. Common guillemots are widespread in winter, however densities are generally much lower in the central and southern North Sea than those seen in areas further north.

Sources: Tasker & Pienkowski (1987), Skov *et al.* (1995), Furness (2015)

A BEIS SEA-funded project on the movements of lesser black-backed gulls and great skuas from SPAs at Orford Ness (part of the Alde-Ore Estuary SPA) (lesser black-backed gulls) and Foula SPA and Hoy SPA (great skua); these latter sites are in the Regional Sea 8 section. The study aimed to understand the connectivity of these species with areas of proposed or consented wind farm sites, the extent to which these species used the areas of already constructed/partially constructed wind farms and provide an assessment of the flight altitudes of these species that could inform collision risk modelling (Thaxter *et al*. 2011, 2012, 2014).

The maximum foraging range of lesser black-backed gulls was recorded as 159km, and, of the birds tagged, connectivity with areas either consented or identified for offshore renewable developments (at that time) was recorded. Over half the birds in each year (7 of 10 birds (2010), 14 of 18 (2011) and 8 of 14 (2012)) used areas of operational, consented or proposed offshore wind farm including the East Anglia development zone, the Greater Gabbard wind farm and the Galloper extension to the Gabbard site. The area usage for all years is shown in Figure A1a.5.14).

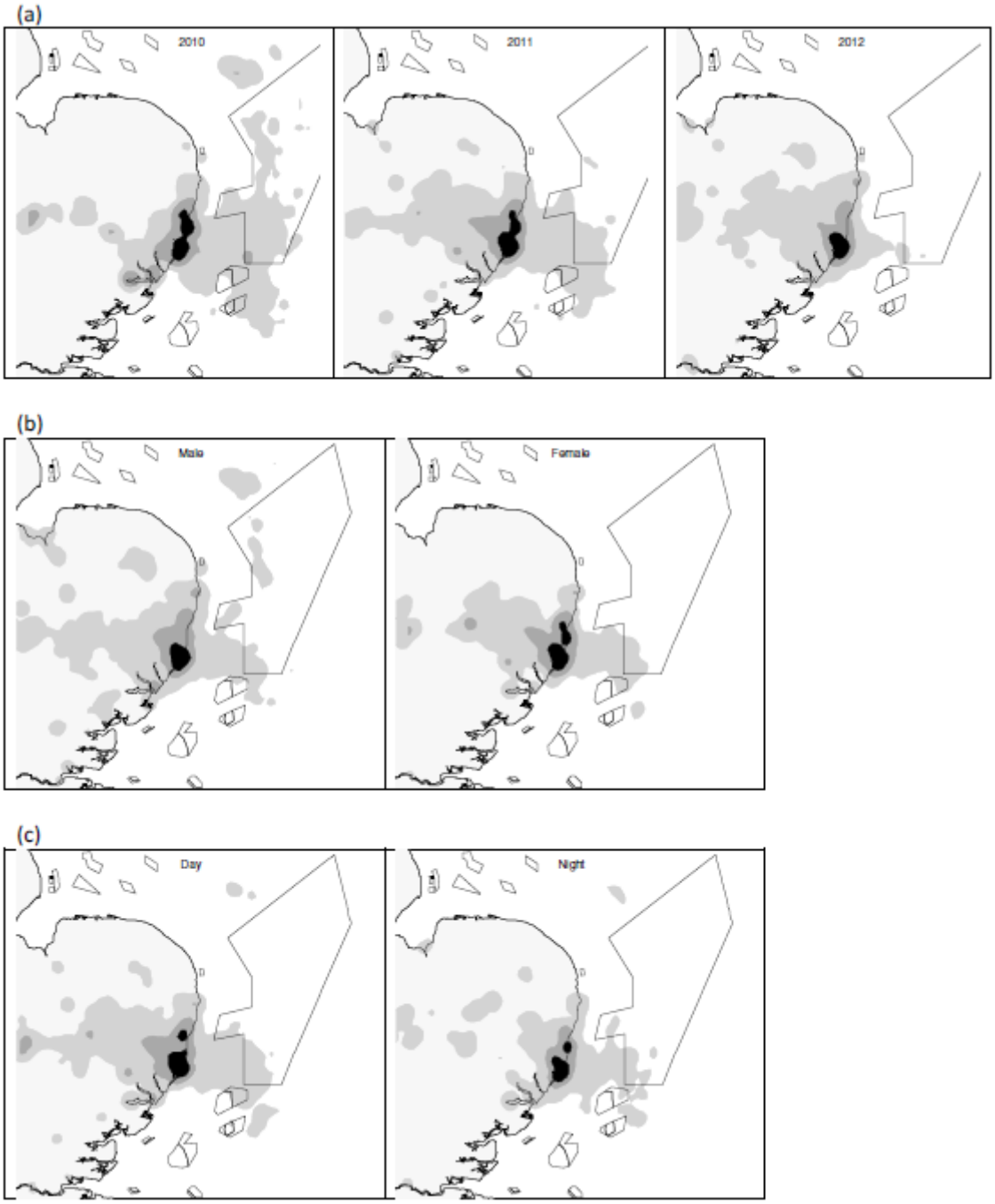
Time spent offshore across all birds was an average of 15% in 2010, 6% in 2011 and 7% in 2012 and although the East Anglia Zone was used most out of all the wind farm areas; the time spent even in this large zone across all bird data only amounted to 4% in 2010 (maximum per bird, 15%), 1% in 2011 (maximum 8%) and <1% in 2012 (maximum 1%) and much less time was spent in the smaller existing, consented and proposed wind farms in each year (Thaxter *et al*. 2014).

Individual lesser black-backed gulls showed significant differences in their behaviour, with some foraging over a wider area and more offshore than others, individuals also differed significantly in their wind farm usage across the season and between years (Figure A1a.5.14).

Data was also collected on migration and wintering locations. Information was available for six (for the period 2010/11), fifteen (2011/12) and eleven (2012/13) birds and of these, six, fourteen and six birds from the respective time periods, had sufficiently functioning tags to provide over-winter information. For those birds which information was complete over the three years, four birds remained in the UK and thirteen migrated to wintering areas to the south – i.e. Mediterranean areas of Spain, Portugal and Morocco with one bird in 2010 reaching as far south as Mauritania – see Figure A1a.5.15 for flight paths – see also Thaxter *et al*. 2019, details in Regional Sea 6 section).

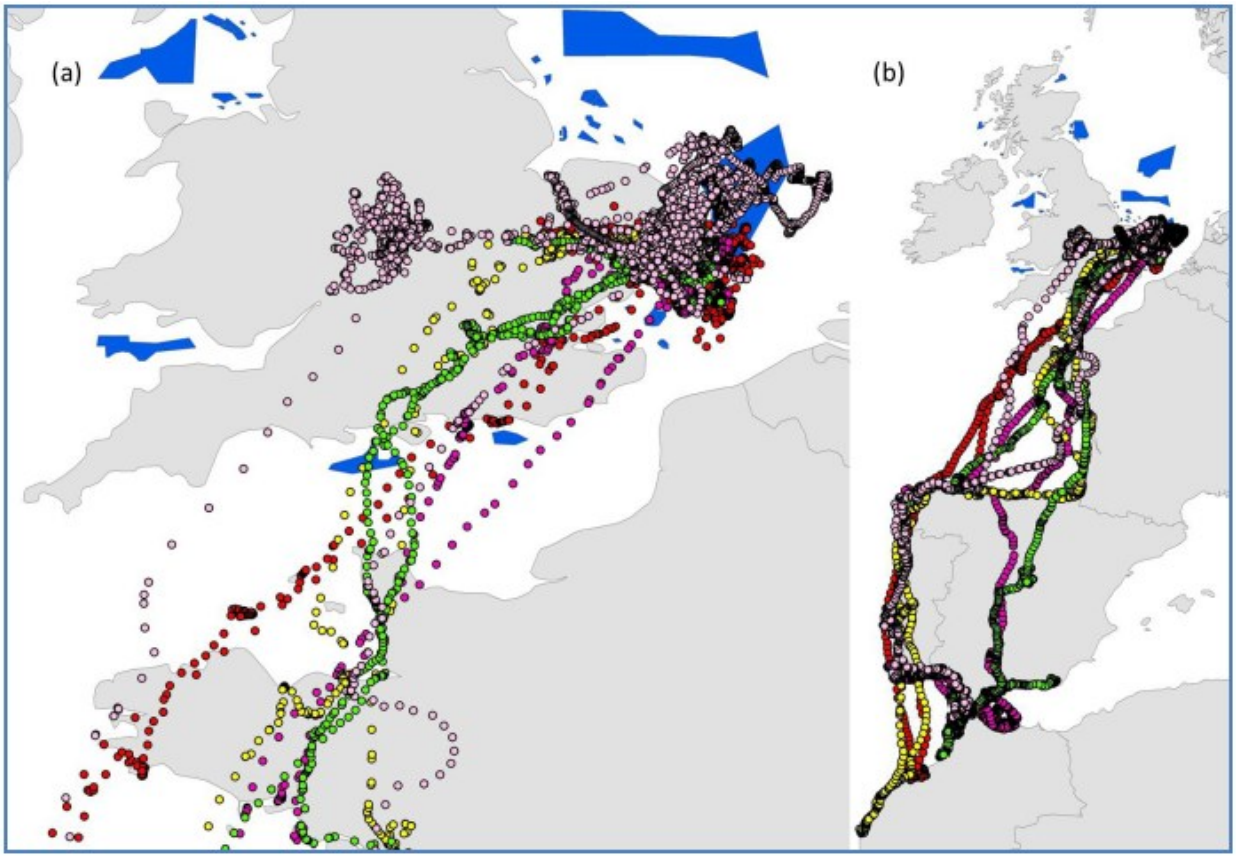
Wintering destinations were consistent within individuals between years and temporally, outward migration across the English Channel and Bay of Biscay appeared to be variable, depending on whether the individual left straight after breeding, or remained for longer elsewhere in the UK (late July to early December, peaking in November). Return routes were more focused (mid-February to mid-April, peaking in mid-March) (Thaxter *et al*. 2014).

Figure A1a.5.14: Area usage by lesser black-backed gulls during 2010, 2011 and 2012



Notes: Spatial area usage by lesser black-backed gulls during (a) respective years of 2010, 2011 and 2012, b) by male and female lesser black-backed gulls and (c) by all birds between day and night. Shown are the 95% KDE (Kernel Density Estimation) (light grey) representing the total area usage, 75% KDEs (medium grey) and 50% KDE, representing core area usage. Source: Thaxter *et al.* (2014).

Figure A1a.5.15: Flight path of tagged lesser black-backed gulls on migration 2010/2011



Notes: Flight path of tagged lesser black-backed gulls a) leaving and returning to Orford Ness on migration between July 2010 and April 2011 and b) their movements throughout migration and overwinter. Tracks of different individuals are shown in different colours, and UK offshore developments are shown in blue. Source: Thaxter *et al.* (2012a).

A1a.5.14 Seabird vulnerability to pollution

Figure A1a.5.16a and b below shows the monthly vulnerability for the Regional SEA 2 area.

In contrast with Regional Sea 1, Regional Sea 2, with a couple of notable exceptions, has few large seabird breeding colonies, resulting in a predominately low to medium sensitivity during the breeding season; the exception being waters around the Flamborough Head/Filey/Bempton colonies. The area sees higher sensitivities in the winter and spring months (November-March) as birds transit in and out of the North Sea, winter in the area, and able to forage across the wider area without having to return to the nest and furnish chicks. As for Regional Sea 1, there are extensive data gaps for several months of the year.

Figure A1a.5.16a: Monthly seabird oil sensitivity index scores for Regional SEA 2 (Jan-Jun)

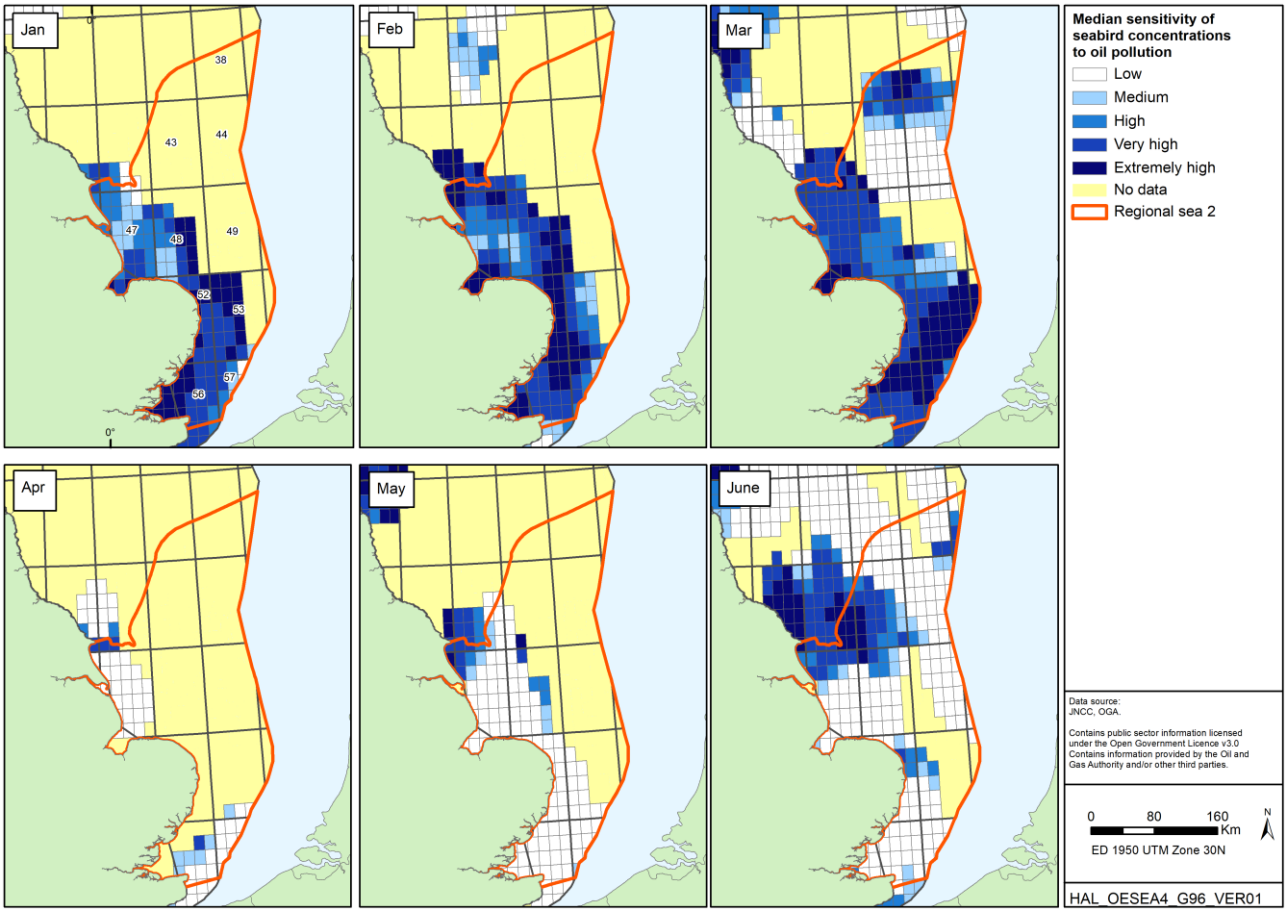
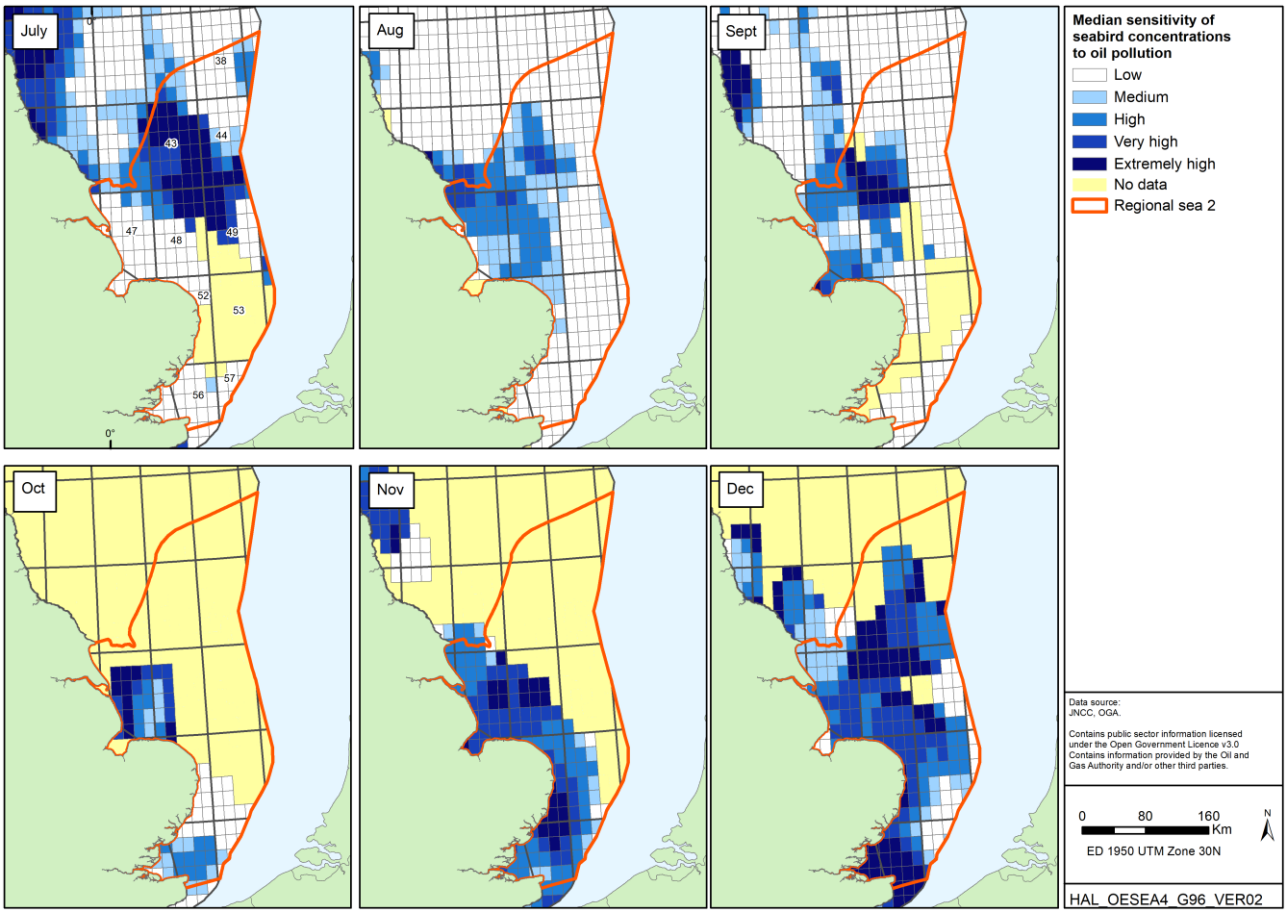


Figure A1a.5.16b: Monthly seabird oil sensitivity index scores for Regional SEA 2 (Jul-Dec)



A1a.5.15 Waterbird species and distribution (breeding, wintering and migratory)

Along this coastline, estuarine and/or soft coast habitats, including vegetated shingle, sand dunes, coastal lagoons, saltmarshes, dry and wet (and seasonally flooding) grasslands support high densities of breeding waterfowl, particularly waders, and several areas are of local, national and international importance. Notable wetland species breeding in Regional Sea 2 include bittern and avocet and a number of areas have been designated as SPAs partly due to their breeding populations of these species: North Norfolk Coast (avocet and bittern); Broadland (bittern); Benacre to Easton Bavents (bittern); Minsmere-Walberswick (avocet and bittern); Alde-Ore Estuary (avocet); Foulness (avocet); Medway Estuary and Marshes (avocet), and The Swale (avocet).

Some of the most important sites in the Region, all of which are designated as SPAs and some of which are also designated as Wetlands of International Importance, along with the species they support, are described in Table A1a.5.12.

Table A1a.5.12: Important sites[1] for non-breeding waterbirds in Regional Sea 2

Site	Site total[2] 2019/2020	5-year average[2]	Species (designated feature)
Humber Estuary	114,857 (↓)	140,519	Great bittern, shelduck, wigeon, teal, mallard, common pochard, greater scaup, goldeneye, oystercatcher, pied avocet, ringed plover, golden plover, grey plover, lapwing, red knot, sanderling, bar-tailed godwit, curlew, redshank, ruddy turnstone, black-tailed godwit, dunlin, dark-bellied brent goose, ruff, whimbrel, greenshank **Waterfowl assemblage**
Gibraltar Point	-	-	Bar-tailed godwit, grey plover, sanderling
The Wash	422,232 (↑)	397,158	Bewick's swan pink-footed goose, shelduck, wigeon, gadwall, pintail, common scoter, goldeneye, oystercatcher, grey plover, knot, sanderling, bar-tailed godwit, curlew, redshank, black-tailed godwit, dunlin, dark-bellied brent goose, turnstone **Waterfowl Assemblage**
Greater Wash	-	-	Red throated diver, common scoter
North Norfolk Coast	148,879 (↑)	123,990	Pink-footed goose, wigeon, avocet, knot, dark-bellied brent goose. **Waterfowl Assemblage**
Breydon Water (numbers for Breydon Water and Berney Marshes)	141,204 (↑)	111,118	Bewick's swan, avocet, golden plover, lapwing, ruff **Waterfowl Assemblage**
Minsmere-Walberswick (numbers for Minsmere)	4,559 (↓)	5,401	Gadwall, shoveler, greater white-fronted goose
Alde-Ore Estuary (numbers from Alde Estuary)	30,416 (↑)	26,692	Pied avocet, ruff, redshank
Deben Estuary	16,104 (↓)	16,667	Pied avocet, dark-bellied brent goose
Stour & Orwell Estuaries (numbers from Stour	38,119 (↓) 14,369 (↓)	45,241 18,267	Great crested grebe, mute sawn, shelduck, wigeon, gadwall, northern pintail greater scaup, goldeneye, ringed plover, golden plover,

Site	Site total[2] 2019/2020	5-year average[2]	Species (designated feature)
Estuary and separately for Orwell Estuary)			lapwing, knot, curlew, redshank, ruddy turnstone, black-tailed godwit, dunlin, dark-bellied brent goose, grey plover, **Waterfowl Assemblage**
Hamford Water	41,196 (↓)	42,839	Shelduck, teal, pied avocet, ringed plover, grey plover, redshank, black-tailed godwit, dark bellied brent goose
Colne Estuary (Mid-Essex Coast Phase 2)	18,007 (↑)	18,688	Redshank, dark-bellied brent goose **Waterfowl Assemblage**
Abberton Reservoir	37,595 (↓)	34,632	Great crested grebe, mute swan, wigeon, gadwall, teal, shoveler, pochard, tufted duck, goldeneye, coot **Waterfowl Assemblage**
Blackwater Estuary (Mid-Essex Coast Phase 4)	93,723 (↑)	88,152	Ringed plover, grey plover, black-tailed godwit, dunlin, dark-bellied brent goose **Waterfowl Assemblage**
Dengie (Mid-Essex Coast Phase 1) (numbers for Dengie Flats)	36,481 (↓)	52,004	Grey plover, knot, dark-bellied brent goose **Waterfowl Assemblage**
Crouch-Roach Estuaries (Mid-Essex Coast Phase 3)	55,436 (↑)	32,538	Dark-bellied brent goose **Waterbird Assemblage**
Foulness (Mid-Essex Coast Phase 5)	-	-	Oystercatcher, pied avocet, grey plover, knot, bar-tailed godwit, redshank, dark-bellied brent goose **Waterfowl Assemblage**
Benfleet and Southend Marshes	-	-	Ringed plover, grey plover, knot, dunlin, dark-bellied brent goose **Waterfowl Assemblage**
Thames Estuary and Marshes (numbers for Thames Estuary)	165,410 (↑)	141,686	Pied avocet, grey plover, knot, redshank, black-tailed godwit, dunlin, ringed plover **Waterfowl Assemblage**
Outer Thames Estuary (marine SPA)	-	-	Red-throated diver
Medway Estuary	43,327 (↓)	39,652	Red throated diver, great crested grebe, Bewick's swan, shelduck, wigeon, teal, mallard, pintail, shoveler common pochard, oystercatcher, pied avocet, ringed plover, grey plover, knot, curlew, redshank, greenshank, ruddy turnstone, black-tailed godwit, dunlin, dark-bellied brent goose. **Waterfowl Assemblage**
The Swale (numbers for Swale Estuary)	66,897 (↓)	65,979	Gadwall, teal, oystercatcher, ringed plover, grey plover, curlew, redshank, dunlin, dark-bellied brent goose **Waterfowl Assemblage**

Notes : [1]Sites for non-breeding waterbirds in the UK as described in the WeBS annual publication and the JNCC SPA website, designated features as described in JNCC UK Natura 2000 spreadsheet, version dated 2019-10-31, and latest changes to sites webpage. [2]Site total and 5-yr average from WeBS report online (site total tab),

https://app.bto.org/webs-reporting/principal.jsp, ↓↑ denotes decrease or increase from previous years site total. Source: Frost *et al.* (2021), https://www.bto.org/our-science/projects/wetland-bird-survey/publications

The Greater Wash SPA was designated in 2018. Numerically this area is one of the most important areas in Britain for wintering waterbirds, moulting waders (early autumn), breeding waders, terns and other seabirds. An extension of the existing Outer Thames Estuary SPA boundary, to encompass the marine environment around the breeding colonies has also been designated, to protect seabird foraging areas. The SPA supports the largest aggregation of wintering red-throated diver in the UK, with numbers thought to be over 20,000 (Irwin *et al*. 2019) and the area also supports foraging areas for common tern and little tern during the breeding season.

Other areas within the region that support important numbers of wintering and passage waterbirds, but are not designated as SPAs include Pegwell Bay (e.g. greenshank, red-throated diver great-crested grebe and barnacle goose) and Orwell Estuary (e.g. black-tailed godwit, dunlin, shelduck and dark-bellied brent goose). At the 2019/2020 WeBS count these sites recorded around 7,938 and 14,369 birds respectively (Frost *et al*. 2021). The area is also important for some species which only winter at a few sites in Britain e.g. the bean goose and the dark-bellied brent goose.

The general distribution of birds is described in Table A1a.5.13.

Table A1a.5.13: General waterbird distribution in the Regional Sea 2 area

Month	General distribution
January	Severity of the weather will influence the movement westward of some bird species from the Wadden Sea. In mild winters, more birds will remain on the eastern side of the North Sea. The Thames area is important for diver species and shelduck (the Wash is also important for this species). Goldeneye are present in large numbers at Blackwater, the Colne and the Wash.
February	Sites such as the Wash, the north Kent marshes, Medway, Blackwater, Hamford Water and Stour support large numbers of shelduck and are important for flocks of waders, including grey plover and redshank.
March	Some bird species that have wintered in the UK begin to return to breeding grounds and numbers start declining at British sites, however numbers are still high, particularly at sites such as Medway, Swale, Dengie, Hamford Water and Blackwater. Large numbers of shelduck still present at the Wash, Stour and Blackwater.
April	Birds with breeding sites outwith the UK, continue to leave their wintering grounds along the British coast. Birds on passage continue to use these sites. The Wash and the Humber remain important for species e.g. dark-bellied brent goose, dunlin, knot and curlew, and the Wash continues to support important numbers of shelduck. Concentrations of common scoter are found off the Kent coast.
May	Peak of migration to breeding grounds (outwith the UK) for several species such as ringed plover, grey plover, knot, sanderling, dunlin, bar-tailed godwit and turnstone. The Wash and the Humber continue to support important numbers of birds, including dark-bellied brent geese and dunlin.
June	Peak of breeding season for species which breed in the UK. Migrant birds that winter in the UK and passage birds have all returned to their breeding grounds, with eider being the only seaduck which breeds in any significant numbers. Strongholds for this species are further north, in Scotland and also the Wadden Sea.
July	Large numbers of waders move to sites along the coast including the Wash, Blackwater and Stour estuaries. Shelduck moult during this month, peak numbers occur in the Helgoland Bight (east of the Wadden Sea), with smaller concentrations found in the Humber and the

Month	General distribution
	Wash. Relatively small flocks of moulting common scoter also found in the outer Thames estuary and smaller numbers of this species off North Norfolk Coast; larger numbers recorded off the coast of south Suffolk and north Essex.
August	Start of the main influx of wading birds and ducks to the North Sea, e.g. the Wash and the estuarine systems further south, e.g. Blackwater, Dengie, Stour and the Medway, with many sites supporting important numbers of birds.
September	Peak month for estuary usage. Large numbers of waders and ducks at estuaries, such as the Wash and the Humber.
October	Areas including the Wash and the Humber remain important for oystercatcher, grey plover, sanderling, dunlin, knot and redshank and the Thames estuary complex supports large numbers of ringed plover, grey plover and redshank. During early winter, large numbers of common scoter present in the Wash, with smaller numbers located off the North Norfolk Coast. Most common scoter occurred in the outer parts of the Wash, with no obvious distribution change as winter progressed and no apparent movement offshore.
November	Some birds, including knot and sanderling move west from the Wadden Sea to sites on the east coast of England, e.g. Humber and the Wash. Other sites remain important, supporting similar numbers and species to that seen in October. Shelduck moult has been completed and large flocks move from sites in the Wadden Sea to areas on the Wash and further north at Teesmouth. The Wash and Colne support large influxes of goldeneye and pink-footed goose return to the North Norfolk area. During much of the winter, the Thames has high numbers of divers (e.g. red-throated, black-throated and great northern) with highest concentrations occurring off estuarine mouths and in inshore areas; low densities recorded far from shore.
December	More estuaries on this coast become important for shelduck as numbers increase: Medway, Blackwater, Colne and Hamford. The Wash remains one of the most important estuaries in the western North Sea for wading birds. Small numbers of divers (e.g. red-throated, black-throated and great northern) occurred far from shore, with what appears to be a general movement offshore in late winter. Large numbers of eider recorded throughout the winter, with greatest numbers in the Greater Wash area during mid winter. Very few eiders recorded in the Thames during mid winter.

Source: Tasker & Pienkowski (1987), Skov *et al.* (1995), WWT Consulting (2008).

The outer Thames estuary is one of the most important sites in the UK for wintering red-throated diver. The importance of the area for this species has been reflected in the area being designated as an SPA; the area is also important for common and little terns and a further seaward extension was added to the original boundary, which includes areas of coastal mudflats off Foulness. Since 2002, a number of surveys have been undertaken in the Outer Thames area in order to try and estimate the red-throated diver population (see Table 39 in Irwin *et al*. 2019), the most recent of these being the HiDef survey carried out in 2018, which also included the additional area added to the revised SPA boundary, the results of which are in Irwin *et al.* (2019). Red-throated diver was the most abundant species recorded, and showed high densities and widespread distribution. The survey was split between a northern sector (off the coast of Foulness) and a southern sector and densities in the southern sector showed a strong increase in waters either side of the shipping lanes and the London Array wind farm. Whilst it was acknowledged that the previous surveys were not directly comparable, i.e. survey methods, effort, etc, a general trend of increasing population of red-throated diver was thought to be evident (Irwin *et al*. 2019).

A pilot study was undertaken as part of the SEA-programme, looking at the migratory movements of shelduck; data on flight height and flight speed were also collected (Green *et al*. 2020). As a breeding species in the UK, shelduck predominantly occur on the coast, but has a significant inland breeding range (Balmer *et al*. 2013) and a substantial proportion of the UK

breeding shelduck population annually migrate across the North Sea to the European continent (Wadden Sea) to moult, before returning to the UK to over winter. The species is widespread across UK coasts during passage and winter; shelduck is a non-breeding feature of 32 SPAs (Stroud *et al*. 2016).

Four tags were successfully deployed on adult birds (2 males and 2 females), caught on Havergate Island within the Alde-Ore Estuary SPA in 2019 and all four birds migrated from the Suffolk coast to the Dutch Wadden Sea, crossing the southern North Sea, taking slightly different routes (Figure A1a.5.17) (Green *et al*. 2020). Prior to migrating, all four birds made pre-migration movements around the Suffolk coast, almost all of these local movements of >5km happened at dawn, and no large movements occurred during the day.

Figure A1a.5.17: Routes taken across the North Sea by four tracked shelduck

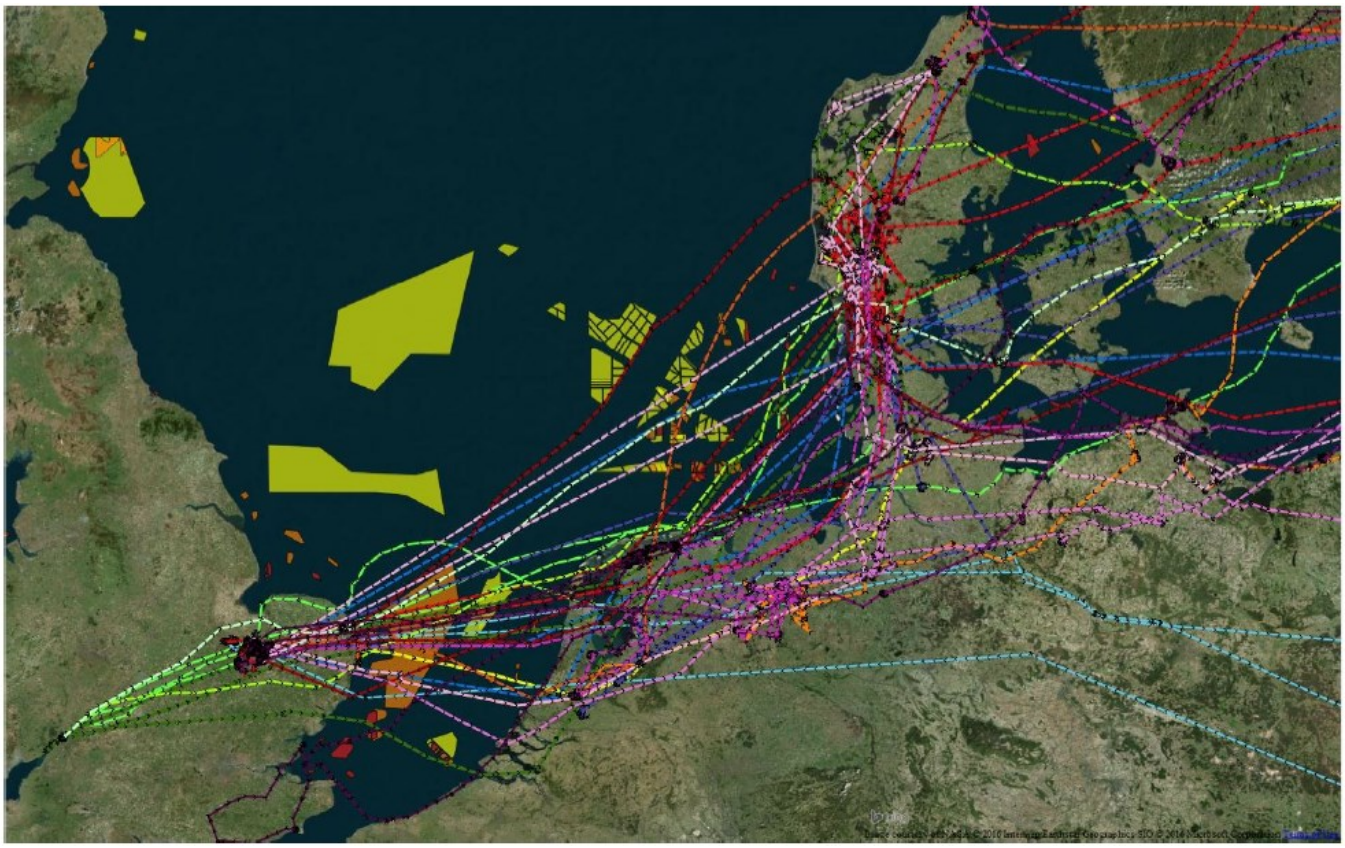
Source: Green *et al.* (2020)

All birds arrived in the Dutch Wadden Sea (DWS) at the same location, and spent an extended period in the 20km stretch of coastline between Sexbierum and Zwarte Haan, before three of the birds moved onto the area around the Elbe Estuary, within the German Wadden Sea (GWS) (it was not possible to determine if the fourth bird also moved into the Elbe Estuary as the tag had fallen off); stopping in the DWS for an extended period before moving to the GWS had not previously been reported in the literature review conducted prior to the pilot study (Green *et al.* 2019). One of the birds also moved between moulting locations within the Wadden Sea, travelling from the DWS to the Elbe Estuary (~250km) for a day trip then returning to the DWS, staying for nine days, before returning to the Elbe Estuary and staying for four days, before returning to the DWS until the tag fell off; movements such as these between known moulting locations have not previously been recorded (Green *et al*. 2020),

As part of a wider programme of working looking at the movement of several swan and goose populations along coastal Britain, Bewick's swans were tracked from the winters of 2013/14 and 2014/2015 to understand their migration movements between southeast England and the Low Countries of Continental Europe (Griffin *et al*. 2016). Bewick's swans generally have a southerly distribution within the UK and there are sites of international (Ouse Washes, Nene

Washes and Severn Estuary) and national (Breyden Water/Berney Marshes, Dungeness to Pett Level and Ranworth/Cockshoot) importance are located in the southern part of the country (Holt *et al.* 2012, Griffin *et al*. 2016). Of these, the Ouse Washes is of particular importance and generally holds around a quarter of the total flyway population in mid-winter and, birds were tagged on the site, with their migration movements tracked (Figure A1a.5.18); flight height data was also obtained from some of the birds tagged.

Figure A1a.5.18: Flight lines of individual Bewick's swans from the Ouse Washes



Notes: NW European part of the flyway of the 18 GPS-tagged Bewick's swans. Migrating between 2014 and 2015. Arrows on tracks denote the direction of bird travel and the various blocked-in coloured shapes denote various wind farm areas; yellow = wind farm at the application stage, orange = consented, red = operational – note, this was status of OWF at time of tagging study report (2016) and has since changed. Source: Griffin *et al*. (2016)

Preliminary inspection of the Bewick's Swans' migratory tracks within the UK suggest that the birds (particularly those wintering further west) follow valleys or lower lying areas during migration, rather than taking the shortest routes to the UK exit/entry points.

A1a.5.16 Features of Regional Sea 3

This region encompasses the eastern Channel, from Deal in the east to close to Dartmouth in Devon. Suitable habitat for nesting seabirds is limited. There are some estuarine and soft coastal areas notable for breeding, wintering and passage waterbirds. Sites referred to or described in this section are listed geographically east to west where possible.

A1a.5.17 Seabird species and distribution

Of the seabird species currently known to breed in the UK, thirteen do not breed along the eastern Channel coastline (Mitchell *et al*. 2004). The remaining twelve species breed throughout the area in varying numbers.

Overall, this region is of relatively less importance for breeding seabirds than elsewhere in the UK; with the exception of the Mediterranean gull, which although colonising other parts of England, appears to be maintaining a small central breeding presence along the south coast. The most notable breeding sites along this coast are described in Table A1a.5.14, as all of which are designated as SPAs and have breeding seabirds listed as qualifying features. However, none of these sites have been designated as supporting Seabird Assemblages of International Importance.

Table A1a.5.14: Important breeding seabird colonies in Regional Sea 3

Site	Species includes designated features and those present in assemblages)
Dungeness, Romney Marsh and Rye Bay	Common tern, little tern, Mediterranean gull, sandwich tern
Pagham Harbour	Little tern, common tern
Chichester and Langstone harbours	Little tern, sandwich tern, common tern
Solent and Southampton Water	Common tern, little tern, Mediterranean gull, roseate tern, sandwich tern
Poole harbour	Common tern, Mediterranean gull, sandwich tern l
Chesil Beach and The Fleet	Little tern
Thanet Coast and Sandwich Bay	Little tern

Source: JNCC (2021) JNCC (seabird monitoring programme) website https://app.bto.org/seabirds/public/data.jsp, JNCC Special Protection Areas https://jncc.gov.uk/our-work/list-of-spas/

The Poole Harbour SPA was extended to include two additional features, breeding Sandwich tern and overwintering little egret, and the original boundary extended to encompass the harbour mouth and the subtidal and intertidal areas, reflecting the importance of the area for these species.

The Balearic shearwater does not breed in the UK (this species breeds solely in the western Mediterranean) but movements after the breeding season does bring it into UK waters, particularly those of the English Channel. It was believed there could be a northward shift in the distribution during the non-breeding season (e.g. Yésou *et al.* 2003, Wynn *et al.* 2007, Luczac *et al*. 2011, cited in Parsons *et al*. 2019) and with numbers recorded in UK waters, analysis of at-sea surveys and land-based count was undertaken to identify any potential areas that may be suitable for classification as SPAs for this species (Parsons *et al*. 2019). This concluded that, whilst the occurrence of the species in UK waters was regular, this was only when considered over a large spatial scale (i.e. the whole English Channel) and densities were generally low, and no regularly occurring hotspots for the species was identified, that would be appropriate for possible SPA designation (Parsons *et al*. 2019).

A1a.5.18 Seabird distribution at sea

Seabird numbers in coastal waters off this stretch of coastline are generally low, with most breeding seabird species from the region feeding in estuaries, on exposed intertidal areas or in other shallow, inshore waters (Tasker 1998).

Between November and February, northern fulmar are widely distributed throughout the eastern Channel and a similar distribution continues through to July and the species only appears to be absent between August and October. Northern gannets move from the North

Sea to the Channel in winter, and although widely distributed throughout its North Sea range, there are several distinct concentrations one of which is the Channel, e.g. eastern area of the Channel and off of Start Point (Skov *et al*. 1995). Northern gannets are also distributed throughout the whole of the Channel between May and August, probably associated with the breeding colonies on the Channel Islands. In winter, the eastern area of the Channel supports good numbers of common gull.

After the breeding season, lesser black-backed gulls in the Channel are likely to be from the Channel Island colonies, while some ~15,000 birds can winter in the area; this species also uses the Channel to enter and exit the North Sea (Skov *et al.* 1995). Lesser black-backed gulls largely abandon the North Sea in winter, with large numbers spending winter in the English Channel, with many found in the Celtic and Irish Seas and SW Approaches (Regional Sea 4 and 6) (Furness 2015). Herring gulls are widely distributed throughout the Channel between November and February with distribution more concentrated in the eastern Channel between May and October. During winter, great black-backed gulls are widely distributed throughout the Channel with distribution concentrating in the eastern and western areas between August and October. Black-legged kittiwakes are also widely distributed in low numbers in the Channel throughout the year (Barton & Pollock 2007).

In winter common guillemots are widely distributed in low numbers, with distribution concentrated in the eastern Channel between March and April. Razorbills are present in low numbers in the Dover Strait and the eastern Channel in winter and appear to be scarce or absent during the remainder of the year (Skov *et al*. 1995).

A1a.5.19 Seabird vulnerability to pollution

Figures A1a.5.19a and b below shows the monthly vulnerability for the Regional SEA 3 area. Generally, the area can be considered low in terms of seabird sensitivity to pollution; few areas are extremely high or very high, and for very short periods (i.e. 1 to 2 months). January to February are the months with the highest overall sensitivity, with a few blocks also showing higher sensitivity in June and July. This reflects the general lack of seabirds present in the area, there are few significant breeding colonies, resulting in very low sensitivity during this time, with higher sensitivity likely to be reflecting the movement of birds existing and entering the North Sea during migration, augmented by those wintering in the area. As for the other Regional sea areas, there are data gaps, spanning several months of the year.

Figure A1a.5.19a: Monthly seabird oil sensitivity index scores for Regional SEA 3 (Jan-Jun)

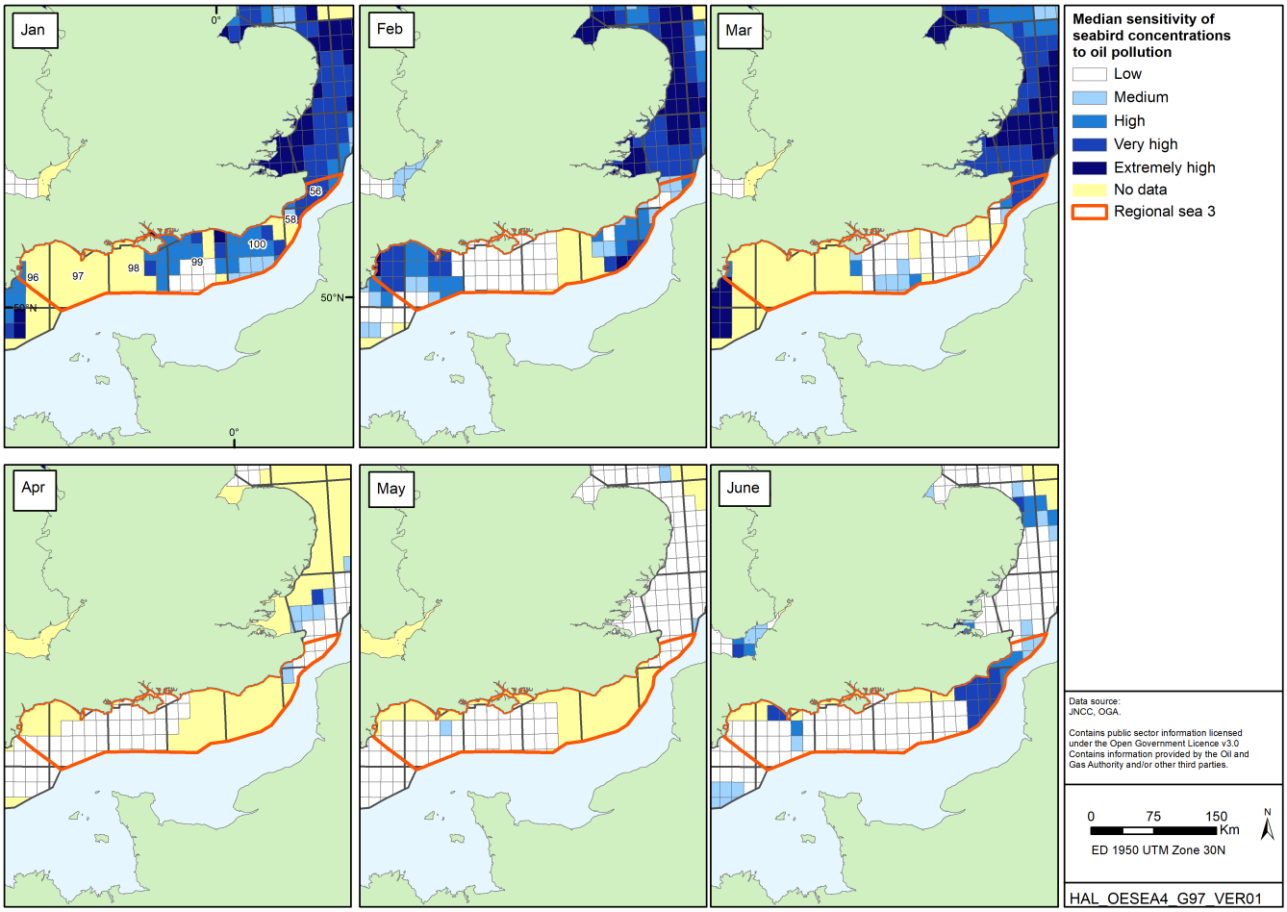
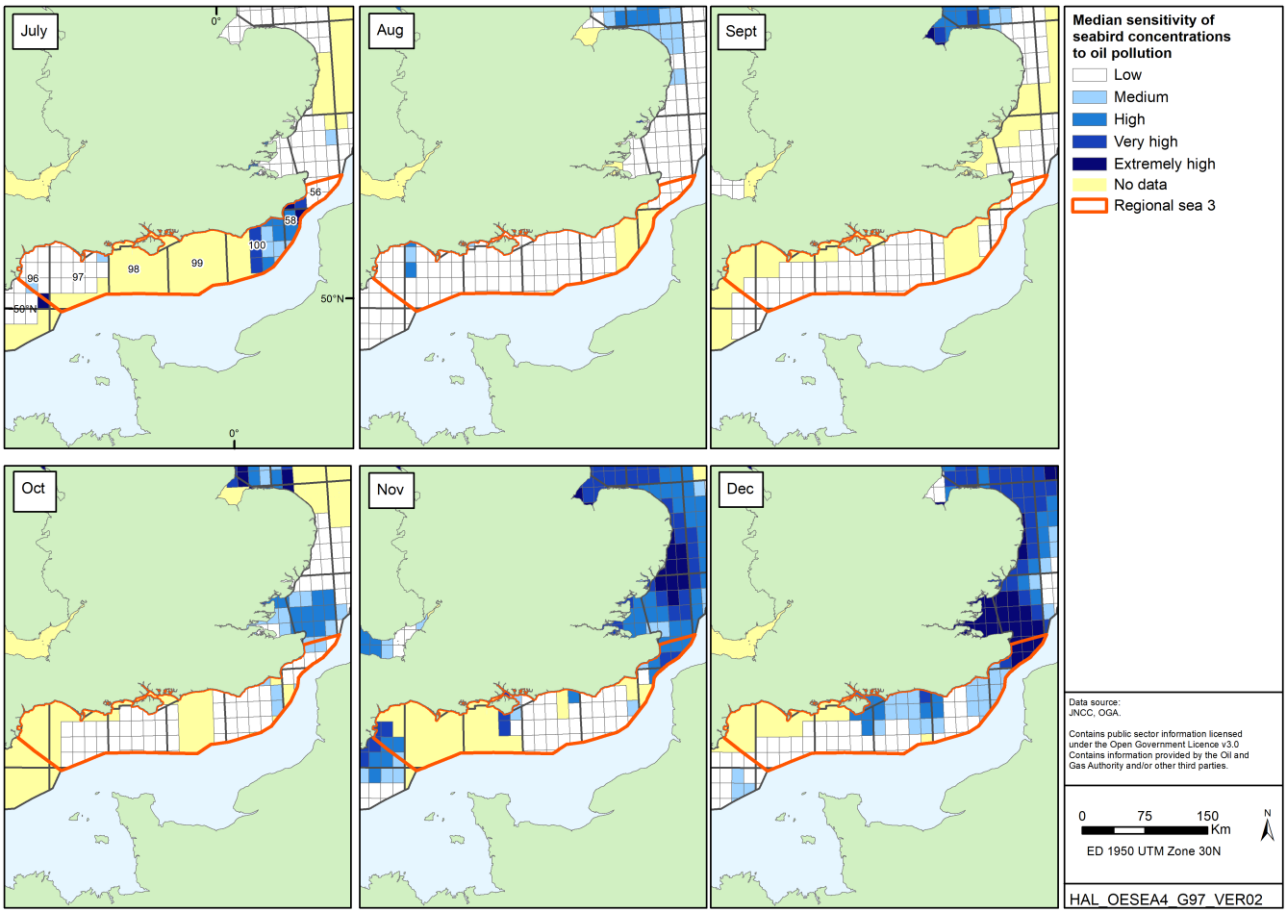


Figure A1a.5.19b: Monthly seabird oil sensitivity index scores for Regional SEA 3 (Jul-Dec)



A1a.5.20 Waterbird species and distribution (breeding, wintering and migratory)

Coastal habitats suitable for waterbird breeding within this region include estuaries, wet grassland, shingle/sand beaches and chalk cliff, and there are several notable breeding assemblages: Pagham Harbour (e.g. garganey, shoveler, gadwall and lapwing), Pett Levels (e.g. garganey and shoveler) and Rye and Chichester Harbour (e.g. ringed plover and oystercatcher). Chichester Harbour also provides important breeding areas for shelduck, while Pagham Harbour supports important numbers of Slavonian grebe during winter. Breeding redshank, lapwing, snipe and oystercatcher are found at sites further along the coast, including Poole Harbour, Southampton Water, Newton Estuary and Solent Marshes, with the Solent/Isle of Wight a stronghold for ringed plover in the region, while Abbotsbury supports colonially breeding mute swans.

The mixture of habitats along this coastline also attracts wintering and passage species, with several notable sites (see table A1a.5.15).

Table A1a.5.15: Important sites[1] for non-breeding waterbirds in Regional Sea 3

Site	Site total[2] (2019/20)	5-year average[2]	Species (designated feature)
Thanet Coast and Sandwich Bay (numbers are for Thanet Coast)	2,477 (↑)	1,724	Turnstone, golden plover
Dungeness, Romney Marsh and Rye Bay (numbers for Dungeness and Rye Bay)	22,142 (↓)	25,550	Great bittern, Bewick's swan, shoveler, golden plover, ruff **Waterbird Assemblage**
Pagham Harbour	13,953 (↑)	14,233	Ruff, dark-bellied brent goose,
Chichester and Langstone Harbours (numbers for Chichester Harbour and separately for Langstone Harbour)	33,658 (↓) 25,745 (↑)	41,881 27,293	Shelduck, wigeon, teal, pintail, shoveler, red-breasted merganser, ringed plover, grey plover, sanderling, bar-tailed godwit, curlew, redshank, ruddy turnstone, dunlin, dark-bellied brent goose **Waterfowl Assemblage**
Portsmouth Harbour	7,872 (↓)	7,568	Red-breasted merganser, black-tailed godwit, dunlin, dark-bellied brent goose
Solent and Southampton Water (numbers for North West Solent and separately for Southampton Water)	10,498 (↓) 11,258 (↓)	13,193 12,742	Teal, ringed plover, black-tailed godwit, dark-bellied brent goose **Waterfowl Assemblage**
Poole harbour	27,798 (↑)	25,042	Little egret, shelduck, pied avocet, black-tailed godwit **Waterbird Assemblage**
Chesil Beach and The Fleet (numbers for Fleet Estuary)	5,104 (↑)	3,046	Wigeon
Exe Estuary	19,484 (↓)	22,533	Slavonian grebe, oystercatcher, pied avocet, grey plover, black-tailed godwit, dunlin, dark-bellied brent goose **Waterfowl Assemblage**

Notes: [1]Sites for non-breeding waterbirds in the UK as described in the WeBS annual publication and the JNCC SPA website, designated features as described in JNCC UK Natura 2000 spreadsheet, version dated 2019-10-31, and latest changes to sites webpage. [2]Site total and 5-yr average from WeBS report online (site total tab), https://app.bto.org/webs-reporting/principal.jsp, ↓↑ denotes decrease or increase from previous years site total. Source: Frost *et al.* (2021), https://www.bto.org/our-science/projects/wetland-bird-survey/publications

There are also a number of RSPB reserves[11] in the region including Adur Estuary and Pilsey Island, notable for their wintering and passage birds, which include dark-bellied brent goose, which returns to Pilsey Island in the autumn months.

A1a.5.21 Features of Regional Sea 4 & 5

Regional Seas 4 and 5 include the western English Channel and Celtic Sea (4) and the Atlantic South West Approaches (5). Regional Sea 4 extends along the south-east English coast encompassing Devon, Cornwall, Somerset and Gloucestershire and the south Wales coast around to St Govan's Head, while Regional Sea 5 is entirely open sea (oceanic).

Sites referred to or described in this section are listed geographically south to north where possible.

A1a.5.22 Seabird species and distribution

The region is close to the southern limit of the breeding ranges of several species and 17 species are listed as breeding in Regional Sea 4 and compared to other areas around the UK, there are a limited number of sites designated for either individual species or seabird assemblages. Table A1a.5.16 provides a summary of important colonies in the region, all of which are designated as SPAs.

Table A1a.5.16: Important breeding seabird colonies in Regional Sea 4 and 5

Site	Species (designated features)
Isles of Scilly	European storm petrel, lesser black-backed gull **Seabird Assemblage**
Grassholm	Northern gannet
Skomer, Skokholm and the Seas off Pembrokeshire / Sgomer, Sgogwm a Moroedd Penfro	European storm petrel, lesser black-backed gull, Manx shearwater, Atlantic puffin **Seabird Assemblage**

Note: Sites designated as Seabird Assemblages of International Importance, under Article 4.2 of the Birds Directive, are shown in bold (qualifying level is 20,000 birds). Source: JNCC (2020) JNCC (seabird monitoring programme) website https://app.bto.org/seabirds/public/data.jsp, JNCC Special Protection Areas https://jncc.gov.uk/our-work/list-of-spas/

The Isles of Scilly form an archipelago of over 200 islands and rocks. They lie some 45km south-west of Land's End and experience low levels of disturbance and predation, making them suitable for nesting seabirds. The Isles of Scilly are important for breeding Manx shearwater, with the archipelago and Lundy (see below), the main areas where this species breeds in England.

Lundy Island in the Bristol Channel is important for its breeding seabird populations. Surveys have shown that the population of Manx shearwater had declined on the island as a result of predation by rats, and at the time of the Seabird 2000 census, numbers were recorded as 166

[11] https://www.rspb.org.uk/reserves-and-events/reserves-a-z/

AOS. A rat eradication project was completed in spring 2004 and appears to have benefited the species. A series of whole island surveys have shown significant increases compared to that seen in 2000: 1,081 AOS in 2008; 3,451 AOS in 2013 and 5,504 AOB in 2018 (JNCC website).

There is a single northern gannet colony in Wales on Grassholm, thought to be the third largest in the UK; see Regional Sea 6 regarding a possible second colony of breeding northern gannet in Wales. With the exception of numbers at Sule Stack (Orkney) and Scar Rock (Irish Sea), which both recorded a 1% decline between Seabird 2000 and their counts in 2013 and 2014 respectively, all other gannetries counted between Seabird 2000 and their most recent count, recorded increases, including Grassholm. An estimated 36,011 AON/AOS were counted in 2015, compared to 32,094 at Seabird 2000, representing an increase of 12% over this period.

Skomer and Middleholm islands support internationally important numbers of Manx shearwater and lesser black-backed gull and nationally important numbers of common guillemot and razorbill. The colony of lesser black-backed gull on Skomer was once the largest colony in Britain and Ireland while the island also supports the largest colonies of common guillemot, razorbill and northern fulmar in Wales. Skokholm has internationally important numbers of Manx shearwater and nationally important numbers of lesser black-backed gulls, while both Skokholm and Skomer also support European storm petrel, herring gull and the main Welsh colonies of Atlantic puffin. In 2018, all three Welsh colonies for Manx shearwater (Skomer, Skokholm and Midland) were surveyed, with the population here now estimated to be 500,000 pairs, and this, along with the count of 76,000 from Rum (the other stronghold for this species), suggests the UK population of Mans shearwater to be approximately 600,000 pairs, representing an increase of 50% since Seabird 2000 (JNCC 2021). In contrast, from the most recent count in 2018, lesser black-backed gull numbers have declined at Skomer and Skokholm by 46% and 56% since Seabird 2000 respectively.

As seen in many other colonies around the UK where it breeds, black-legged kittiwake numbers at Skomer and Skokholm have reduced in recent years, with a -41% change from seabird 2000 (2,257 AON) and a count in 2017 (1,336). In contrast to declines seen at many other colonies, with few notable exceptions, numbers of common guillemot at Skomer and Skokholm recorded a +120% increase from Seabird 2000 (15,171 individuals) and the count in 2019 (33,452), with numbers of razorbill also increasing from 5,306 (individuals) at Seabird 2000 to 10,120 at 2018, an increase of +91% (JNCC 2021); fewer colonies have shown a decline for this species, although like common guillemot, declines are prominent in Northern Isle colonies (Shetland and Orkney). Full details of birds present on Skokholm and Skomer throughout 2019 and the 2020 breeding season can be found in Wildlife Trust 2020 and Zbijewska *et al*. 2020, respectively.

A1a.5.23 Seabird distribution at sea

The numbers of birds at sea are generally low compared to waters further to the north. The greatest concentrations of birds at sea generally occur outside the breeding period when northern gannets and gulls are more common offshore and there is immigration by common guillemots and razorbills to offshore waters in winter (Barton & Pollock 2007).

In the breeding season the largest concentrations of birds occur around the Castlemartin coast as birds remain relatively near the Grassholm and Skomer and Skokholm colonies and waters in the far west of the region are used by relatively high numbers of Manx shearwater and northern gannet. Prior to dusk during the breeding season, adult Manx shearwaters assemble in rafts on the sea surface before returning to their burrows to feed their chicks. These rafts

can consist of several thousand individual birds and the proposed extension will cover this rafting area.

With the exception of August and October, low numbers of northern fulmar are present in the western Channel. Relatively high numbers of northern gannet are concentrated just off the Plymouth coast between November and February, with low numbers present throughout the rest of the western Channel and also between May and August. Small numbers of great skua are found off the Plymouth coast between November and March but are absent from the area during the rest of the year. Lesser black-backed gulls are present in low numbers throughout the western Channel between November and February. The species may also be present in low numbers between May and June, but their distribution is not as widespread in the Channel as previously (historically).

Great black backed gull are widespread, in low numbers, throughout the Channel between November and February, while between August and October they are concentrated in the western Channel. Black-legged kittiwake are present throughout the Channel in all months of the year.

Common guillemots are present in the Channel in low numbers between November and February, and May and June. Razorbill, which can often be associated with common guillemot, are present off the coast of Plymouth in low numbers between December and February and are relatively absent from the area for the remainder of the year (Skov *et al.* 1995). However, during the mid-winter period, at least, there are potentially substantial numbers of auks to the west of Bude Bay near Plymouth with numbers increasing, in early spring, off north Cornwall.

The Balearic shearwater breeds in the Balearic Islands and the south coast of France, before migrating and traditionally, gathering to moult in late summer in northern and central parts of the Bay of Biscay. Over the last 10 years, this moulting population has shifted northwards, with large numbers now recorded, principally between July and October, in the western English Channel, with Portland Bill in Dorset (Regional Sea 3) being a prime site. Birds are also seen off the Cornwall, Devon and west Wales coast.

A1a.5.24 Seabird vulnerability to pollution

Figures A1a.5.20a and b below shows the monthly vulnerability for the Regional SEA 4&5 areas.

There are data gaps for seven out of twelve months of the year for Regional Sea 5, with extensive data gaps also present throughout Regional Sea 4. The only month recording sensitivity for Regional Sea 5 is May (very high), with the remainder considered low. There are concentrated areas of extremely high, very high and high sensitivity for seabirds throughout the year, with the exception of April and September, where sensitivity is low throughout the area.

Figure A1a.5.20a: Monthly seabird oil sensitivity index scores for Regional SEA 4&5 (Jan-Jun)

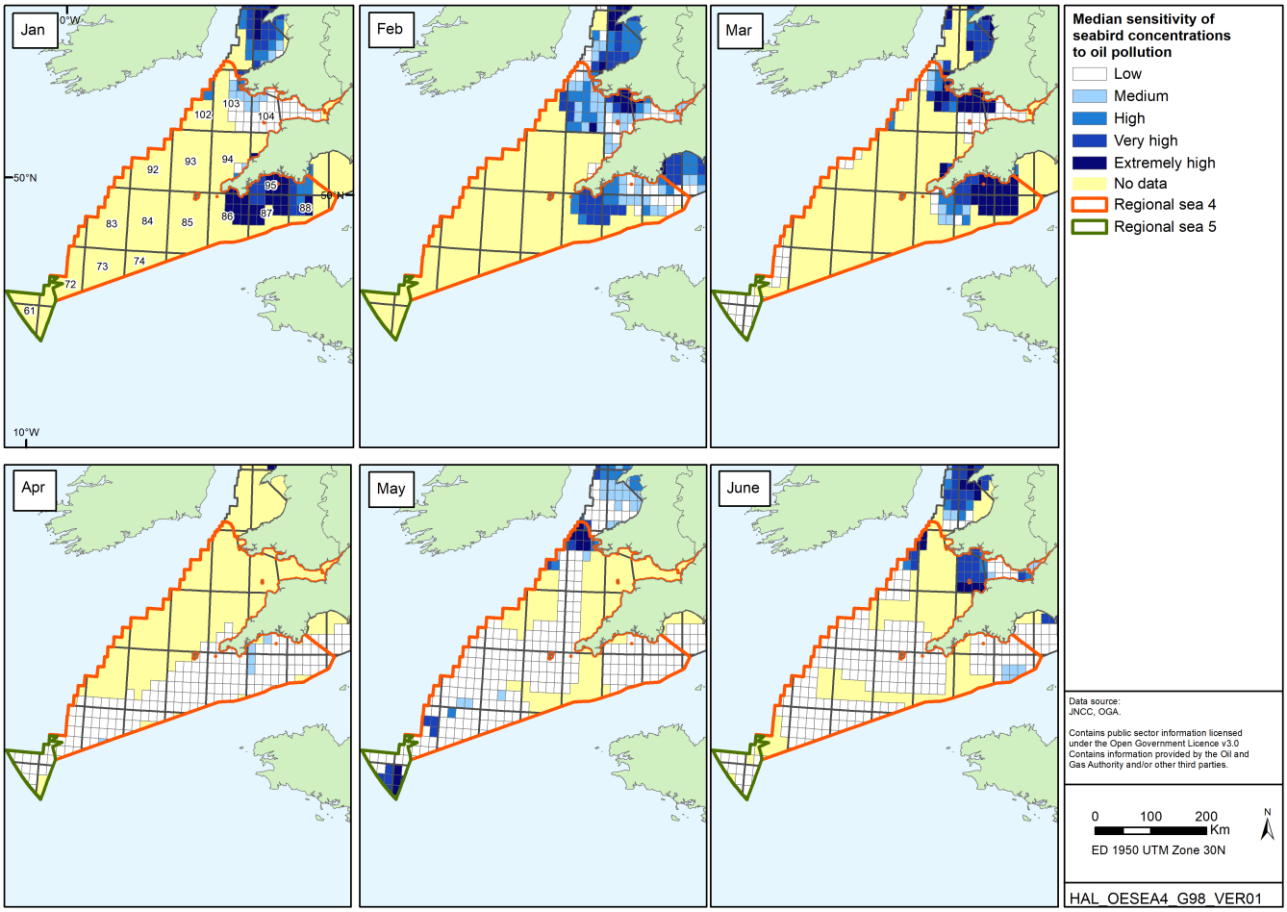
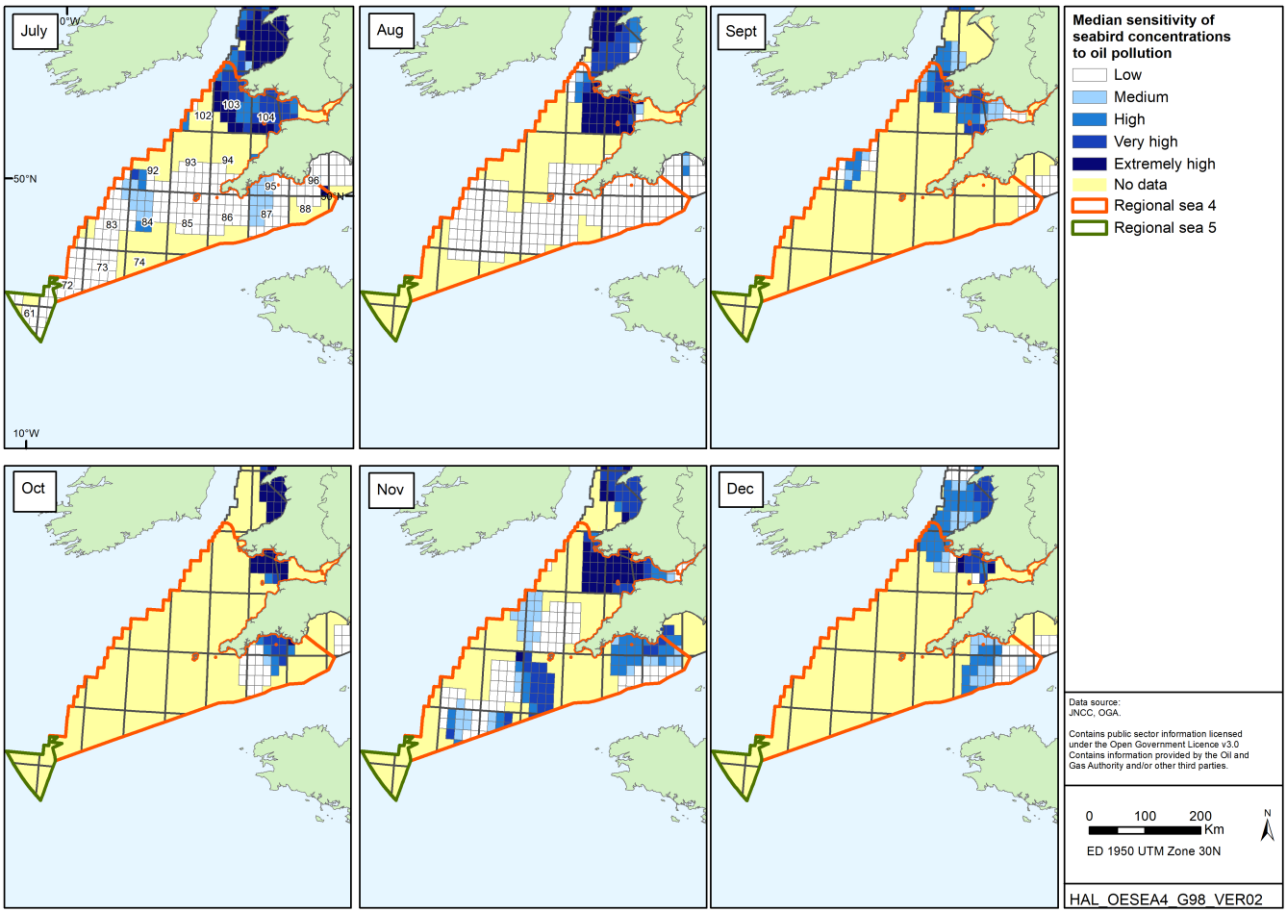


Figure A1a.5.20b: Monthly seabird oil sensitivity index scores for Regional SEA 4&5 (Jul-Dec)



A1a.5.25 Waterbird species and distribution (breeding, wintering and migratory)

The region has a number of key areas for wintering (and some breeding) waterbirds; the oceanic nature of Regional Sea 5 means that no breeding waterbirds are present. Similarly, there are no areas for wintering waterbirds and any birds within the Regional Sea 5 area are likely to be on passage. The presence of breeding and wintering waterbirds is therefore confined to Regional Sea 4.

The Severn Estuary along with the Somerset and Gwent Levels provide breeding habitat for a number of species. These areas comprise extensive areas of saltmarsh and associated wet grassland, expanses of intertidal sand and mud flats, as well as large vegetated sand dune systems and reed beds; the Somerset Levels is one of the most important areas in the region for breeding waders. Important numbers of redshank breed in the region and other notable species that breed here include snipe, teal, lapwing, ringed plover, oystercatcher and shelduck.

Smaller sites within the region, such as the Exe and Tamar estuaries support important numbers of breeding shelduck which also breed on the Isles of Scilly, along with mallard, oystercatcher and ringed plover.

The region is important for wintering birds as well as birds on passage; the region lies on the major migratory flyway of the east Atlantic, with many birds passing through this area on their way to and from wintering areas on the African, Mediterranean and south-west European coasts to Arctic breeding grounds. The important of the region can also increase for these birds if severe weather affects sites in the east of Britain or Europe, with numbers at sites such as the Severn Estuary seen to increase thought to be as a response to cold weather elsewhere and using the area as a cold weather refuge (BTO website).

The most important sites for non-breeding waterbirds in the region are shown in Table A1a.5.17 below, all of which are designated as SPAs, some of which are also designated for their Wetland Assemblages of International Importance (see also Conservation section A1j). Sites are listed geographically south to north.

Table A1a.5.17: Important sites[1] for non-breeding waterbirds in Regional Sea 4

Site	Site total[2] (2019/2020)	5-year average[2]	Species (designated feature)
Tamar Estuaries Complex (numbers for Tamar Complex)	4,799 (↓)	4,985	Pied avocet
Somerset Levels and Moors (numbers for Somerset Levels)	98,843(↓)	99,261	Teal, golden plover, lapwing, Bewick's swan **Waterfowl Assemblage**
Falmouth Bay to St Austell Bay	-	-	Black-throated diver, great northern diver, Slavonian grebe
Severn Estuary	64,877 (↓)	85,643	Bewick's swan, shelduck, gadwall, redshank, greater white-fronted goose, dunlin **Waterfowl Assemblage**
Burry Inlet	18,208 (↓)	36,468	Shelduck, wigeon, teal, pintail, shoveler, oystercatcher, grey plover, knot, curlew, redshank, ruddy turnstone, dunlin **Waterfowl Assemblage**

Site	Site total[2] (2019/2020)	5-year average[2]	Species (designated feature)
Bae Caerfyrddin/Carmarthen Bay (marine SPA)	14,083 (↓)	18,729	Common scoter
Northern Cardigan Bay / Gogledd Bae Ceredigion	-	-	Red throated diver

Notes: [1]Sites for non-breeding waterbirds in the UK as described in the WeBS annual publication and the JNCC SPA website, designated features as described in JNCC UK Natura 2000 spreadsheet, version dated 2019-10-31, and latest changes to sites webpage. [2]Site total and 5-yr average from WeBS report online (site total tab), https://app.bto.org/webs-reporting/principal.jsp, ↓↑ denotes decrease or increase from previous years site total. *Source: Frost et al. (2021), https://www.bto.org/our-science/projects/wetland-bird-survey/publications*

Two other SPAs in the region are Castlemartin Coast and Ramsay and St David's Peninsula Coast, both with breeding and wintering chough as their protected feature.

For breeding species, key areas in the region for wintering birds are the Severn Estuary and the Somerset Levels and Carmarthen Bay, with inshore areas also important for wintering seaduck including the area around Falmouth; the Falmouth Bay to St Austell SPA designated in 2021, ,acknowledging the importance of the area for diver and Slavonian grebe.

The Severn Estuary is one of the largest estuaries in the UK and supports significant numbers of wintering and passage birds; wintering numbers at this site are regularly in excess of 70,000 individuals and at peak times, is one of the few UK estuaries that support in excess of 100,000 birds. Aggregations of shelduck gather to moult post-breeding and British and Irish birds move to the Helgoland Bight of the Wadden Sea and can be here from mid-July to the end of August, before returning to wintering grounds. Significant late summer moulting concentrations of shelduck can also occur in the UK, including at Bridgewater Bay in the Severn Estuary (JNCC website).

Carmarthen Bay was the first wholly marine SPA designated in the UK – and this was designated for a single feature, wintering common scoter. It is estimated that more than 50% of the non-breeding population of this species is found at fewer than ten sites in the UK and Carmarthen Bay is considered one of the most important, although numbers here do fluctuate, with numbers and distribution thought to reflect the density of food available. The most consistent feeding areas are offshore from Amroth and Pembrey Sands (Carmarthen Bay and Estuaries European Marine Site website[12]).

Although not designated as an SPA (numbers counted did not meet threshold for designation), the South Cornwall Coast is important for black-necked grebe; as part of the assessment of the area for potential designation, 39 individuals were counted, this being the highest marine population counted, making this area the most important in the UK for this species (O'Brien *et al.* 2014). The number for red-necked grebe (6 individuals) was the largest population in England and the most southerly population in the UK, making the area a potential contributor to the range requirements for this species and the number counted for European shag (333 individuals) was one of the largest populations in England and one of the most southerly, again contributing to the range requirements (O'Brien *et al*. 2014).

[12] http://english.cbeems.org/the-ems/carmarthen-bay-spa/

Outside Scotland, the South Cornwall area is the most important area for a number of these species: the area is several hundred miles south of the main UK wintering population of great northern diver; the area is the third most important for red-necked grebe, after the Firth of Forth and Scapa Flow and during winter, European shag have a northerly distribution, with coastal areas of Scotland supporting high numbers, so numbers at Gerrans's Bay on the South Cornwall coat are amongst the most important outside Scotland (O'Brien *et al*. 2014).

A1a.5.26 Features of Regional Sea 6

Regional Sea 6 encompasses the Irish Sea and includes several important seabird breeding colonies, most notably those on offshore islands and estuarine systems.

Sites referred to or described in this section are listed geographically south to north where possible.

A1a.5.27 Seabird species and distribution

All 25 seabird species known to breed in the UK, breed in the Irish Sea area; the majority of those breeding however are made up of just five species: Manx shearwater; northern gannet; lesser black-backed gull; common guillemot and herring gull. The area supports one of two large gannetries located in the wider west coast region, at Ailsa Craig (see below), the other being Grassholm (see Regional Sea 4 and 5).

There are a number of important seabird colonies (Table A1a.5.18) in the region and all sites listed below are designated SPAs.

Table A1a.5.18: Important breeding seabird colonies in Regional Sea 6

Site	Species (designated features)
Glannau Aberdaron and Ynys Enlli / Aberdaron Coast and Bardsey Island	Manx shearwater
Anglesey Terns / Morwenoliaid Ynys Môn	Arctic tern, common tern, roseate tern, sandwich tern
Ynys Seiriol / Puffin Island	Great cormorant
Mersey Narrows and North Wirral Foreshore	Common tern (also designated for concentrations of common tern and little gull)
The Dee Estuary	Common tern, little tern
Ribble and Alt Estuaries	Common tern, lesser black-backed gull, black-headed gull **Seabird Assemblage**
Morecambe Bay and Duddon Estuary	Little tern, sandwich tern, common tern, herring gull, lesser black-backed gull (also for concentrations of lesser black-backed gull) **Seabird Assemblage**
Morecambe Bay	Sandwich tern **Seabird Assemblage**
Liverpool Bay / Bae Lerpwl	Common tern, little tern, little gull (non-breeding season)
Irish Sea Front	Manx shearwater
Carlingford Lough	Common tern, sandwich tern
Strangford Lough	Arctic tern, common tern, sandwich tern
Belfast Lough	Common tern, Arctic tern

Site	Species (designated features)
Outer Ards	Arctic tern
Copeland Islands	Manx shearwater, Arctic tern
Larne Lough	Common tern, roseate tern, sandwich tern, Mediterranean gull
Ailsa Craig	Lesser black-backed gull, northern gannet, herring gull, black-legged kittiwake, common guillemot **Seabird Assemblage**

Notes: Sites designated as Seabird Assemblages of International Importance are shown in bold (qualifying level is 20,000 birds). Source: JNCC (2020) JNCC (seabird monitoring programme) website https://app.bto.org/seabirds/public/data.jsp, JNCC Special Protection Areas https://jncc.gov.uk/our-work/list-of-spas/

There are also a couple of coastal SPAs in the region for breeding and wintering chough, e.g. Mynydd Cilan, Trwyn y Wylfa ac Ynysoedd Sant Tudwal / Mynydd Cilan, Trwyn y Wylfa and the St Tudwal Islands SPA and Glannau Ynys Gybi / Holy Island Coast SPA.

The Glannau Aberdaron and Ynys Enlli/Aberdaron Coast and Bardsey Island SPA holds a large breeding population of Manx shearwater (as well as a resident population of chough, the other bird species listed as a feature of the site) in excess of 16,000 birds. Manx shearwater feed outside the SPA as well as in the Irish Sea, but the importance of the waters around the SPA have been acknowledged in the extension to the SPA boundary to include marine feeding areas. Work is continuing between the Welsh government, Natural Resources Wales and JNCC in identifying potential sites, including marine protected areas, for potential future designation and the management of existing sites.

Sandwich terns are confined to one location in Wales, at Cemlyn Lagoon on Anglesey, and Arctic tern, in Wales, only breed on Angelsey. Between 2001 and 2015 (with the exception of 2008), the colony of Sandwich terns regularly held over 2,000 pairs with numbers fluctuating since then; numbers declines in 2017 and 2018 to 1,980 AON and 519 AON respectively and increased in 2019 to 1,200 AON (JNCC 2021).

The Skerries, lying approximately 3km off Carmel Head, Anglesey, holds at least 95% of the Welsh population of Arctic tern, and over 3,500 pairs were recorded nesting here between 2013 and 2015, with numbers declining in 2017 (2,770 AON) and increasing slightly, but still lower than the peaks of 2013-2015, to 2,814 in 2019 (JNCC 2021).

The islands were recolonised by terns in 1980 following historic fluctuations in numbers from 10,000 pairs of Arctic terns recorded in 1908, to their absence between 1961 and 1979. Since the 1980's the population of Arctic Terns steadily increased until 2016 when an apparent botulism outbreak caused the death of adults and fledgling Arctic and Common Terns. A dip in numbers followed in 2017, before recovering to around 3,000 pairs of Arctic terns and 300 pairs of common terns in 2018 and 2019. The island has been recently recolonised by a small number of Roseate Terns and also supports Atlantic puffin, herring gulls, lesser – and great black-backed gulls (Booth, 2020).

Currently there are only two colonies of little tern in Wales, at Gronant (Clwyd) at the Dee Estuary, where numbers have fluctuated over the years, but has shown a general upward trend and a small colony (3 AON recorded in 2019) at Point of Ayr (JNCC 2021).

During the breeding season, over 61,000 individual seabirds can be present at Morecombe Bay, and this site is a Seabird Assemblage of International Importance, as are the Ribble and

Alt Estuaries which, regularly support 30,000 individual seabirds, including black headed gull and lesser black-backed gull; the area is also important for its breeding population of common tern. The Ribble Estuary is the larger of the two and during the summer, the large expanse of saltmarsh and areas of coastal grazing marsh support large concentrations of breeding seabirds which feed both offshore and inland.

St Bee's Head is the only English breeding site for black guillemot where numbers have been steadily declining; fourteen individuals were counted during the Seabird Colony Register census, numbers halving by Seabird 2000, with ten individuals counted in 2011 and 2012, this further declining to only four individuals recorded in 2018 and five in 2019 (JNCC 2021).

The Isle of Man has a diversity of habitats suitable for supporting a number of different breeding seabirds; but like other areas of the UK, breeding bird numbers have fluctuated. A census of the Isle of Man breeding seabirds was undertaken between 2017 and 2018[13] (the OIM 2017-2018 census) (see Hill *et al*. 2019 for full details).

Approximately 1km off the north coast of Anglesey is the small island of Middle Mouse (Ynys Badrig), which supports over 5,000 breeding common guillemot, a colony that is believed to be increasing (The Seabird Group 2022). Since a recent (2019) observation of northern gannet on the rock (*ca* 20 individuals), along with birds circling (*ca* 150), cameras were deployed in 2020 and 2021 to record any presence and behaviour, suggestive of breeding birds. Images captured suggested birds, thought to be adults and not immatures, occupied the island from late May, through to middle of July, departing the same time as the common guillemot; images from 2021 suggests considerably more northern gannet settled in 2021, compared with 2020 and there was evidence of breeding behaviour displays (e.g. sky-pointing and nest building) (The Seabird Group 2022). Monitoring work is continuing during the 2022 summer, by Bangor and Swansea University, which may provide evidence of the development of a new colony for this species in Wales.

In Northern Ireland, three species have moved from the amber list of the birds of conservation concern Ireland (BoCCI) due to their international level of conservation importance: Atlantic puffin; razorbill and black-legged kittiwake. The latter of these, black-legged kittiwake, whilst remaining relatively stable in Northern Ireland, or at least declining at a lower rate than the rest of the UK, has moved to the red list due to their increased global conservation status (BTO 2022). There are a number of important sites for seabirds in this region: Carlingford Lough; Strangford Lough; Outer Ards; Big Copland; Copeland Islands; Larne Lough; Bird Island; The Gobbins and The Maidens. There remains some monitoring gaps for some of these, whereby annual coverage, or regular monitoring is unavailable, e.g. Big Copland, the Copeland Islands, principally due to accessibility issues.

The largest colony for black-legged kittiwakes is on Rathlin Island (see regional sea 7), the second biggest being on The Gobbins, approximately 10% the size of the Rathlin colony which recorded 1,145 AON in 2019, an increase of 68% over 2018 numbers (there have been no counts of this site in 2020 or 2021) (BTO 2022). In 2020, there was also a count of black-legged kittiwake at the coastal colony between Maggy's Leap to Newcastle (east coast), where numbers had increased to 759 AON, following a pattern of increase since 2015 (BTO 2022). The population on Muck Island has also continued to increase (BTO 2022). Although the population remains relatively stable in Northern Ireland, productivity seems more variable,

[13] The census commenced in 2017 however, due to logistics issues, the census of black guillemot was undertaken in 2018.

however, there are few sites where this is monitored and this may not reflect the overall trend for this species.

The most important site in Northern Ireland for great black-backed gulls is on Great Minnis's Island, Strangford Lough, where in 2021, 143 AON were recorded. Burial Island, Outer Ards peninsula, is now thought to be the second biggest colony in Northern Ireland; although there has been no survey here since 1998, when no birds were present, a population has re-established here (BTO 2021). At Carlingford Lough, although numbers here are low, this is the third most important site in Northern Ireland for great black-backed gull. The population across Northern Ireland appears to have more than doubled since the last census, and an estimated 1,000 great black-backed gull are also thought to be present in Northern Ireland during the winter, with the result, this species has been downgraded from Amber listed to Green listed on the Birds of Conservation Concern Ireland list (Gilbert *et al*. 2021). The population of lesser black-backed gulls at Strangford Lough has continued to grow, with the largest count to date made in 2021, when 442 AON were recorded.

At Carlingford Lough, Sandwich terns formerly bred here before abandoning the site. However, in 2014, the species had the first successful breeding here since 2010 (BTO 2015). In 2015, 250 AON were recorded however, in 2021 breeding success was still very poor with only 52 AON were recorded (BTO 2022); numbers have been consistently low in recent years, and whilst the reasons for this are unknown, predation of eggs and young by otter is suspected. Widespread throughout Northern Ireland, the most significant number of breeding common tern are found at a few sites, including the coastal sites at Strangford Lough and Belfast Lough (BTO 2022). Compared with 2020 records, significant increases of this species was seen at both sites in 2021, although it is suspected that mink predation at Belfast Lough did impact overall numbers.

Arctic terns also breed at Carlingford Lough, although these have not been counted in recent years, a decline was evident between the last counts at 2018 and 2019 (BTO 2020).

In Northern Ireland, the black headed gull is a widespread breeding species in relatively few large colonies, with major concentrations at several sites including Strangford Lough, Belfast Lough, and Copeland Islands (BTO 2022).

Small numbers of Atlantic puffin (54 individuals) were recorded in 2019 on The Gobbins, where numbers have remained similar to that recorded between 2013 and 2018, and, while they have occasionally been seen on Muck Island, breeding has not been confirmed here. However, on Copeland Islands, where a conservation project has been carried out, using decoys and lures, breeding was confirmed here in 2015, with 68 individuals recorded in 2021 (BTO 2022). The main colony for this species is on Rathlin, as is the main colony for razorbill. In regional sea 6, individuals were recorded for the first time on Copeland Islands, and whilst not thought to be breeding individuals, the sighting is encouraging for future potential breeding attempts. At Muck Island, in 2019, 1,118 individuals were recorded, the highest ever recorded, but, in 2021, the lowest numbers were recorded since 2014; decreases where also seen at The Gobbins colony nearby, with a 23% decrease between 2018 and 2019, although no counts were made during 2020 and 2021 (BTO 2022).

One of the largest colonies of lesser black backed gulls in England was located at South Walney, which during Seabird 2000 held over 30% of the national population (Mitchell *et al.* 2004). Since then, numbers have fallen considerably; in 1999 some 19,487 AON were recorded, compared to only 3,850 AON in 2014 (JNCC 2015). This decline has continued over recent years (2017 = 2,782 AON, 2018 = 1,981, 2019 = 390, 2020 = 381 (the count from 2020 undertaken using drones) (colony count data - JNCC 2021).

Ailsa Craig in the outer Firth of Clyde, is important for cliff nesting species including black-legged kittiwake, northern fulmar, common guillemot, razorbill, northern gannet and herring gull. The area is a Seabird Assemblage of International Importance as it supports some 65,000 individual seabirds during the breeding season. The decline of black-legged kittiwake numbers has also been evident at this colony; 1,675 Apparently Occupied Nests (AON) were recorded at Seabird 2000, compared to only 300 AON recorded in 2019 survey, a decline of over 80% (JNCC 2021). There has also been a 34% decline in common guillemot numbers on Ailsa Craig between Seabird 2000 (9,415 individuals) and the most recent survey in 2019 (6,180 individuals) (JNCC 2021).

A1a.5.28 Seabird distribution at sea

The offshore feeding areas for birds from breeding colonies in Regional Sea 6 are of key importance (Tasker 1995) and this is being recognised through either extensions to existing SPA boundaries (i.e. Liverpool Bay/Bae Lerpwl) and areas being considered for protection (e.g. seas around Anglesey for Arctic, common, Sandwich and roseate tern and). Most auks feed within 30km of the colony, while northern gannets and lesser black-backed gulls frequently forage near fishing fleets in and around the area (Stone *et al*. 1995). Offshore sandbanks, such as Bais Bank (off St David's Head, Pembrokeshire) are important for sandeels (*Ammodytes* spp), a key prey species for a number of seabirds.

Areas of the Irish Sea vary in importance over the year. Manx shearwater returns to European waters in spring to breed and from May to August birds remain relatively close to their breeding colonies. Fronts are regions of enhanced biological productivity and in August and September, flocks of Manx shearwater in the Irish Sea Front area possibly hold the majority of the population from the adjacent UK breeding colonies before they leave for their wintering grounds. Different species (e.g. Manx shearwater, common guillemots, and razorbills) have been observed to utilise spatially distinct areas of the Irish Sea Front, indicative of different foraging strategies.

Northern gannet, are present throughout the year, but are generally only in the North Channel and St George's Channel in autumn and winter (Mackey *et al*. 2005). Moderate numbers of birds are recorded in summer, with highest numbers in mid to late summer (peak counts from WWT surveys carried out between 2001 and 2007 were 357 birds) (BERR 2007). Birds concentrate around colonies during the breeding season and following breeding, are more widely distributed throughout the Irish Sea, with concentrations found around the Irish Sea and Celtic Sea Fronts. Small numbers have been recorded in early winter (96 birds), dropping as winter progressed. Birds occurred offshore from Fleetwood to the Ribble Estuary and off north Wales, with birds off the Cumbrian coast occurring closer to shore. Highest densities were recorded offshore during this time (BERR 2007).

Other species found in the area throughout the year are great cormorant and European shag primarily in coastal regions off Liverpool (great cormorant) and in the North Channel (European shag). Herring gulls are also present year round with concentrations offshore and in coastal waters of the central Irish Sea. Black-legged kittiwakes are widely distributed over the whole of the area (Mackey *et al.* 2005). The WWT surveys between 2001 and 2007 recorded peaks of 281 birds in early summer and 325 birds in mid-winter (BERR 2007), with little variation in numbers during winter. During summer, distribution is patchy and areas off north Wales hold larger numbers, with more birds off Blackpool than in winter and few birds off Cumbria.

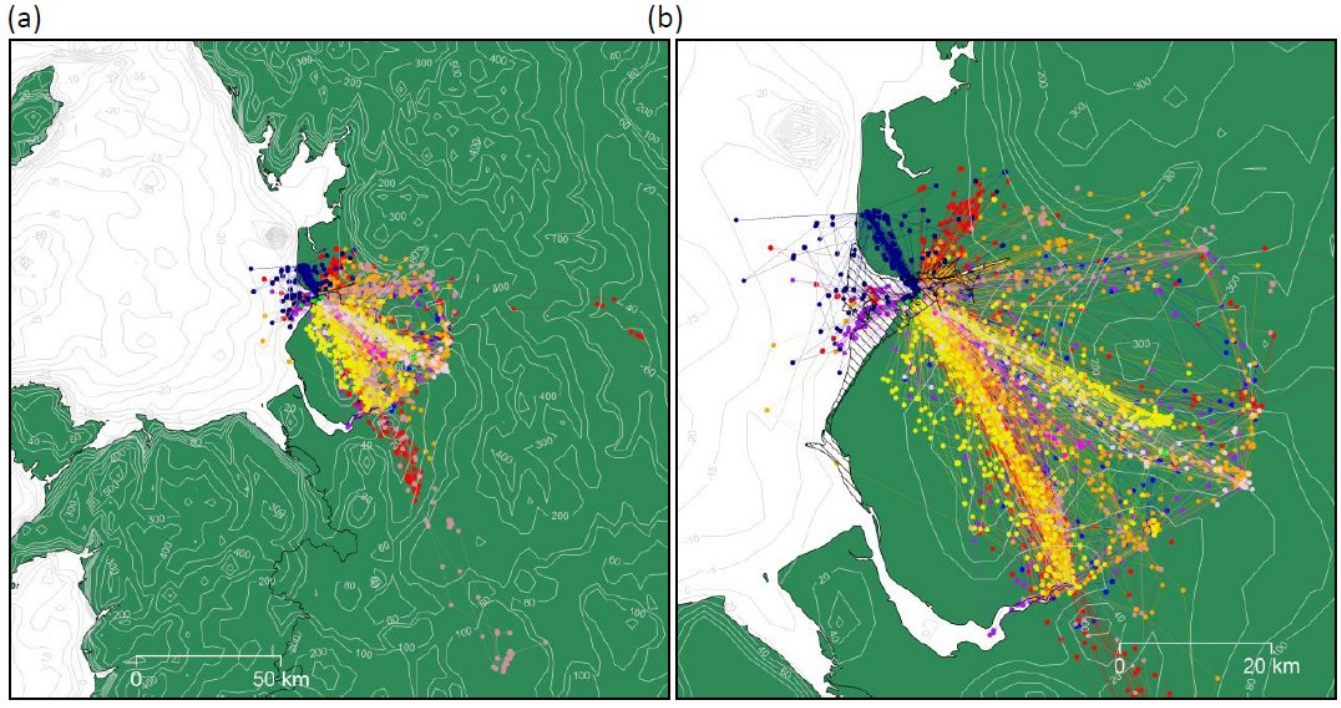
Highest densities of common guillemot are generally observed during the breeding and post-breeding seasons, located in coastal waters around colonies. Densities decrease during autumn and winter, but they remain present in the area (Mackey *et al*. 2005). Razorbill

distribution is generally less widespread than that of common guillemots. Both species congregate in large concentrations post breeding, where adults moult and the young are still flightless. Concentrations of moulting auks are found throughout the Irish Sea from July through August, becoming more localised in the western and central Irish Sea during late August and September. In mid-late summer, concentrations have been recorded in offshore waters off Blackpool and inshore areas around Great Ormes head (BERR 2007) and by October and through November high densities are still present in the North Channel, with concentrations also found in the eastern Irish Sea and Cardigan Bay (Webb *et al.* 1995). Peak numbers of auks in early and mid-winter have been recorded in the north-west of the region, after which numbers dropped slightly and large concentrations recorded off Anglesey and offshore from the mouth of the Solway (BERR 2007).

In winter, concentrations of little gull are found in Liverpool Bay, with a wintering population in the Irish Sea, some utilising sandbanks south of Dublin Bay (area outwith the scope of this SEA) as roosts. The WWT surveys from 2001-2007 found little gulls in offshore areas from Cumbria to the Dee Estuary and that these gradually moved closer to shore from the Ribble Estuary southwards as winter progressed (BERR 2007).

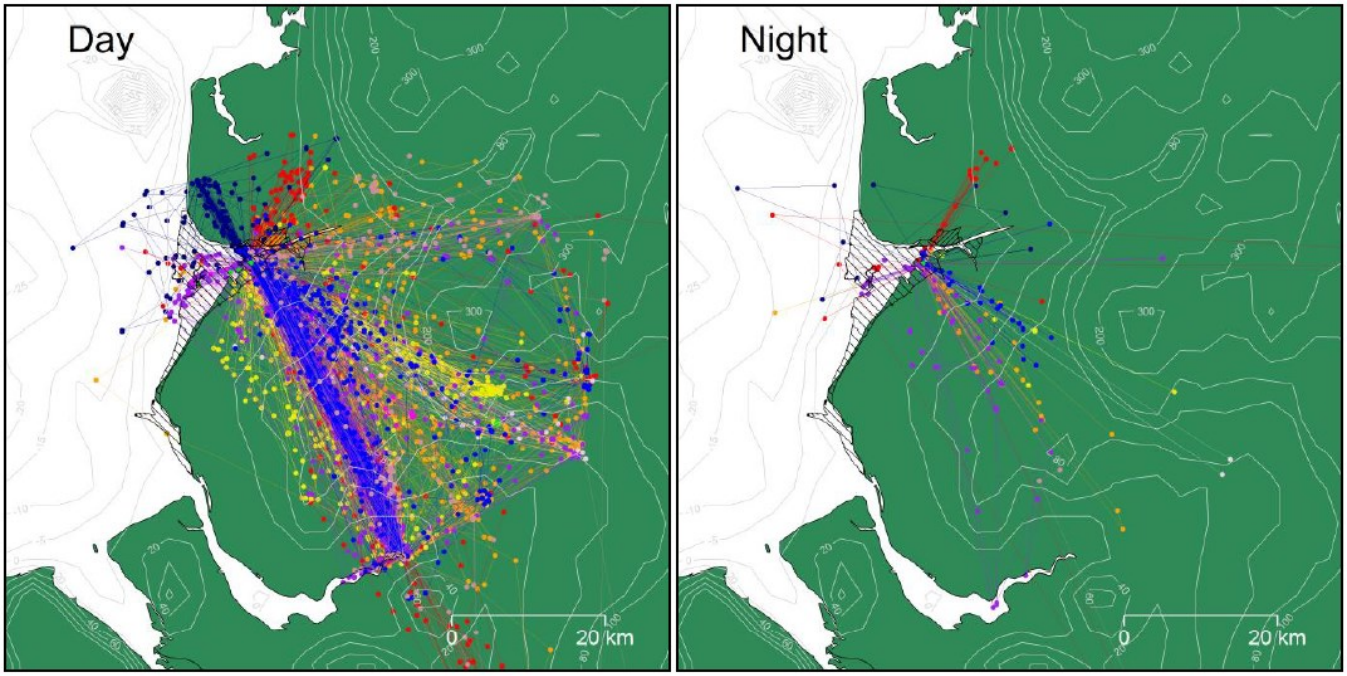
A study was undertaken to track lesser black-backed gulls, from the Ribble and Alt Estuaries SPA, in order to assess the home ranges of adult birds and also to assess their flight altitudes (Scragg *et al*. 2016). Tracks from 10 birds were obtained during the 2016 breeding season (see Figure A1a.5.21), with tracks also recorded for night activity (Figure A1a.5.22).

Figure A1a.5.21: Tracks of lesser black-backed gulls from the Ribble Estuary during the 2016 breeding season



Note: a) the total extent of movement, and b) a finer-scale representation with the SPA (diagonal hash top-left to bottom-right) and Warton Aerodrome (diagonal hash bottom-left to top-right) overlain. Each bird (n=10) movements are represented as a different colour. Source: Scragg *et al.* (2016)

Figure A1a.5.22: Tracks of lesser black-backed gulls from the Ribble Estuary during the 2016 breeding season during day and night



Note: a) day time and b) night-time, for which overlaps were assessed with the SPA (diagonal hash top-left to bottom-right) and Warton Aerodrome (diagonal hash bottom-left to top-right) overlain. Each bird (n=10) movements are represented as a different colour. Source: Scragg *et al.* (2016)

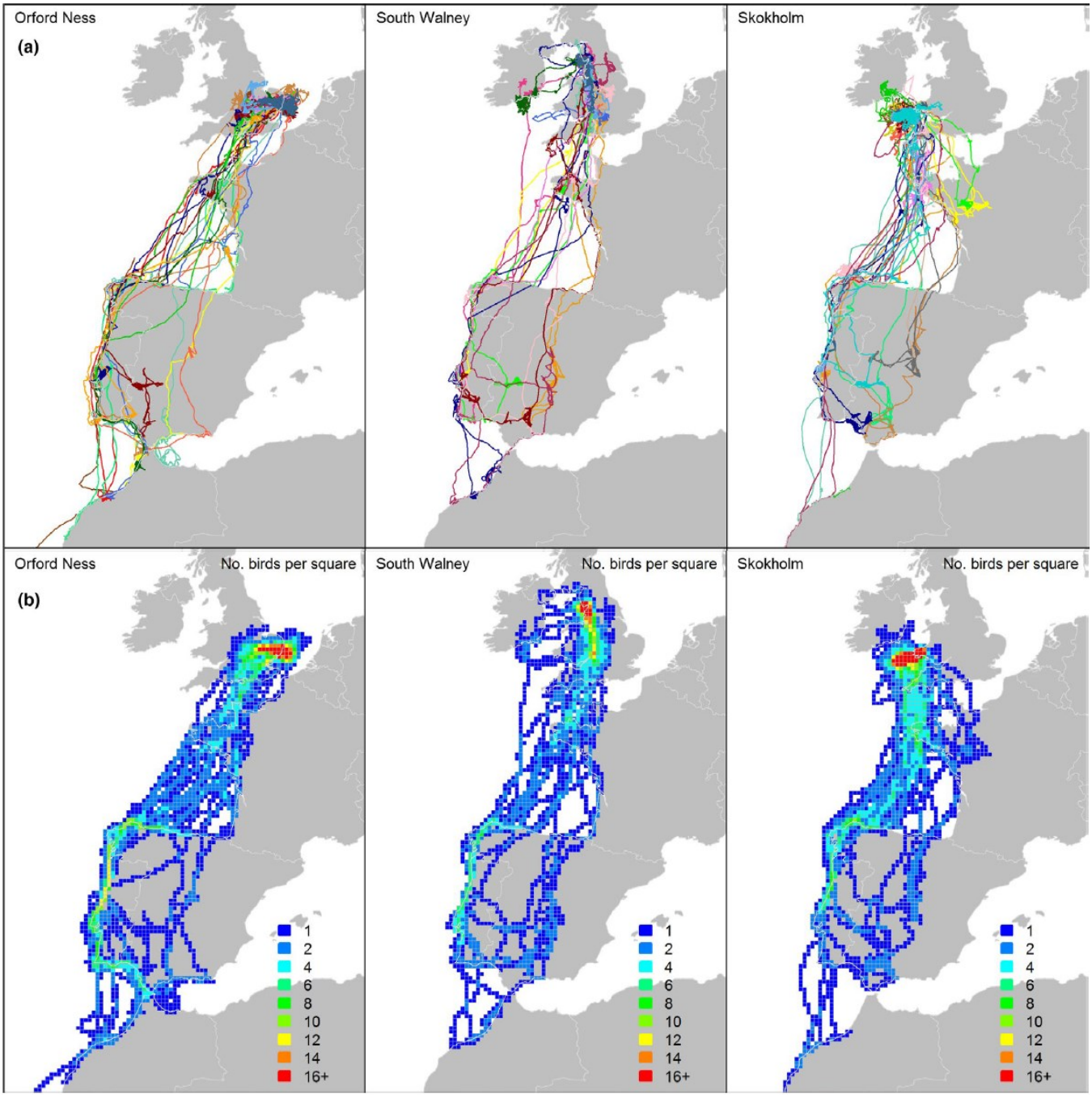
As part of the SEA-programme of research, lesser black back gulls were tagged from three colonies; South Walney (Regional Sea 6), Skokholm (Regional Sea 4) and Orford Ness (Regional Sea 2), to look at the migratory movements of this species from the three different colonies (Figure A1a.5.23) to identify the possible connectivity with offshore wind farms (constructed and proposed) in the UK and those that may be present along their migration route (Thaxter *et al.* 2019).

A further project to assess the distribution of lesser black-backed gulls from the colonies at South Walney and Barrow-in-Furness, and their connectivity with the extensions to the Walney Extension and Burbo Bank Extension offshore wind farms was undertaken (Clewley *et al*. 2020). Over a three year period (2016-2018) a total of 57 birds were tagged (South Walney n=25, Barrow = 32).

Clewly *et al*. (2020) collected tag data over four breeding seasons (2016, 2017 and 2018 and 2019) and three non-breeding seasons (2016/2017, 2017/2017 and 2018/2019). Work was undertaken in order to understand the connectivity between lesser black-back gulls and renewable developments in the Irish Sea and Liverpool Bay, (i.e. Walney and Burbo Bank developments, and the subsequent extensions of these) (see Figure A1.a.5.24 and Clewley *et al*. 2020 for further details).

Lesser black-backed gulls are recorded travelling up to 236km during the breeding season (mean max (km) (+1SD) (Woodward *et al.* 2019); annual mean foraging ranges from South Walney were reported as between 11-14km (Thaxter *et al.* 2018) and 9-14km (Clewley *et al*. 2020), with ranges appearing to be colony specific; foraging ranges from birds tagged at Barrow had significantly smaller ranges with a maximum annual mean of *ca*. 6km, with the core home ranges for both colonies indicating predominately terrestrial foraging with very limited overlap with the wind farm extension areas.

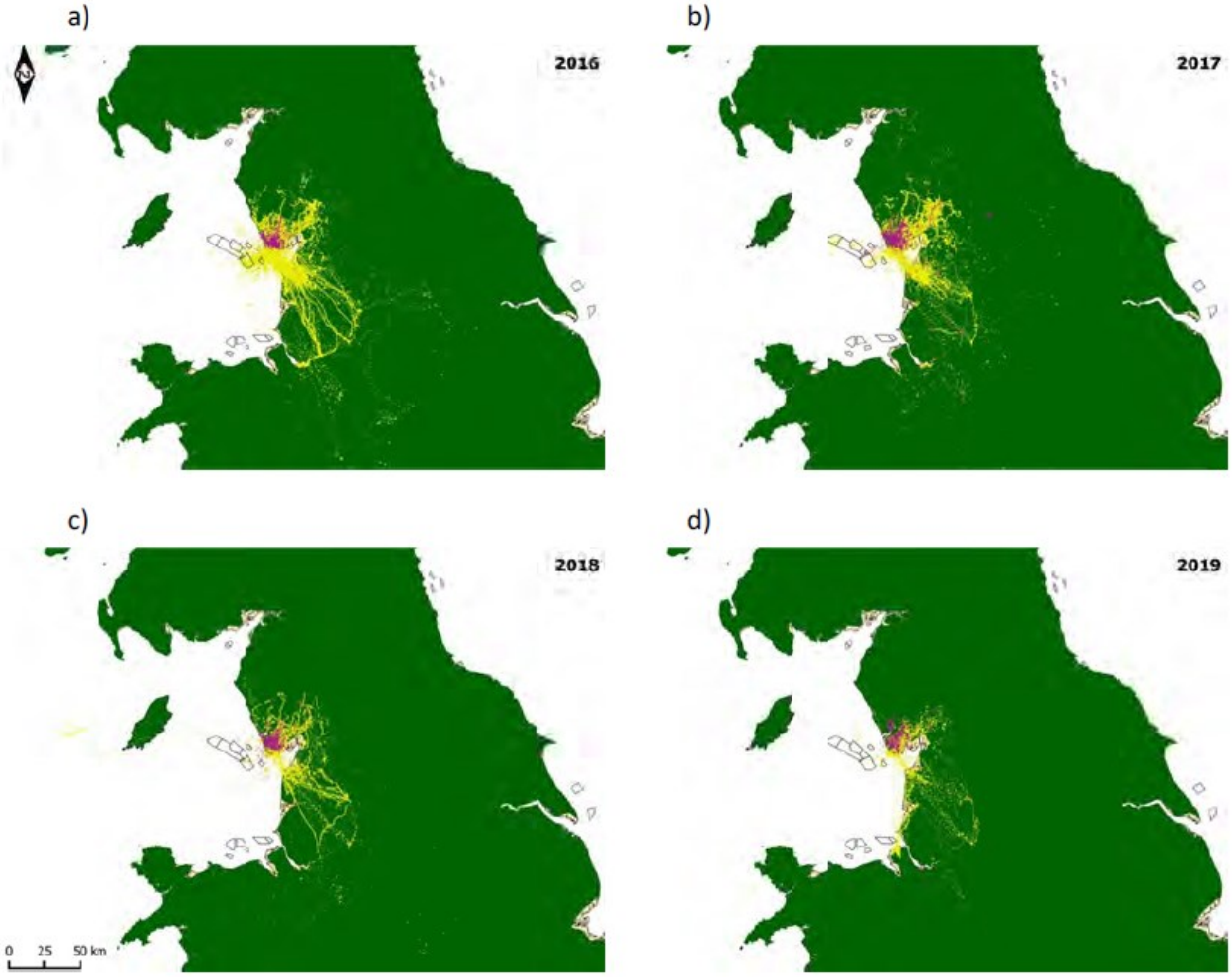
Figure A1a.5.23: Tracked migration routes of lesser black-backed gull from three UK colonies



Note: Movements of birds through the year as (a) GPS tracks and (b) the annual flux of movement, depicted as number of bird per square per year. Source: Thaxter *et al.* (2019)

The study found little overlap of birds from South Walney and the OWF extensions and only marginal overlap of birds from the Barrow colony; the core home range for both colonies indicated predominately terrestrial foraging, with little overall time (<5%) spent offshore (Clewley *et al*. 2020).

Figure A1a.5.24: Tracked lesser black-backed gulls breeding at South Walney and Barrow-in-Furness for the 2016-2019 breeding seasons



Note: All GPS fixes from tracked birds from South Walney (yellow) within the Morcambe Bay and Duddon Estuary SPA and Barrow-in-Furness (purple). Outlines of offshore wind farm areas of interest shown in black. Source: Clewley *et al.* (2020)

The importance of marine areas in the region for black guillemot has also been acknowledged by the designation of the Clyde Sea NC MPA. This covers an area from the Mull of Kintyre to the Rhins of Galloway, and encompasses a persistent thermal front located where the waters of the Irish Sea meet the calmer, less saline waters of the Clyde Sea. There are a number of protected features within the site, including black guillemot, a breeding colony of which forage around Sanda, Sheep Islands and Glunimore in the north-west of the MPA (NatureScot SiteLink 2022a).

In 2016, aerial surveys were carried out in order to assess the occurrence and distribution of seabird species in the western Irish Sea (Jessop *et al*. 2018) and, whilst this records seabirds out to the extent of the surveyed area, birds from colonies on the east coast of Ireland, could be present in the regional sea 6 area.

A1a.5.29 Seabird vulnerability to pollution

Figures A1a.5.25a and b below shows the monthly vulnerability for the Regional SEA 6 area.

Figure A1a.5.25a: Monthly seabird oil sensitivity index scores for Regional SEA 6 (Jan-Jun)

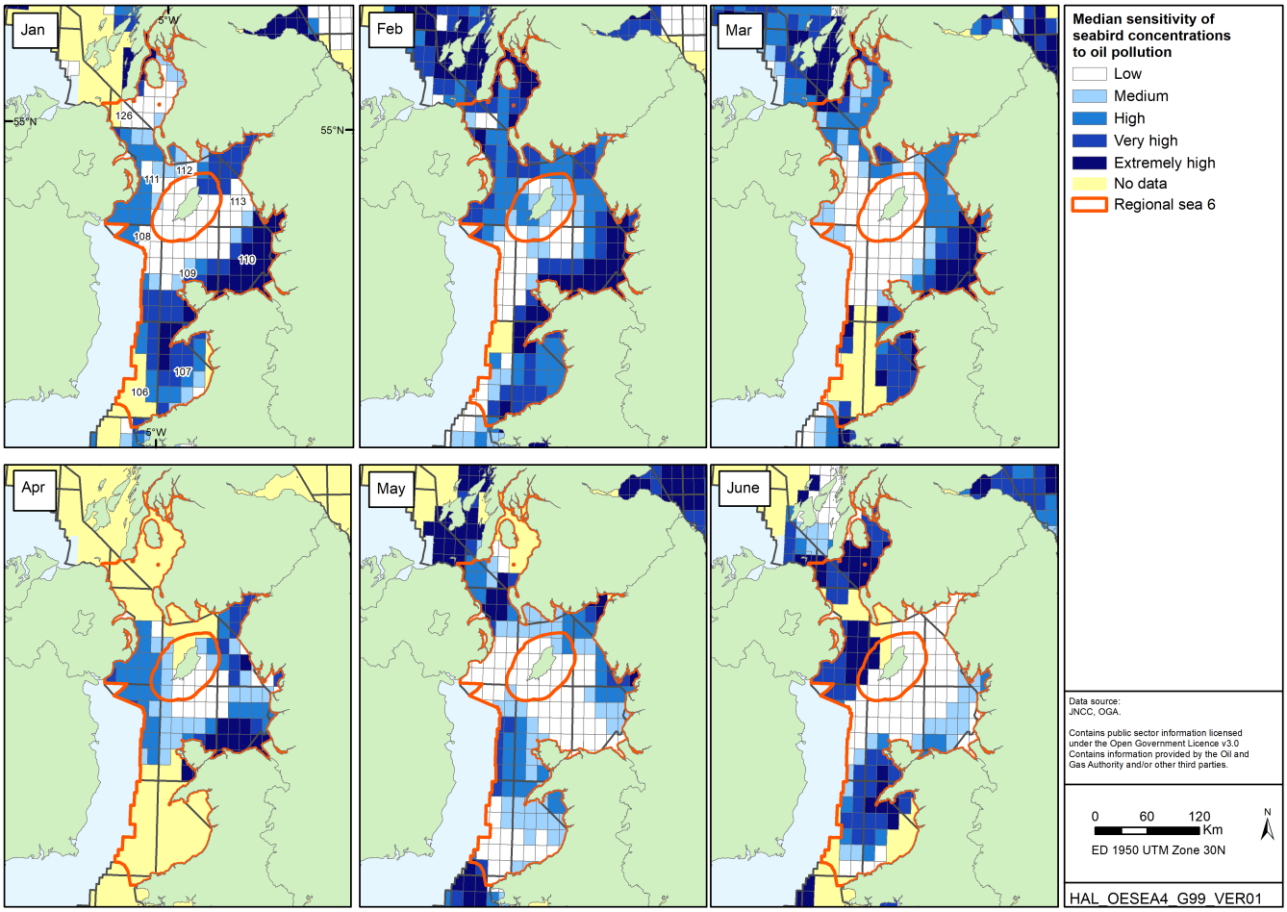
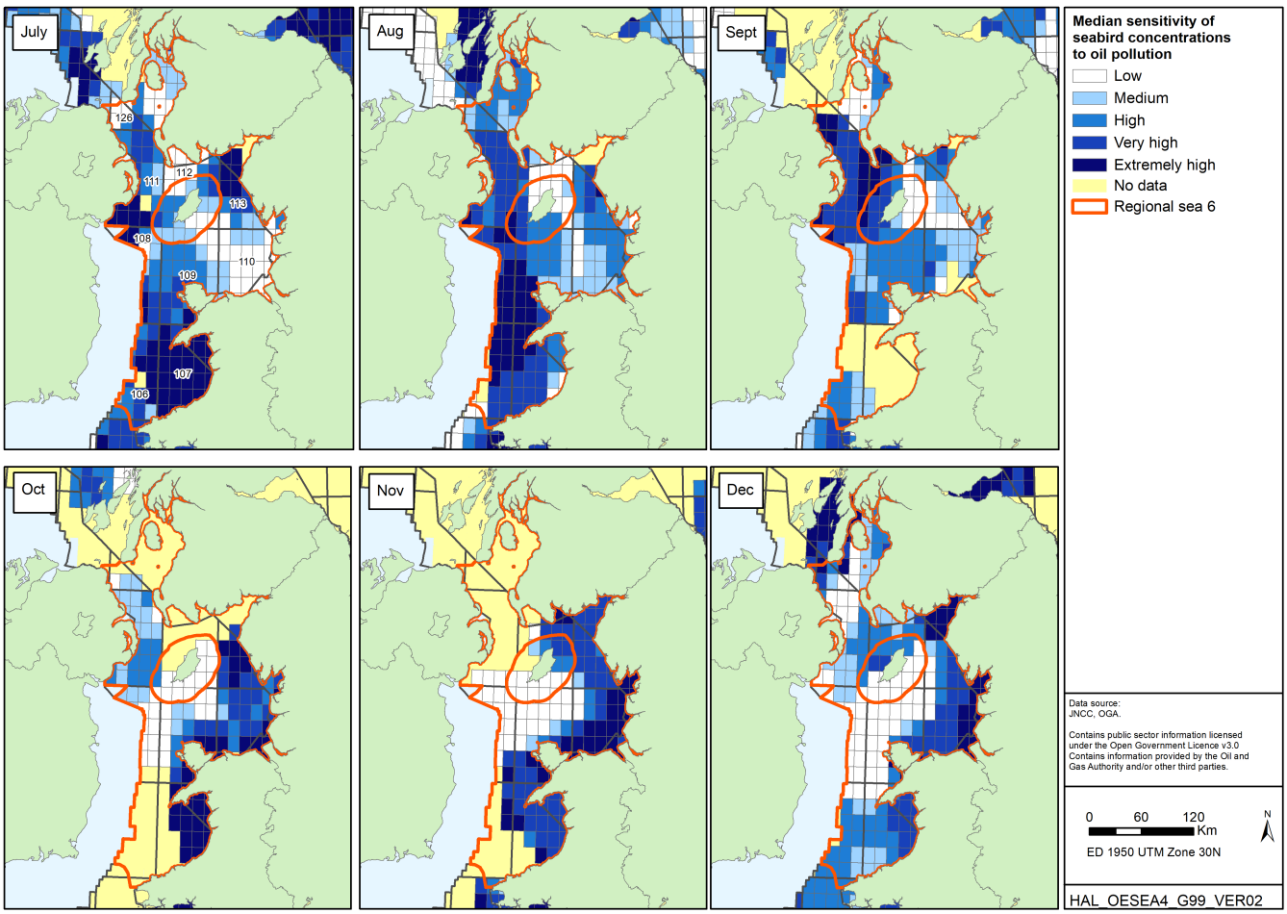


Figure A1a.5.25b: Monthly seabird oil sensitivity index scores for Regional SEA 6 (Jul-Dec)



With the exception of a few months of the year, the Irish Sea records extremely high or very high sensitivity for across the region. The most sensitive times being through the mid to late breeding season. Data coverage is good, with only April the most data gaps, but even then, it is only the southern area of Regional Sea 6 with gaps.

A1a.5.30 Waterbird species and distribution (breeding, wintering and migratory)

The numbers of breeding waders and other waterbirds in this region is relatively low compared to other parts of Britain, though the Dyfi Estuary is one of the most important areas in Wales for breeding waders, particularly breeding redshank, teal, red-breasted merganser and shelduck and breeding eider, oystercatcher and lapwing are found on the Isle of Man.

Large numbers of ringed plover breed in Morecambe Bay, the Solway Firth and Luce Bay, with these areas holding the main breeding concentrations of this species on the west coast of Britain outside the Western Isles (Cradock & Stroud 1996). The area also includes Milford Haven which support breeding shelduck. The Inner Solway, the Ribble, Morecambe Bay and Duddon Estuary have large breeding populations of shelduck, redshank, oystercatcher, dunlin (the most southerly regularly saltmarsh breeding dunlin in Britain) and curlew. The dry grassland breeding population of shelduck in the Ribble Estuary is the most numerous in Britain. Breeding eider are also found in Morecambe Bay (the most southerly breeding population in Britain) and around Walney Island (Gibbons *et al*. 1993).

For wintering birds and birds using the area on passage between sites, there are a number of important sites within the region, some supporting well in excess of 100,000 birds each year (Table A1a.5.19).

Table A1a.5.19: Important sites[1] for non-breeding waterbirds in Regional Sea 6

Site	Site total[2] (2019/2020)	5-year average[2]	Species (designated feature)
Dyfi Estuary / Aber Dyfi	8,169 (↓)	9,947	Greenland white-fronted goose
Traeth Lafan / Lavan Sands, Conwy Bay (numbers for Lavan sands and separately for Conwy Estuary)	14,508 (↓) 1,942 (↓)	16,909 3,369	Red-breasted merganser, oystercatcher, curlew, redshank, great crested grebe
The Dee Estuary (numbers for Dee Estuary – England & Wales)	145,188 (↓)	157,230	Shelduck, teal, pintail, oystercatcher, grey plover, knot, bar-tailed godwit, curlew, redshank, black-tailed godwit, dunlin **Waterfowl Assemblage**
Liverpool Bay / Bae Lerpwl (marine SPA)	-	-	Red-throated diver, common scoter **Waterbird Assemblage**
Mersey narrows and North Wirral Foreshore	-	-	Oystercatcher, grey plover, sanderling, bar-tailed godwit, redshank, knot, dunlin **Waterfowl Assemblage**
Mersey Estuary	72,521 (↓)	94,529	Great crested grebe, shelduck, wigeon, teal, pintail, golden plover, grey plover, lapwing, curlew, redshank, black-tailed godwit, dunlin, ringed plover
Martin Mere (numbers for WWT Martin Mere)	18,116 (↓)	35,799	Bewick's swan, whooper swan, pink-footed goose, wigeon, pintail

Site	Site total[2] (2019/2020)	5-year average[2]	Species (designated feature)
			Waterfowl Assemblage
Ribble and Alt Estuaries (numbers for Ribble Estuary and separately for Alt Estuary)	201,883 (↓) 67,167 (↑)	191,485 75,092	Bewicks swan, Whooper swan, pink-footed goose, shelduck, wigeon, teal, pintail, greater scaup, common scoter, oystercatcher, golden plover, grey plover, lapwing, knot, sanderling, bar-tailed godwit, curlew, redshank, black-tailed godwit, dunlin, ringed plover, whimbrel **Waterfowl Assemblage**
Morecambe Bay and Duddon Estuary (numbers for Morecambe Bay and separately for Duddon Estuary)	147,034 (↓) 29,474 (↑)	186,303 25,252	Pintail, pink-fronted goose, ruddy turnstone, sanderling, dunlin, red knot, ringed plover, whooper swan, little egret, oystercatcher, bar-tailed godwit, black-tailed godwit, curlew, ruff, golden plover, grey plover, shelduck redshank **Waterfowl Assemblage**
Killough Bay	-	-	Light-bellied brent goose
Carlingford Lough	5,582 (↓)	7,295	Light-bellied brent goose
Strangford Lough	59,653 (↓)	60,514	Knot, redshank, light-bellied brent goose **Waterbird assemblage**
Outer Ards (numbers for Outer Ards Shoreline)	5,327 (↓)	6,458	Ringed plover, golden plover, ruddy turnstone, light bellied brent goose
Belfast Lough	11,945 (↓)	15,214	Bar-tailed godwit, redshank, black-tailed godwit
Belfast Lough – Open Water	-	-	Great crested grebe
Larne Lough	4,086 (↑)	3,928	Light-bellied brent goose
Loch of Inch and Torrs Warren	-	-	Greenland white-fronted goose
Upper Solway Flats and Marshes (figures for Solway Estuary)	131,188 (↓)	134,964	Whooper swan, pink-footed goose, (Svalbard) barnacle goose, shelduck, teal, pintail, shoveler, greater scaup, goldeneye, oystercatcher, golden plover, grey plover, knot, sanderling, bar-tailed godwit, curlew, redshank, ruddy turnstone, dunlin **Waterfowl Assemblage**
Black Cart (numbers for Black Cart Water (Gryfe-White Cart)	2,262 (↓)	2,525	Whooper swan
Inner Clyde Estuary (numbers for Inner Firth of Clyde)	13,600 (↑)	14,435	Redshank

Notes: [1]Sites for non-breeding waterbirds in the UK as described in the WeBS annual publication and the JNCC SPA website, designated features as described in JNCC UK Natura 2000 spreadsheet, version dated 2019-10-31, and latest changes to sites webpage. [2]Site total and 5-yr average from WeBS report online (site total tab), https://app.bto.org/webs-reporting/principal.jsp, ↓↑ denotes decrease or increase from previous years site total. Source: Frost *et al.* (2021), https://www.bto.org/our-science/projects/wetland-bird-survey/publications

The proposed extension to the Liverpool Bay/Bae Lerpwl SPA, as well as including seabirds (see above) also looks to add red-breasted merganser as a named feature of the assemblage. There are also two other SPAs in the region, both for breeding and wintering chough. In addition to those sites already designated as SPAs in the region, the Solway Firth was

designated in 2020 and features of the site area a combination of non-breeding, wintering, birds non passage and assemblages, with species such as red-throated diver, Whooper swan, golden and ringed plover, pink-footed geese, curlew, redshank and oystercatcher listed as features (NatureScot SiteLink 2022b)

Two other important sites in the region, not designated as SPAs, but which have a 5year mean in excess of 20,000 individual birds each are Wigtown Bay and the Cleddau Estuary – species include little grebe, shelduck, wigeon, teal, dunlin and curlew).

The WTT aerial surveys conducted between 2001 and 2007 primarily in winter, to aid in the identification of potential marine SPAs recorded distribution of a number of waterbird species. These surveys included locations on the east coast of the UK (e.g. Thames/The Wash areas – see regional Sea 1) and the west coast and information from these was included in the OESEA document published in 2009. A summary of the distribution in the Regional Sea 6 area is provided in Table A1a.5.20 below.

Table A1a.5.20: Summary description of waterbird distribution

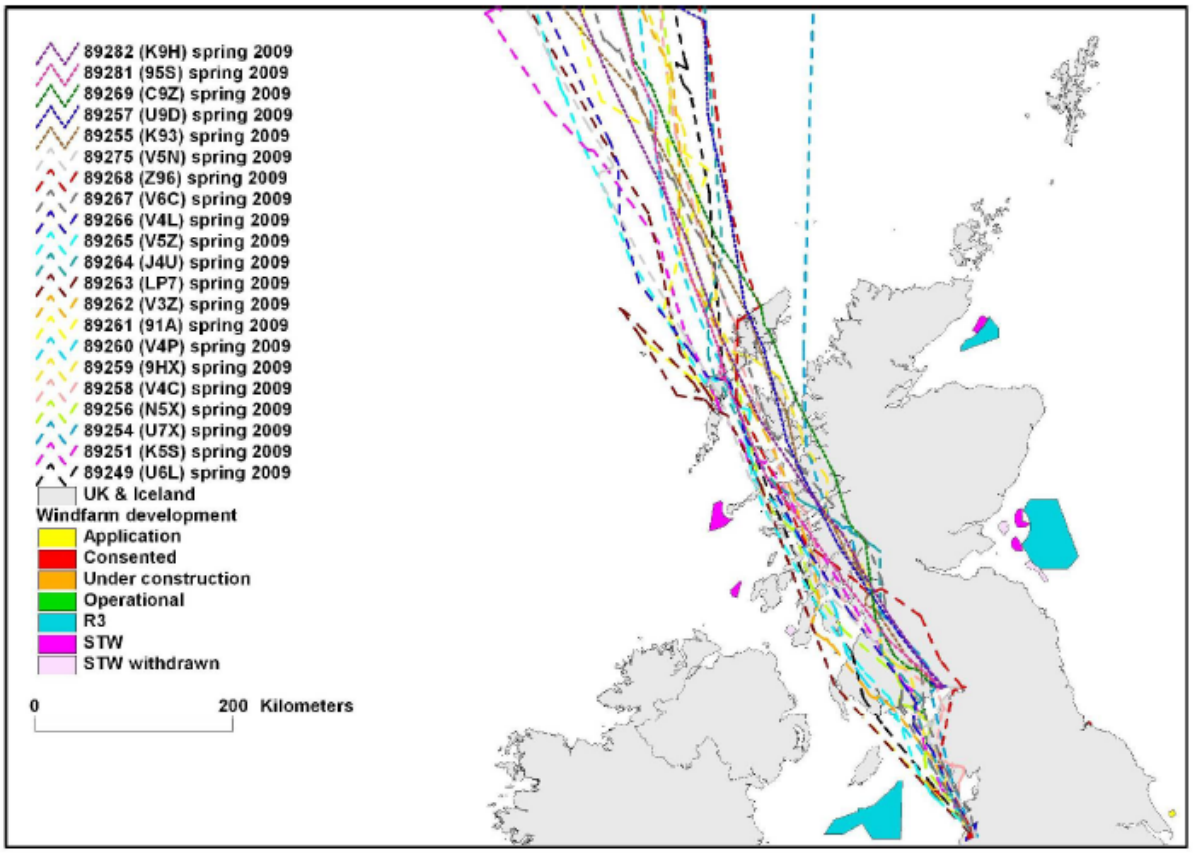
Species	Description of distribution
Common scoter[1]	In winter, highest numbers recorded in the north west of the region, distribution clumped. Peak numbers ~ 25,000 birds. Highest numbers over Shell Flat, extending south to the mouth of the Ribble and in Colwyn Bay. The Solway holds moderate numbers in early winter but as winter progresses there appears to be a gradual distribution shift southwards, with a movement to offshore areas in late winter.
Divers[2]	Birds present in low, but consistent numbers, throughout winter, widely distributed with highest concentrations from the Ribble Estuary along the north Wales coast to Conway Bay and in the Solway Firth. Smaller numbers present in areas offshore from Morecambe Bay (birds found up to 30km from shore). Numbers dropping in mid-winter and remaining low for rest of winter.
Eider	During winter the majority of birds recorded (peak of 986 birds in mid-winter) were in the outer parts of Morecambe Bay, with small numbers around Walney Island. Small numbers also present in Conwy and Colwyn Bay, off the mouths of rivers Conwy and Clwyd. During summer all eider recorded occurred around the outer part of Morecambe Bay.

Note: [1] These survey programmes includes locations on the east coast of the UK (see regional Sea 2) and the west coast UK survey areas held significantly higher numbers than the east coast survey areas. [2] Red-throated, black-throated, great northern and those not identified to species. Source: BERR (2007).

Griffin *et al*. (2011) published findings from a BEIS-funded extension to a previous study commissioned by COWRIE Ltd on the migration routes of whooper swans and geese in relation to wind farm footprints. These studies build a picture of migratory movements of these birds, tracked from sites within the Regional Sea 6 area (Caerlaverock/Martin Mere (whooper swan); Northern Ireland (light-bellied Brent goose), Loch Ken, Dumfries and Galloway (Greenland white-fronted goose) and Solway Firth (Svalbard barnacle goose), and aimed to identify any potential connectivity with existing and potential (at that time) renewable development zones; there have been no updated or more recent studies for birds from the sites within Regional Sea 6.

Routes were found to traverse through a number of different Regional Sea areas, i.e. 7, 8 and 10, and these are shown in Figures A1a.5.26 – A1.a.5.28 below. Whooper swans had a broad migration route and showed variation between years; birds starting at the same starting point took different routes between the UK and Iceland, (Figure A1a.5.25) and the same individual showed variation in the route taken in repeat tracks.

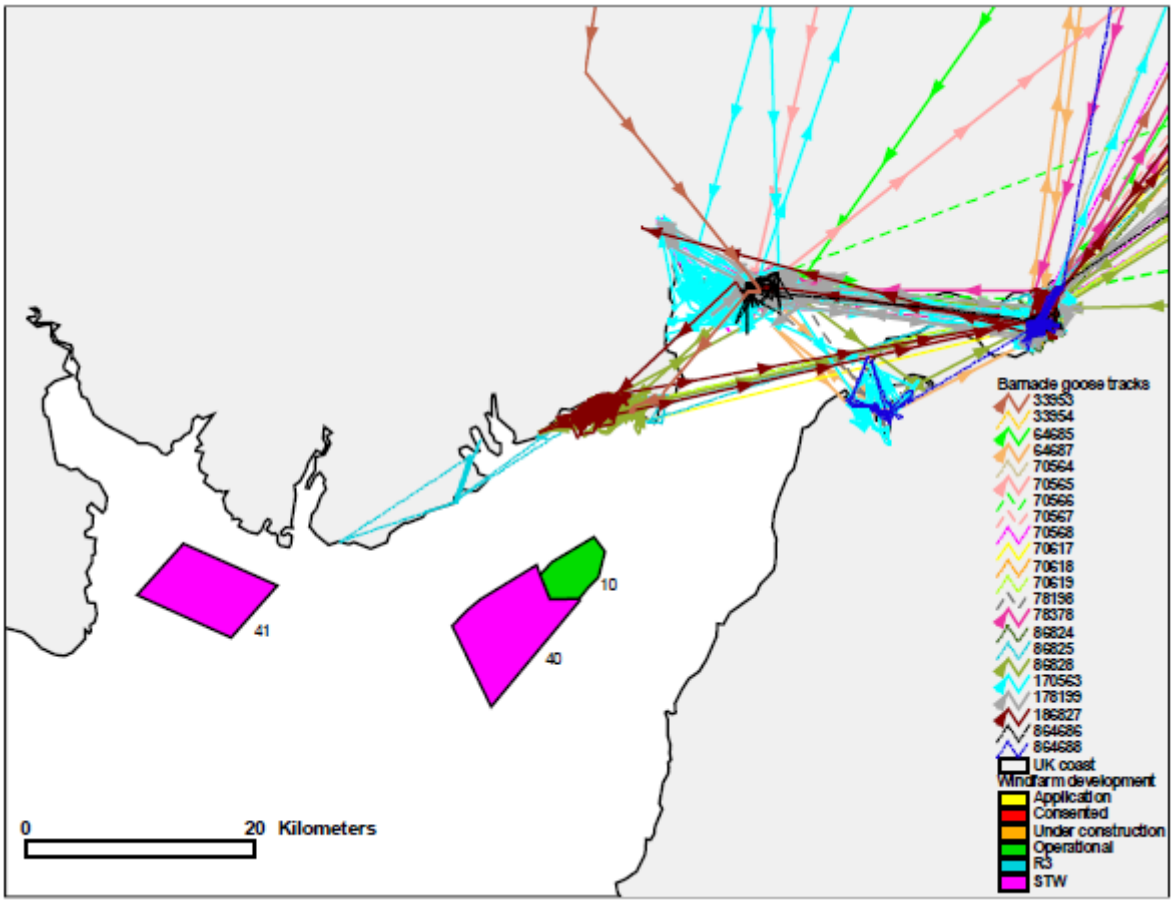
Figure A1a.5.26: Migration routes of 21 adult male Whooper swans tracked in spring 2009



Source: Griffin *et al.* (2011). Migration routes of 21 adult male Whooper swans tracked in 2009. Tracks selected for birds that completed their migration to Iceland alive and with tags intact from either WWT Caerlaverock or WWT Martin Mere. Note, windfarm development shown in this figure is now out of date, but gives an indication of presence.

The Solway Firth is extremely important for Svalbard Barnacle geese (Barnacle geese), with most of the population wintering in this area (Griffin *et al*. 2011) from September to late May. Movements during winter were found to be relatively short (Figure A1a.5.27) with migration overland also relatively short *ca*. 100-110 km.

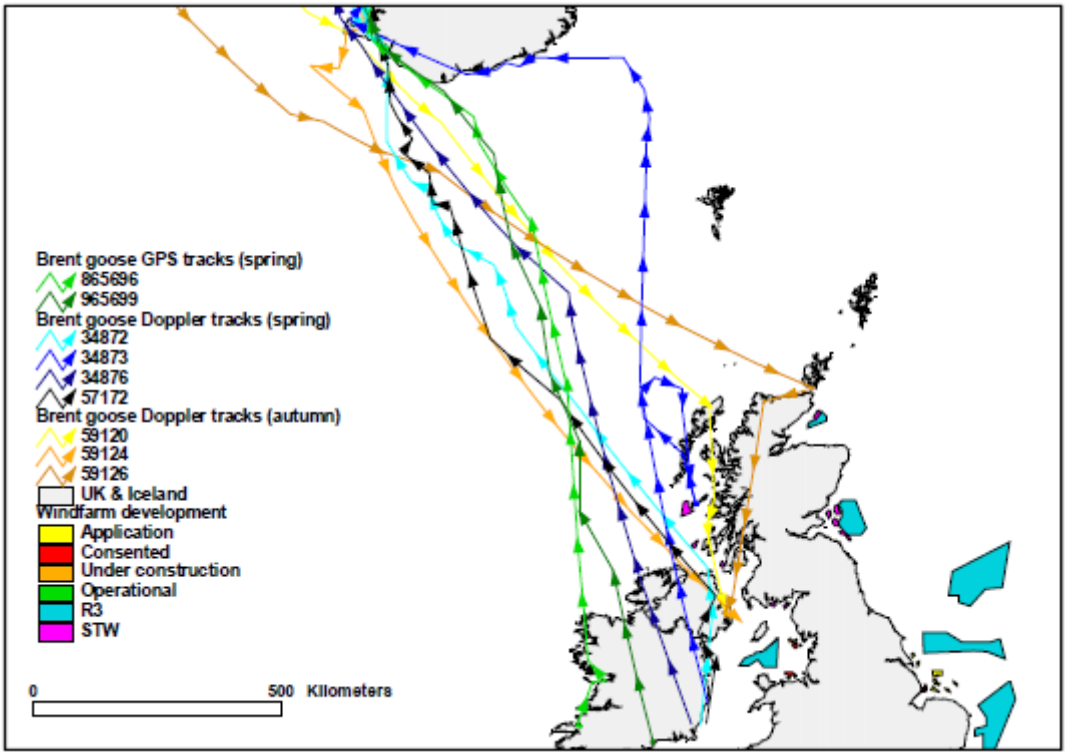
Figure A1a.5.27: Within-winter movements for 22 Svalbard Barnacle geese (2006-2010)



Geese tracked on the Solway Firth between 2006-2010. Note, windfarm development shown in this figure is now out of date, but gives an indication of presence. Source: Griffin *et al.* (2011).

WWT and the Icelandic Institute for Natural History have been tracking light-bellied brent geese which make a significant return migration from their wintering grounds in Northern Ireland/Iceland to their breeding grounds in the Canadian High Arctic (Figure A1a.5.28 overview of routes) (Griffin *et al.* 2011).

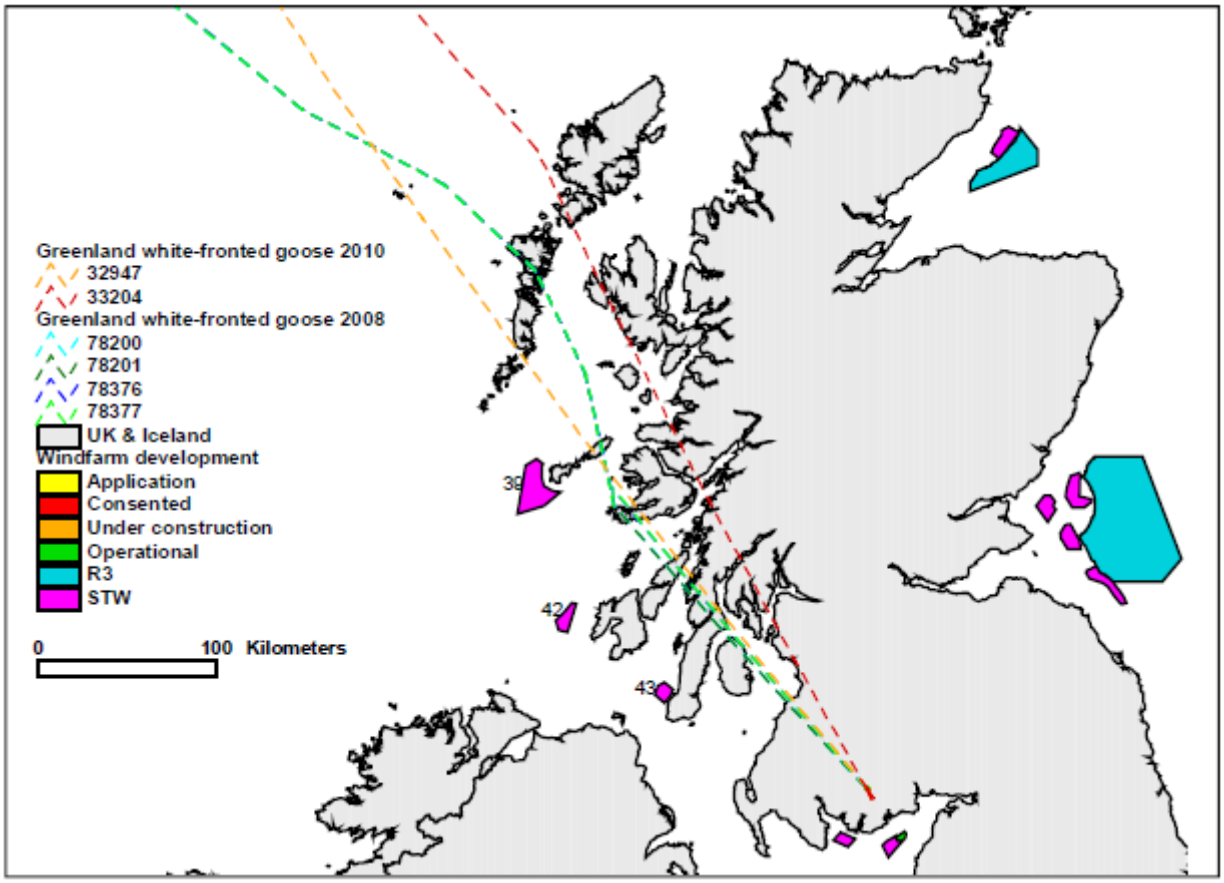
Figure A1a.5.28: Overview of migratory routes of light-bellied brent geese 2005/06



Light-bellied brent geese full migration route to Iceland. Note, windfarm development shown in this figure is now out of date, but gives an indication of presence. Source: Griffin *et al.* (2011).

Only a small number of Greenland white-fronted geese were tracked by WWT in 2008 and 2010 from the population that winters at Loch Ken, Dumfries and Galloway therefore, few generalisations about the migration routes of the population at large were made. Data on movements from these birds are shown in Figure A1a.5.29. Extrapolated tracks suggest all birds probably exited the UK via the Uists or Lewis.

Figure A1a.5.29: Spring migration routes by 6 Greenland white-fronted geese in 2008 and 2010



Migration routes from Loch Ken, Dumfries & Galloway in 2008 and 2010. Note, windfarm development shown in this figure is now out of date, but gives an indication of presence. Source: Griffin *et al.* (2011).

A1a.5.31 Features of Regional Sea 7

Regional Sea 7 encompasses the Minches and western Scotland. The border of this region runs down the centre of the Western Isles and also includes sites in Northern Ireland. The west coast of Scotland has many large and small islands, relatively free from predators and disturbance making them ideal for nesting seabirds. This coast also has a large number of sea lochs and sheltered sounds, suitable for breeding, wintering and migrating waterbirds.

Sites referred to or described in this section are listed geographically south to north where possible.

A1a.5.32 Seabird species and distribution

The coast in this region comprises a diversity of cliff and cliff top habitats, as well as large and varied sand dune systems, many of which are associated with bays and hard cliffs. There are also small offshore islands, islets and stacks, making it ideal for breeding seabirds. Table A1a.5.20 describes the main colonies, all of which are SPAs and the species present.

Table A1a.5.20: Important breeding seabird colonies in Regional Sea 7

Site	Species (designated feature)
Rathlin Island	Razorbill, black-legged kittiwake, common guillemot **Seabird Assemblage**
Sheep Island (NI)	Great cormorant
Glas Eileanan	Common tern
North Colonsay and Western Cliffs	Black-legged kittiwake, common guillemot **Seabird Assemblage**
Treshnish Isles	European storm petrel
Rum	Manx shearwater, black-legged kittiwake, common guillemot **Seabird Assemblage**
Canna and Sanday	Atlantic puffin, common guillemot, black-legged kittiwake, herring gull, European shag **Seabird Assemblage**
Shiant Isles	Razorbill, Atlantic puffin, northern fulmar, European shag, common guillemot, black-legged kittiwake **Seabird Assemblage**
Priest Island (Summer Isles)	European storm petrel
Handa	Northern fulmar, razorbill, great skua, black-legged kittiwake, Arctic skua, common guillemot **Seabird Assemblage**

Note: Sites designated as Seabird Assemblages of International Importance are shown in bold (qualifying level is 20,000 birds). Source: JNCC (2020) JNCC (seabird monitoring programme) website https://app.bto.org/seabirds/public/data.jsp, JNCC Special Protection Areas https://jncc.gov.uk/our-work/list-of-spas/

European Shag – Canna and Sanda -62% change from Seabird 2000 (740 AON) and 2018 count (282). Kittiwake Handa -47% change from Seabird 2000 (7,031 AON) and count in 2018 (3,749). Canna and Sanday -16% change from Seabird 2000 (1,274) and count in 2018 (1,069). Kittiwake -97% change from Seabird 2000 (9,917 AON) and 2018 count (313). Common guillemot -51% change from Seabird 2000 (112,676) and count in 2016 (54,664). Rathlin Island -96% change from Seabird 2000 (95,117) and count of 2018 (3,454).

The main Northern Irish sites within Regional Sea 7 are Rathlin Island and Sheep Island. Rathlin Island has several sea stacks and many of these are important for breeding seabirds. The island supports a diverse assemblage of breeding seabirds, including auk and gull species and is the largest seabird colony in Northern Ireland and one of the most important seabird breeding sites in the UK and Ireland. A complete census of Rathlin Island, along with sections of the North Antrim coast between Runkerry and Murlough was undertaken as part of the INTERREG VA funded Marine Protected Areas Management and Monitoring Project (MarPAMM).

Rathlin Island is of significant importance to breeding seabirds with it being the stronghold in Northern Ireland for many species including northern fulmar, Atlantic puffin, razorbill, guillemot and black-legged kittiwake present; the island is thought to support the largest guillemot colony in Northern Ireland and the UK, with an estimated 149,510 (2021 count) individuals and Rathlin, along with The Maidens also supports the largest colonies of European shag in Northern Ireland.

The Island is also thought to have had, at one time, breeding storm petrels, although there are no recent records, whilst breeding Manx shearwater have not been recorded there for many years (BTO 2022). In recent years, ground/burrow nesting birds such as Atlantic puffin, have suffered significant declines, thought to be caused, in part, by rat/ferret predation; a new 5 year project in 2022 will include eradication project for these predators, after which it is hoped that numbers of ground/burrow nesting will increase, and birds such as storm petrels and Manx shearwater may re-establish (BTO 2022). As part of the 2021 survey, seven species were found to have increased in number, compared to that recorded in the 1998-2000 census: European shag; black-legged kittiwake; lesser and greater black-backed gulls; herring gulls; guillemot and razorbill, the latter of these recording a slight increase, whilst the numbers of black-legged kittiwake (13,706 AON, 2021) are the largest on Northern Ireland (BTO 2022) and amongst the biggest colonies in the UK, with only Fowlsheugh (14,039, 2018) and Flamborough Head and Bempton Cliffs (45,504, 2017) recording higher (JNCC 2021) – the data from Seabirds Count will give an updated assessment of these and other UK colonies. Declines were recorded for three species, northern fulmar, black guillemot and Atlantic puffin, although counts were conducted later than recommended for Atlantic puffin, due to logistical problems (BTO 2022).

The Shiant Isles in the Minch comprise three large and several small islands important for breeding seabirds, especially auks and northern fulmars during summer. After Coquet Island off Northumberland, Glas Eileanan, a group of three small islets in the Sound of Mull, supports one of the biggest common tern colonies in Britain. Birds from these colonies feed in the surrounding offshore areas as well as inshore waters.

Tiree, along with the Sands of Forvie on the Scottish east coast, are the two largest colonies in Scotland. Tiree has seen a decline in numbers between 1987 (54 AON) and 2019 (10 AON), in contrast to Sand of Forvie, which has remained relatively stable. Handa off the west coast provides a strategic nesting site for seabirds that feed in the waters of the northern Minch. Priest Island is the outermost and most exposed of the Summer Isles and lies some 6km off the coast of Wester Ross. It, along with Treshnish Isles (principally Lunga) supports some of the largest European storm petrel colonies outside Mousa (Shetland); in 2019, 4,640 AOS were recorded on Priest Island, a 5% increase since Seabird 2000 (4,400 AOS), whilst an increase of 109% occurred on the Treshnish Isles of Fladda, Lunga and Sgeir a' Chaisteil from 4,127 AOS in 1996 to 8,664 AOS in 2018 (JNCC 2021).

The largest declines in common guillemot numbers since Seabird 2000, have been colonies in Scotland. The colony at Shiant has seen common guillemot numbers decline from 16,456 individuals in Seabird 2000, to 9,054 individuals in 2015 (an overall decline of 45%); while a 51% decline has been recorded at Handa, with numbers dropping from 112,676 individuals in Seabird 2000 to 54,664 in 2016 (JNCC 2021). The decline at Handa has been mirrored by razorbill, with this site recording a 52% decline; numbers at Handa fell from 16,991 individuals in Seabird 2000 to 8,207 in 2019. The most recent count (2015) for this species at the Shiants showed similar numbers (8029 individuals) to that recorded in Seabird 2000 (8046 individuals) (JNCC 2021).

A1a.5.33 Seabird distribution at sea

Seabird distribution off the west coast varies throughout the year. Birds are concentrated in coastal waters and at colonies during the breeding season, while during the post breeding period, adults and young birds disperse from colonies and generally become more widespread throughout offshore areas or leave the area altogether. Table A1a.5.21 provides a summary of seabird distribution and abundance in these waters throughout the year.

Table A1a.5.21: General seabird distribution at sea in the Regional Sea 7 area

Month	General distribution
January-April	Some bird species start returning to breeding colonies (Mar-Apr), e.g. **Manx shearwater**, **European storm petrel**, **northern gannet**. Prior to breeding, high densities of **northern fulmar** over shelf and **northern gannet** remain widely distributed at low densities. **Great cormorants** are resident in the region in shallow inshore waters along almost the entire coast. Throughout the year, low densities of **European shag**, **black-headed gull** and **common gull** found in inshore areas and the Minch.
May-July	Main concentrations of **northern fulmar** in waters west of the Western Isles and higher densities in the Minch. Numbers of non-breeding **European storm petrels** widespread throughout area in low densities. Immature **northern gannet** numbers peak in June. **Pomarine skua** found widely distributed through the northern and southern Minch areas between May and November, while **Arctic skua** are widely distributed at low densities between June and August. **Lesser black-backed gull** distributed throughout the Minch at low densities between April and August. **Black-legged kittiwake** is recorded in all months of the year, however higher numbers found concentrated around Handa between May and July. During breeding season **Arctic tern** found mainly in inshore waters around Western Isles. June & July sees highest densities of **Atlantic puffin** concentrated around colonies, including Shiants.
August-October	**Northern fulmar** densities remain relatively low in the Minch. Low numbers of **great shearwater** recorded in Minch, with majority occurring further offshore. **Northern Gannets** leave the area during September and October. **Great skua** more widespread but at low densities throughout the Minch. **Herring gull** remains widespread throughout the Minch area, small concentrations of birds at Canna and Sanday and at Handa. Concentrations of **black-legged kittiwake** found off Summer Isles and waters around Shiant Islands, during August and September and in waters off Skye during October and December. **Common guillemot** in high concentrations in shallow inshore waters of Minch and Sea of Hebrides southwards to Islay. The Minch is an important area for moulting auks during August and an estimated two-thirds of the west coast population of **razorbill** congregate here with the remainder thought to move south into the Irish sea. High densities recorded between Mull and Skye in August. Slightly more restricted range over the winter months, high densities recorded off Mull in February. Moderate densities of **Atlantic puffin** seen in the Minch. Large movement of **Manx shearwater** through Argyll waters but only small numbers in September and October, and birds from Rum are also thought to migrate past the west of Ireland rather than through the Irish Sea.
November-December	Lowest densities of **northern fulmar**. **European storm petrels** remain widely distributed at low densities throughout the Minch. Few sightings of **Iceland gulls** seen off the east coast of Lewis. **Great black-backed gulls** found throughout the Minch during all months, however slightly higher numbers found around Coll between October and December. Fewer **common guillemots** seen in the Minch between December and April, although adult birds continue to visit colonies during autumn and winter months. High densities recorded off Skye and north coast of Northern Ireland

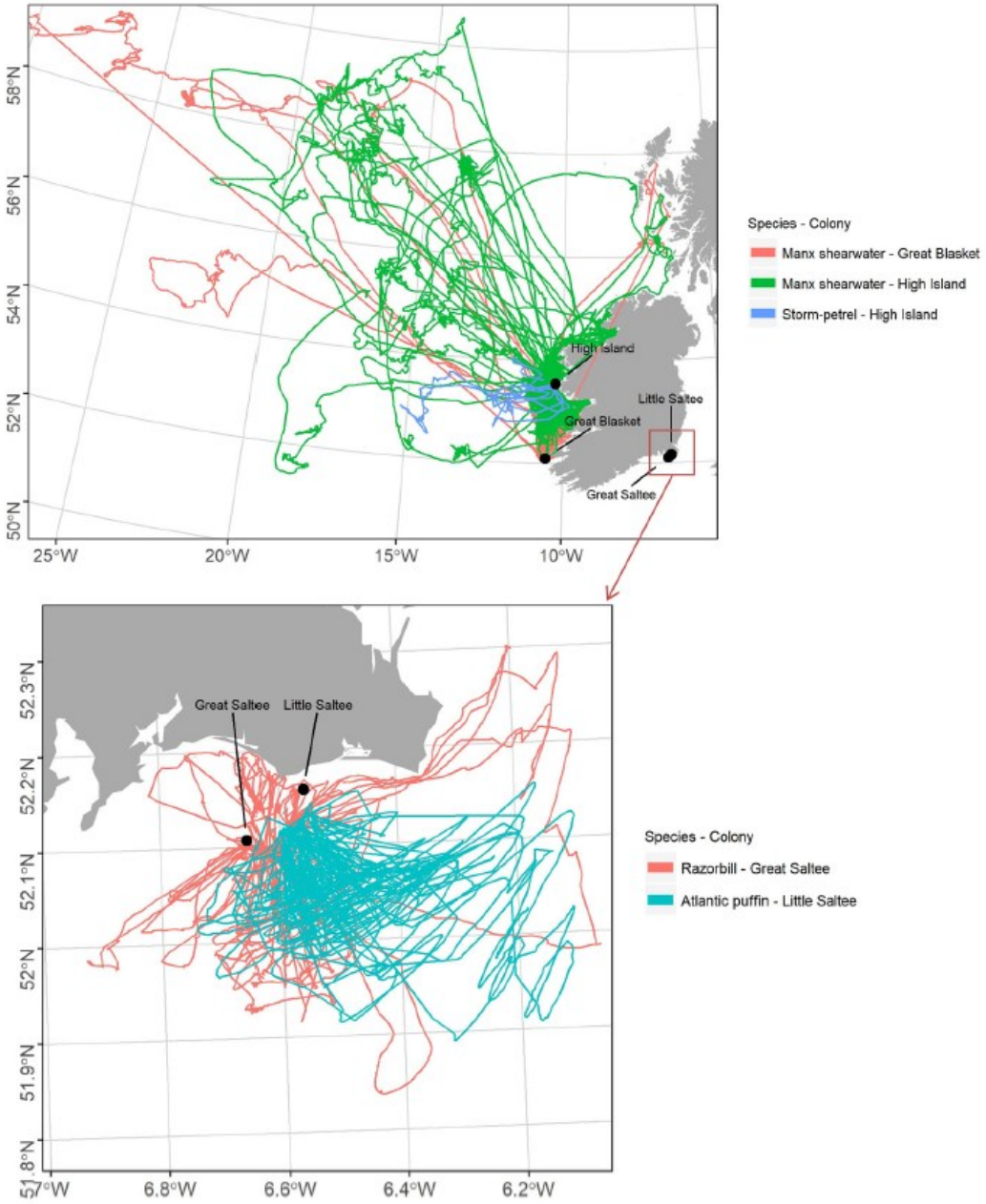
Source: Pollock *et al.* (2000), Furness (2015).

The importance of the waters around The Small Isles for a large breeding colony of black guillemot (>1,200 individuals) has been recognised with the area designated as an NCMPA, the boundary of which overlaps the Rum and Canna and Sanday SPAs.

The waters along the Scottish west coast and around the Outer Hebrides are not only important to seabirds that breed here, but also for birds from further afield. As part of a study in Irish waters comparing foraging radius distributions with data from biotelemetry and at-sea aerial surveys to determine the accuracy of the foraging ranging approach for assessing distribution, seabirds were tracked from colonies on the south and west coast of Ireland (Critchley *et al*. 2019). Four specie of seabird were tagged and tracked, Manx shearwater, storm petrel, razorbill and common guillemot, representative of short and long distance foragers during the breeding season. While the majority of tracks were relatively close to the

colonies and for the colonies on the west coast also out into the wider north Atlantic, tracks of Manx shearwater from the Great Blasket and High Island colonies on the west coast were also recorded across to the west coast of Scotland (see Figure A1a.5.30).

Figure A1a.5.30: GPS tracks of seabirds breeding in Ireland with foraging overlap with Regional Sea 7



Notes: GPS tracks and colony locations for Manx shearwater and European storm petrel on the west coast of Ireland and insert for razorbill and Atlantic puffin on the south east coast of Ireland. Sources: Critchely *et al*. (2017)

A1a.5.34 Seabird vulnerability to pollution

Figures A1a.5.31 a and b below shows the monthly vulnerability for the Regional SEA 7 area.

Figure A1a.5.31a: Monthly seabird oil sensitivity index scores for Regional SEA 7 (Jan-Jun)

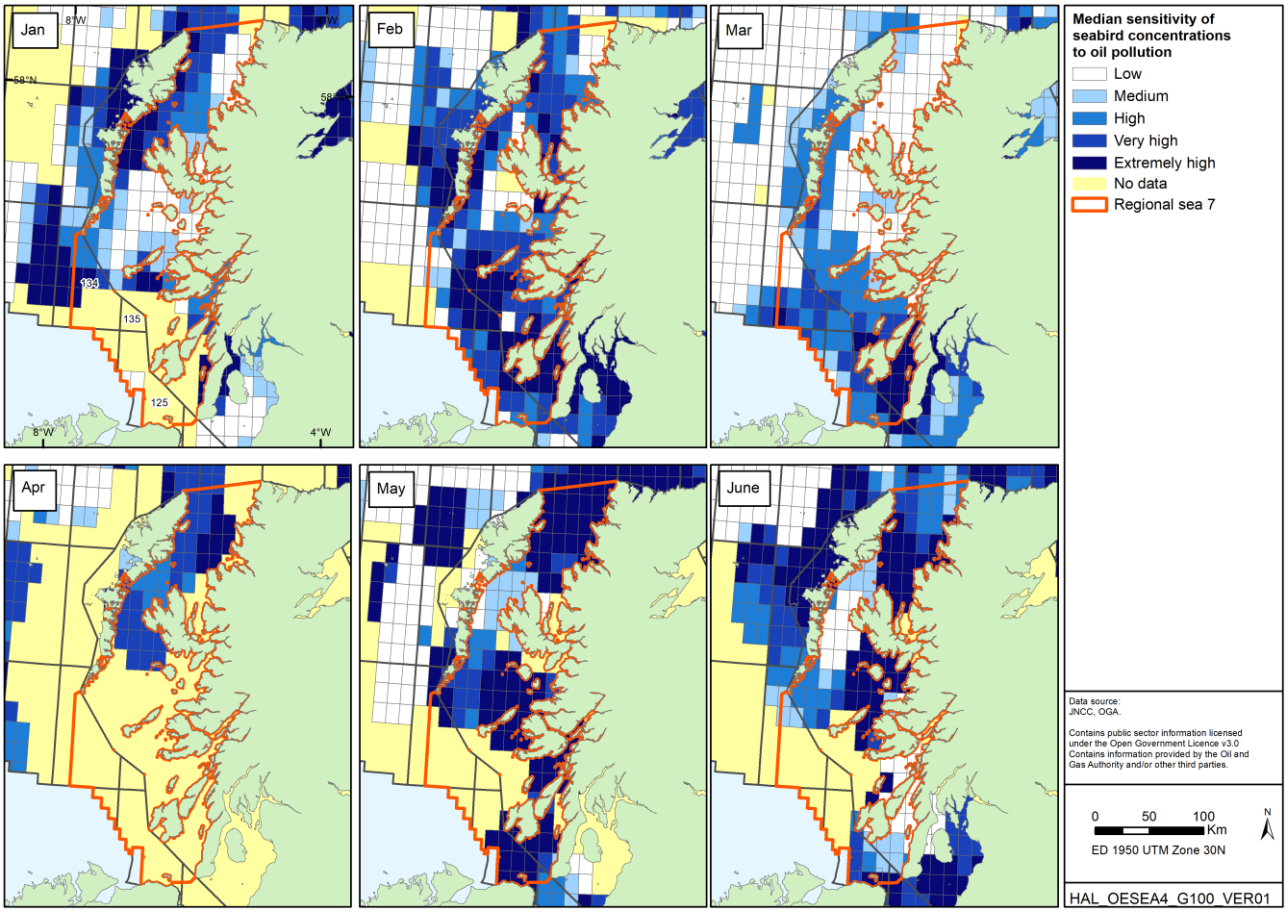
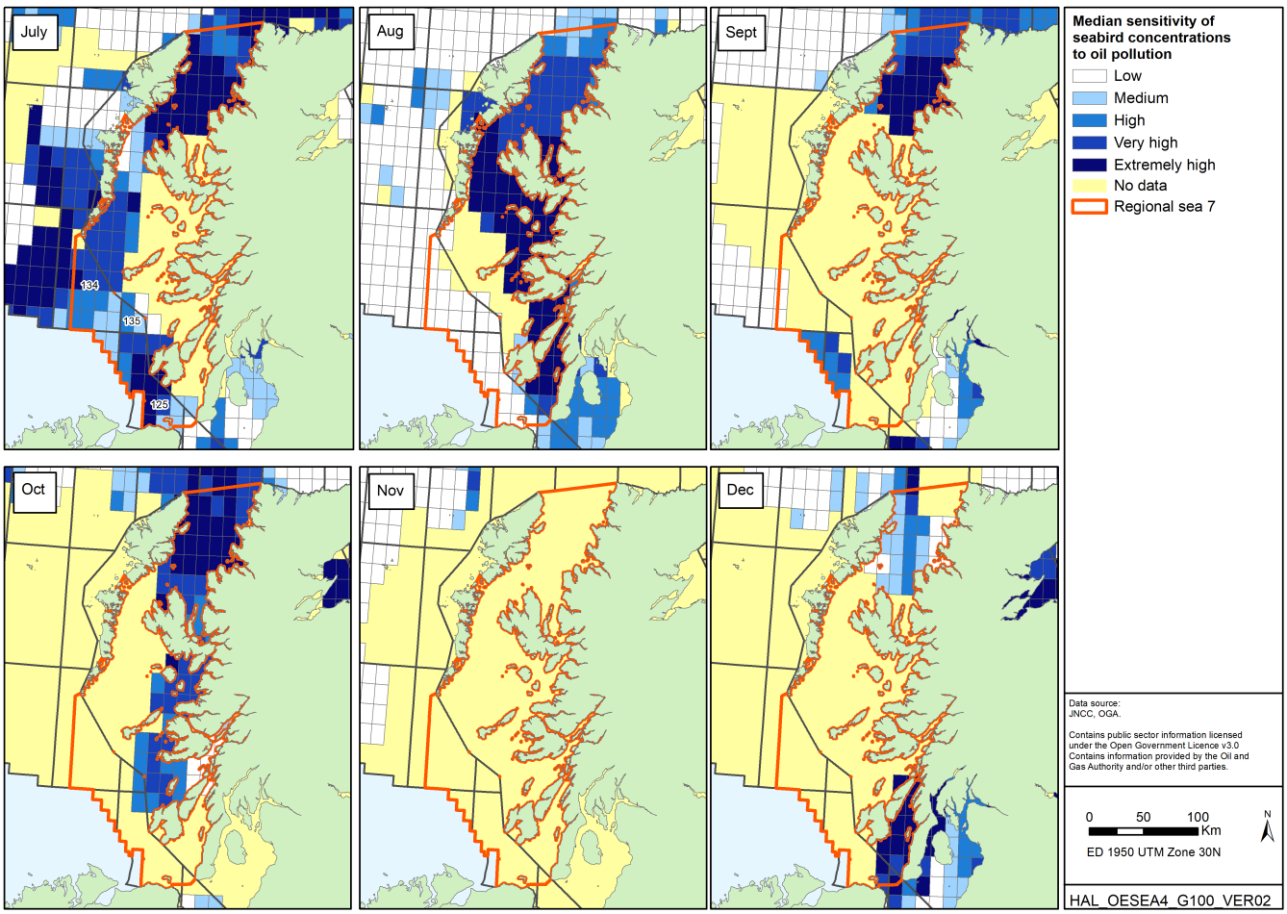


Figure A1a.5.31b: Monthly seabird oil sensitivity index scores for Regional SEA 7 (Jul-Dec)



Regional Sea 7 includes the Minches and there are areas of extremely high and very high sensitivity evident throughout the year, particularly early in the year (February-March) and during the breeding season (May-June) where there are concentrations of highly sensitive areas around the coastlines. There are significant data gaps throughout the area, throughout the year.

A1a.5.35 Waterbird species and distribution (breeding, wintering and migratory)

The presence of sheltered sounds, numerous sea lochs and islands with a varied selection of habitats including machair, makes this region extremely important for wintering and migrating species, particularly geese and wader species. Sites designated as SPAs for their wintering and on passage bird populations are described in table A1a.5.22. One of the sites, Sleibhtean agus Cladach Thiriodh (Tiree Wetlands and Coast) also has qualifying breeding waterbirds as qualifying features (dunlin oystercatcher, redshank and ringed plover).

Table A1a.5.22: Important sites[1] for non-breeding waterbirds in Regional Sea 7

Site	Species (designated feature)
Kintyre Goose Roost	Greenland white-fronted goose (site includes
Bridgend Flats, Islay	(Greenland) Barnacle goose
Laggan, Islay	(Greenland) Barnacle goose, Greenland white-fronted goose
Rinns of Islay	Red-billed chough, Greenland white-fronted goose, whooper swan (site also designated for breeding common scoter, breeding and wintering red-billed chough and passage Whooper swan)
Gruinart Flats, Islay	(Greenland) Barnacle goose, light-bellied brent goose, Greenland white-fronted goose (site also designated for breeding and wintering chough)
Sleibhtean agus Cladach Thiriodh (Tiree Wetlands and Coast)	(Greenland) Barnacle goose, Greenland white-fronted goose, ringed plover, ruddy turnstone (site also designated for breeding oystercatcher, ringed plover and redshank)
Lough Foyle (NI)	Light bellied brent goose, Whooper swan, bar-tailed godwit **Waterbird Assemblage**
Treshnish Isles	(Greenland) Barnacle goose
Coll	(Greenland) Barnacle goose, Greenland white-fronted goose
Shiant Islands	(Greenland) Barnacle goose

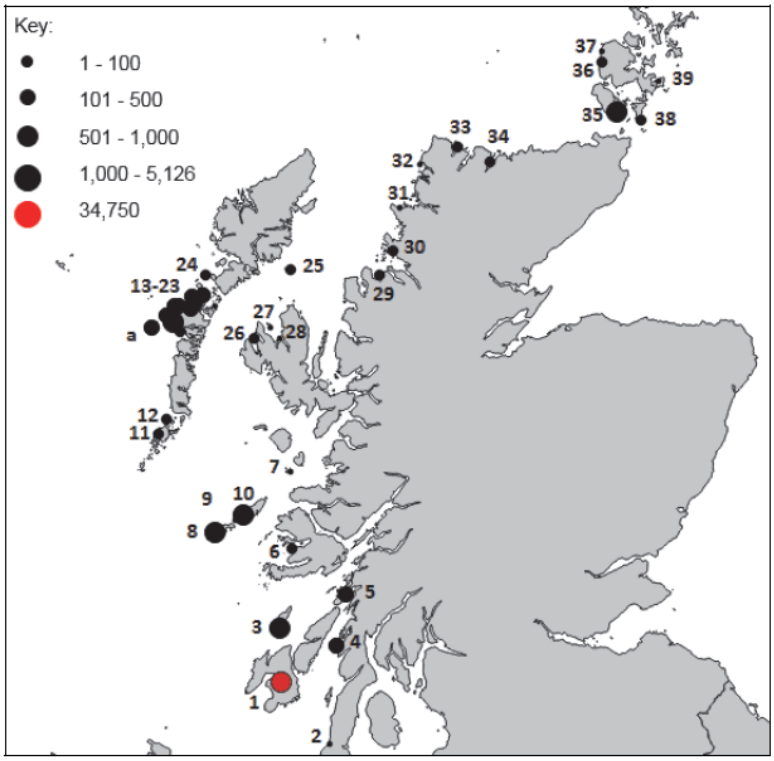
Notes: [1]SPA sites for non-breeding waterbirds in the UK as described on the JNCC SPA website. Annual average numbers of wintering birds at the sites can be obtained from the BTO website, if the site is included in their site counts. Source: JNCC website (http://jncc.defra.gov.uk/page-2598)

Between 1959 and 2018, fourteen full international surveys of the Greenland population of barnacle goose *Branta leucopsis* have been conducted at wintering sites in Scotland and Ireland using a combination of aerial survey and ground count (Mitchell & Hall 2020). The number of geese counted in the 2018, was 10.5% lower than that counted in 2018, but still the second highest total to date (Mitchell & Hall 2020). Islay is the most important site for this species during its winter range, however, numbers here were down in 2018, despite numbers across Scotland being up since the last count.

In Scotland, currently five core areas hold the majority of birds: Islay and North Uist (consolidated), Tiree and Coll, Oronsay/Colonsay and South Walls (Orkney), these five areas account for over 90% of the Scottish total and over 70% of the international total. Whilst

numbers in these core areas have increased considerably over the last 40 years, numbers outside these areas have remained relatively stable (Mitchell & Hall 2020). Counts at all sites in Scotland holding Greenland barnacle gees during the 2018 census (and their locations) are shown in Table A1a.5.23 and Figure A1.a.5.32 below.

Figure A1a.5.32: Sites location[1] of Greenland Barnacle goose counts (census 2018)



Notes: [1]See Table A1a5.23 for site name and goose numbers. Source: Mitchell & Hall (2020)

Table A1a.5.23: Sites[1] with Greenland Barnacle geese during March 2018 census

Map site number	Site name	Number of geese	Map site number	Site name	Number of geese
1	Isla	34,750	20	Ahmore, North Uist	921
2	Machrihanish, Kintyre	5	21	Berneray, North Uist	745
3	Colonsay/Oronsay	2,250	22	Opsay, Sound of Harris	81
4	Danna	650	23	Boreray, Sound of Harris	537
5	Luing	530	24	Copay, Sound of Harris	183
6	Inchkenneth, Mull	226	25	Eilean an Taighe, Shiants	268
7	Muck, Eilean nan Each	38	26	Isay	183
8	Tiree	5,126	27	South Ascrib	46
9	Gunna	85	28	Eilean More	42
10	Coll	1,266	29	Gruinard	120
11	Borve Point, Barra	223	30	Achiltibuie	157
12	Fiaray, Sound of Barra	244	31	Eilean Chrona	35

Map site number	Site name	Number of geese	Map site number	Site name	Number of geese
a	Monach Isles	501[2]	32	Eilean an Ròn Mor	69
13	Baleshare, North Uist	440	33	Durness area	262
14	Paible/Balemore, North Uist	1,442	34	Tongue area	242
15	Balranald/Goula, North Uist	677	35	South Walls	1,460
16	Griminish, North Uist	610	36	Loch of Skaill	137
17	Vallay, North Uist	610	37	Marwick	1
18	Sollas/Grenitote, North Uist	325	38	South Ronaldsay	231
19	Newton, North Uist	180	39	Deerness	20

Notes: [1] Sites numbered 33 through to 39 are within Regional SEA 8, but are included here to align with Figure A1a.5.30. [2] Flight restrictions meant no count was undertaken, instead the estimate for March 2018 was derived from the mean counts made in 2008 (520) and 2013 (482). Source: Mitchell & Hall (2020)

Between 2013 and 2018, the number of Greenland Barnacle geese in the Scotland decreased by 11.5%; there was a long-term increase on Islay since the 1960s however, over the last five years, this appears to have stopped, although overall numbers elsewhere in Scotland have increased since 1994 (Scotland, excluding Islay has seen a 16% change in numbers between 2013 and 2018 (Mitchell & Hall 2020). Long-term changes in abundance are ultimately driven by changes in survival and/or breeding success within the population –a management programme on Islay, resulted in a number of Greenland Barnacle geese being shot every year, and birds can also be legally shot in Iceland and, this, along with the increase in numbers shot on Islay, may contribute to the decrease in the overall population seen between 2013 and 2018 (Mitchell & Hall 2020).

Key sites for wintering species, such as Whooper and Mute swan, greylag goose and Greenland white-fronted goose include sites on Tiree, North and South Uist and Lough Foyle, with the latter of these typically supporting >30,000 species. Other species utilising Lough Foyle during winter includes wigeon, teal, mallard, red-breasted merganser, great-crested grebe, lapwing, dunlin and black-tailed godwit. The rocky shorelines of the region are used as staging areas by passage birds, particularly on Islay and Arran, while large numbers of wintering waterbirds are found at the heads of the larger sea lochs, in shallower and sheltered bays.

The importance of this region can increase during periods of severe cold weather on the east and mainland Europe due to an influx of waterbirds from other coastal or inland regions and the importance is recognised in the designation of sites for species such as great northern and red throated diver, eider and red-breasted merganser.

A1a.5.36 Features of Regional Sea 8

Regional Sea 8 encompasses a broad area of Scottish continental shelf from north of Shetland to south of the Western Isles. The coastal habitats in this region range from extensive and diverse cliff formations, stacks, voes, and sand dune, saltmarsh and estuarine systems.

The west coast of Shetland is within Regional Sea 8, and the east coast is in Regional Sea 1; for simplicity Shetland as a whole was described in Section A1a.5.5 above. Sites referred to or described in this section are listed geographically south to north where possible.

A1a.5.37 Seabird species and distribution

The majority of the seabird species regularly breeding in Britain and Ireland breed within Regional Sea 8. The region is internationally important in terms of seabird numbers and/or the diverse breeding assemblages it supports and is amongst the most important for offshore seabirds in Europe (Tasker 1997a, b & c, Pollock *et al*. 2000). Table A1a.5.24 summarises the most important breeding seabird sites throughout the region, all of which are designated SPAs.

Table A1a.5.24: Important breeding seabird colonies in Regional Sea 8

Site	Species (designated feature)
Mingulay and Berneray	Razorbill, northern fulmar, European shag, black-legged kittiwake, common guillemot, Atlantic puffin **Seabird Assemblage**
South Uist Machair and Lochs	Little tern
Monach Islands	Little tern
St Kilda	Leach's storm petrel, European storm petrel, northern gannet, great skua, Atlantic puffin, razorbill, northern fulmar, Manx shearwater, black-legged kittiwake, common guillemot **Seabird Assemblage**
Seas off St Kilda	Atlantic puffin, northern fulmar, European storm-petrel, northern gannet, common guillemot
Flannan Isles	Northern fulmar, Leach's storm petrel, razorbill, Atlantic puffin, black-legged kittiwake, common guillemot **Seabird Assemblage**
North Rona and Sula Sgeir	European storm petrel, Leach's storm petrel, northern gannet, common guillemot, razorbill, Atlantic puffin, northern fulmar, great black-backed gull, black-legged kittiwake **Seabird Assemblage**
Cape Wrath	Razorbill, black-legged kittiwake, common guillemot, northern fulmar, Atlantic puffin **Seabird Assemblage**
Sule Skerry and Sule Stack	European storm petrel, northern gannet, Atlantic puffin, leach's storm petrel, European shag, common guillemot **Seabird Assemblage**
North Caithness Cliffs	Razorbill, northern fulmar, black-legged kittiwake, common guillemot, Atlantic puffin **Seabird Assemblage**
Pentland Firth Islands	Arctic tern
Hoy	Great skua, northern fulmar, Arctic skua, great black-backed gull, black-legged kittiwake, common guillemot, Atlantic puffin **Seabird Assemblage**
Copinsay	Great black-backed gull, black-legged kittiwake, common guillemot, northern fulmar **Seabird Assemblage**
Marwick Head	Black-legged kittiwake, common guillemot

Site	Species (designated feature)
	Seabird Assemblage
Rousay	Arctic tern, northern fulmar, Arctic skua, black-legged kittiwake, common guillemot **Seabird Assemblage**
Auskerry	Arctic tern, European storm-petrel
West Westray	Arctic tern, common guillemot, northern fulmar, Arctic skua, black-legged kittiwake, razorbill **Seabird Assemblage**
Calf of Eday	Northern fulmar, great cormorant, great black-backed gull, black-legged kittiwake, common guillemot **Seabird Assemblage**
Papa Westray (North Hill and Holm)	Arctic tern, Arctic skua
Foula	Northern fulmar, Arctic tern, leach's storm petrel, great skua, Arctic skua, common guillemot, Atlantic puffin, European shag, black-legged kittiwake, razorbill **Seabird Assemblage**

Note: Sites designated as Seabird Assemblages of International Importance, under Article 4.2 of the Birds Directive, are shown in bold (qualifying level is 20,000 birds). Source: JNCC (2020) JNCC (seabird monitoring programme) website https://app.bto.org/seabirds/public/data.jsp, JNCC Special Protection Areas https://jncc.gov.uk/our-work/list-of-spas/

With the exception of only two colonies where counts are undertaken (and these only showing a ~1% decrease between Seabird 2000 and the most recent counts), northern gannet have increased at all other colonies. The colony at Noup Head has seen a significant increase, with since Seabird 2000 (14 AON/AOS) compared to the 2019 count (1,592), representing an annual change of 37% (JNCC 2021). The colony at Sule Skerry has also seen significant increases in population between the Seabird 2000 count (57 AON/AOS) compared to 2018 count (4,600), this representing an annual change in excess of 36% (JNCC 2021). As well as most northern gannet colonies in the region increasing, new gannetries have formed (e.g. Berneray, Western Isles) or been re-colonised (e.g. Rockall, Western Isles) (JNCC 2021).

Black-legged kittiwake have continued to decrease across most colonies monitored (with a few exceptions, e.g. Canna and Sanday and Flamborough Head and Bempton Cliffs), with numbers at Marwick Head decreasing by over -87% between Seabird 2000 (5,573) and the 2018 count (906). Decreases in common guillemot numbers have also been evident at this colony and at the colony at West Westry, where razorbill have also seen a significant decrease between Seabird 2000 and the most recent count in 2017(JNCC 2021).

Scotland holds the majority of the UK population of northern fulmars and several colonies in this region hold numbers in excess of 1,000 birds. Most recent surveys of Mingulay and Berneray (2014), Flannan Islands (2013) and North Rona (2012) colonies, all recorded decreases from numbers recorded during Seabird 2000 (-14%, -72% and -59% respectively) (JNCC 2021). With the exception of Noss (Shetland), Fair Isle (Shetland) and the Buchan Ness to Collieston Coast (east coast of Scotland) which showed an increase, all colonies in Scotland surveyed post Seabird 2000 declined (JNCC 2021).

A1a.5.38 Seabird distribution at sea

In general, nearshore waters of Orkney and the north coast of Scotland, and waters off the Outer Hebrides, including Lewis, are important for birds and some areas hold large concentrations of birds virtually throughout the year (Stone *et al*. 1995) and like the North Sea, after breeding season, species that feed further offshore e.g. northern fulmar, northern gannet, black-legged kittiwake, common guillemot, Atlantic puffin and razorbill leave coastal waters. SAST/ESAS surveys have found several species are present over the deep waters of the Atlantic Frontier (in and adjacent to Regional Sea 8) throughout the year.

Unlike other auk species, the black guillemot is typically found feeding close inshore and rarely disperses from its breeding area, even in winter. The importance of this region for this species is reflected in the designation of two Marine Protected Areas: the Monach Isles, an island group west of North Uist in the Outer Hebrides and Papa Westray, which includes waters around the north of the Island and includes the Holm of Papa Westray. At the Monach Isles, an estimated 820 breeding black guillemot rely on the feeding grounds encompassed by the MPA and at Papa Westray more than 500 black guillemot forage in coastal waters.

A summary of the distribution of the main species is described in Table A1a.5.25.

Table A1a.5.25: General seabird distribution at sea in the Regional Sea 8

Species	Distribution
January-April	High densities of **northern fulmar** concentrated along the continental slope and around Shetland, prior to breeding season. Adult **northern gannets** return to the area, with juveniles tending to arrive in May. **Black-legged kittiwake** widely distributed along the continental slope and on the shelf, north and north-east of Scotland, with few birds in waters west of Scotland. **Atlantic puffins** are widespread and numerous with the majority of **Atlantic puffins** that breed in the North Sea, breeding in Shetland (Regional Sea 1) and Orkney. Birds also found over deeper waters, as far west as the Rockall Trough and north to the Norwegian Sea – this species often more abundant in oceanic rather than inshore waters. Spring migration of **Arctic skuas** back to area, late March, through April, into May.
May-July	**Northern gannet** distribution is widespread, at low densities throughout the area. High densities of adults are found near breeding colonies around the Northern Isles: immature birds not tied to colonies are more widely dispersed. Concentrations of **black-legged kittiwake** found in coastal waters close to colonies particularly around Orkney and the northern coasts of Caithness and Sutherland. Distribution becomes patchy later in the year with movement away from colonies – distribution also extends to offshore waters south of the Faroes. Concentrations of **common guillemot** also found around Orkney, the north coast of Caithness and Sutherland at this time. **Herring gull** distribution is almost entirely coastal. Some adult **Arctic skuas** and **great skuas** that have failed to breed, and some immatures may start to leave colonies.
August - October	High densities of **northern fulmar** concentrated over shelf waters, particularly north of Scotland and around Shetland. **Common guillemots** disperse from colonies and congregate in inshore waters (moulting adults and flightless young). As winter progresses moulting flocks disperse further offshore. Favoured wintering grounds for **herring gull** include offshore areas to the west and north of Shetland and to the west of Scotland. Autumn migration of **Arctic skua** begins in August, through September/October; birds from western waters probably disperse southwards, or south west wards, rather than moving into the North Sea (spring migration seems to be more often through western waters even for adults returning to colonies on Northern Isles. Some young **black-legged kittiwake** migrate west and may be distributed across the North Atlantic
November - December	Densities of **northern fulmar** relatively low, with the majority of breeding population thought to remain within a few hundred km of colonies: juveniles are thought to disperse over longer distances. Breeding **northern fulmar** birds begin returning to Faroe colonies late winter and high densities concentrated in shelf waters, particularly close to large colonies. **Northern**

Species	Distribution
	gannet densities low after the birds leave the area for southern wintering grounds. Lowest numbers of birds found offshore with some dispersal out into the North Atlantic. High numbers of **black-legged kittiwake** remain concentrated in inshore waters west and north of Scotland, around Orkney and to the east of fair Isle. Moulting flocks of **common guillemot** disperse further offshore, but high densities still present in inshore waters around Orkney (Dec-April). **Atlantic Puffin** distribution becomes scattered (Oct-Mar), with birds from Shetland and Orkney colonies moving south and wintering in the North Sea. Some birds move north-west of Shetland to beyond the shelf break and over deeper waters of the Faroe Bank, the Faroe- Shetland Channel and the Wyville Thomson Ridge.

Source: Pollack *et al.* (2000), Furness (2015).

Thaxter *et al*. (2010, 2011, 2012a) described a three year DECC-funded study tagging great skua from Foula and Hoy to identify connectivity with areas of proposed or consented wind farms/renewable projects. Data was collected during the breeding season (May-August) with analysis of all available results published in Thaxter *et al*. (2014).

Foraging trips were defined by the departure and subsequent return of individuals to their nest sites and for all trips the (a) foraging range (the maximum point reached offshore from the colony); (b) the total travel distance per trip (by summing distances between GPS points along the route) and (c) trip duration (time elapsed between departure and return) were calculated. Area utilisation was assessed using kernel density estimation (KDE) with the 50%, 75% and 95% KDEs of the utilisation distribution taken to represent the core, middle and total areas respectively (Thaxter *et al*. 2014).

In 2010, all great skuas that made offshore trips from Foula (three out of four birds), overlapped with a Scottish Territorial Waters (STW) renewable zone N4 and N6 (these areas identified for potential offshore wind sites for south west of Shetland (N4) and west of Shetland (N6) – see Scottish Development International (2011) near to Foula. Similarly, in 2011, the offshore trips of all ten birds overlapped with the same zone. Of the nine birds from Hoy for which there were breeding season data, the offshore trips of two birds did not overlap with any proposed offshore wind farm development zone, while those of the other six showed connectivity with the N1 STW zone and one other bird made a long foraging excursion overlapping with Moray Firth zones NE2 and NE1 (see Scottish Development International (2011) for NE2 and NE1 locations) (Regional Sea 1) (Thaxter *et al*. 2014). Male great skuas spent significantly more time away from the nest than females and made foraging trips of longer duration.

A1a.5.39 Seabird vulnerability to pollution

Figures A1a.5.33 a and b below shows the monthly vulnerability for the Regional SEA 8 area.

Figure A1a.5.33 a: Monthly seabird oil sensitivity index scores for Regional SEA 8 (Jan-Jun)

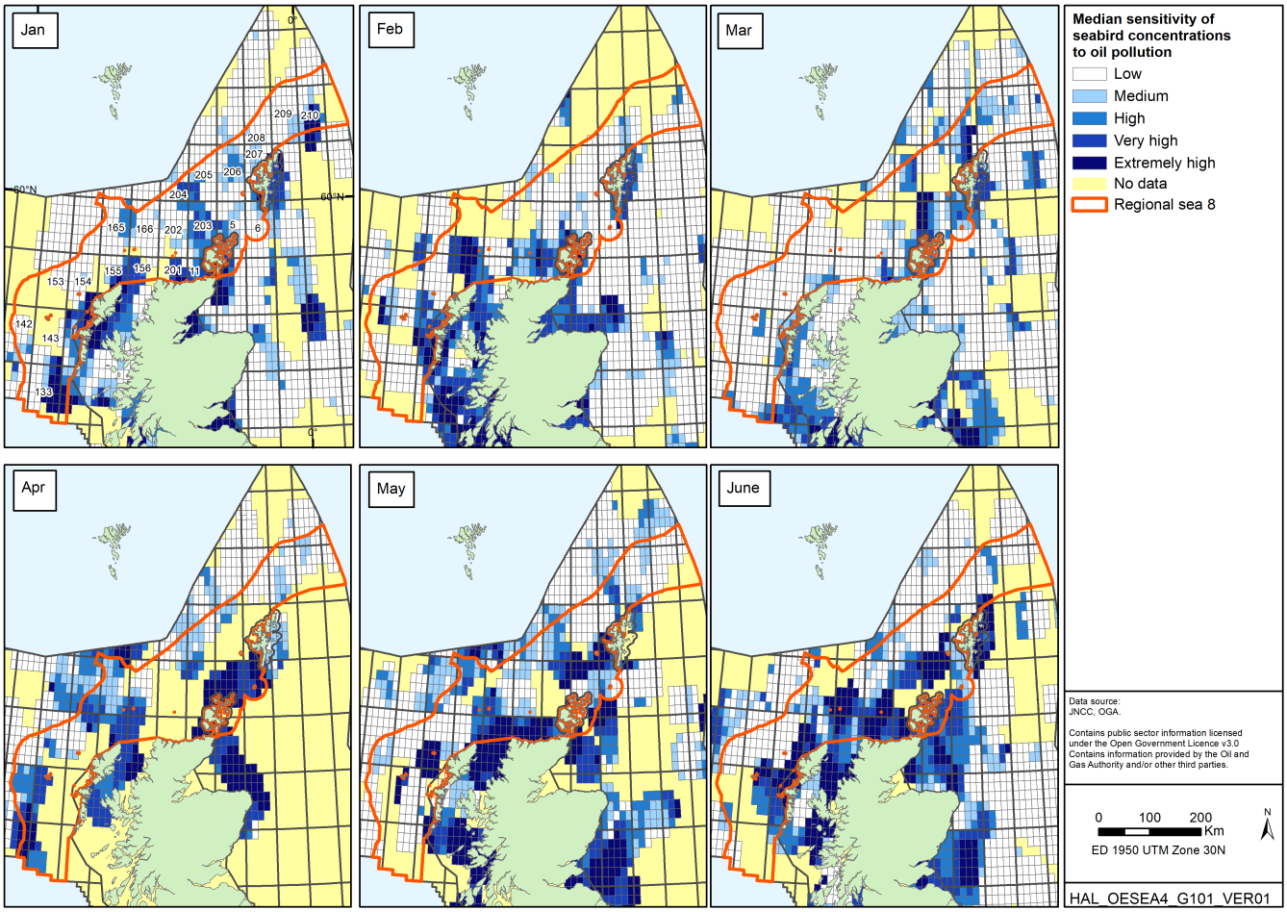
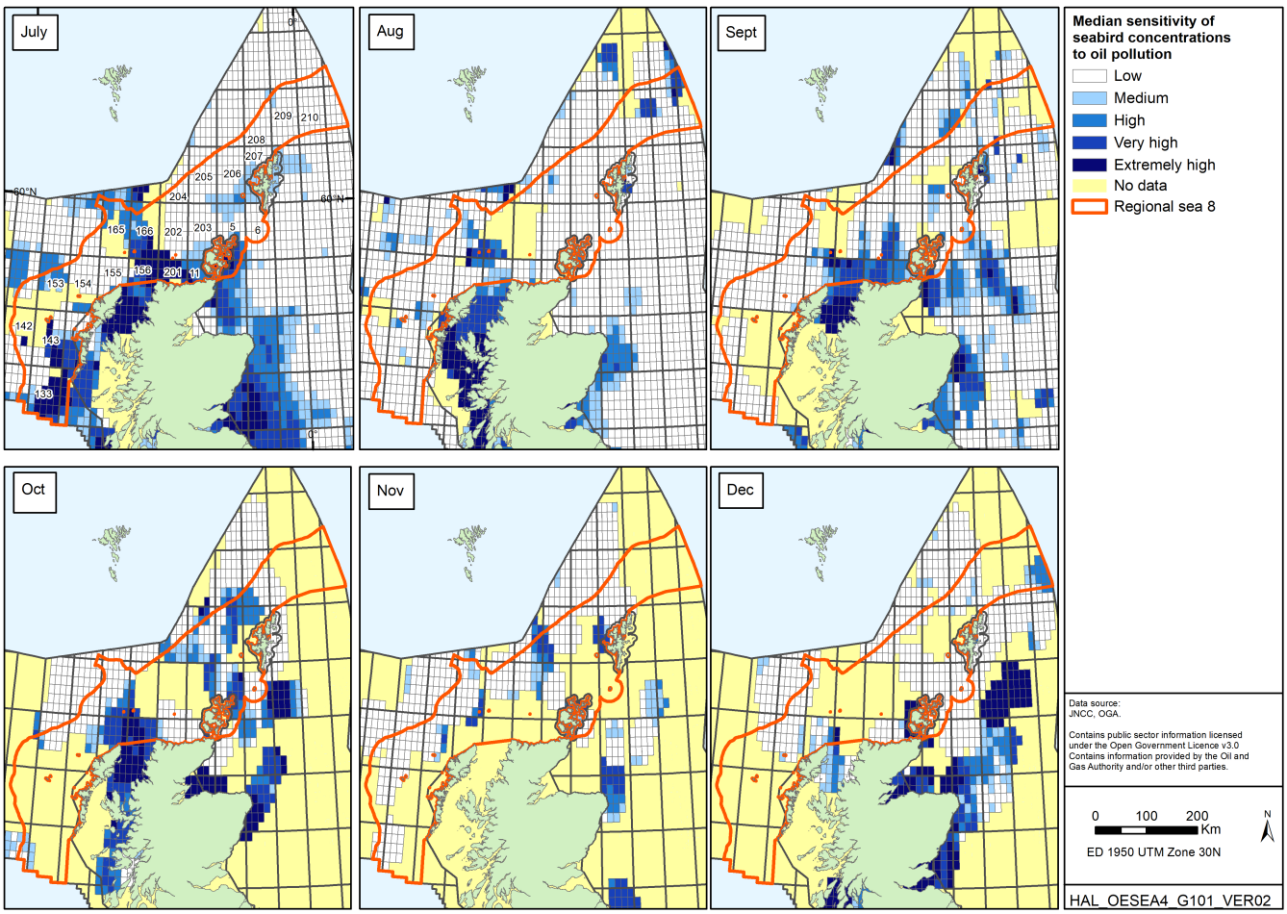


Figure A1a.5.33 b: Monthly seabird oil sensitivity index scores for Regional SEA 8 (Jul-Dec)



Highest sensitivity is seen around coastal waters of the Outer Hebrides, and the Northern Isles throughout the first half of the year up to and including the breeding season, highlighting the importance of these this area and the waters to birds. Data coverage is relatively good for Regional Sea 7.

A1a.5.40 Waterbird species and distribution (breeding, wintering and migratory)

Species of waterbirds known to breed in Regional Sea 8 include several wildfowl and wader species as well as red-throated diver; this species is known to breed at sites on Orkney and travel between hill-top lochan breeding sites and coastal waters to feed, with Hoy, the mainland Orkney moors, Ronas Hill and Tingon important sites for this species. Caithness and Sutherland are also strongholds for this species and there is a long-established breeding population of gadwall in the wetlands of the area.

Important sites for their wintering and on passage bird populations are described in table A1a.5.26. All of these sites are designated SPAs.

Table A1a.5.26: Important sites[1] for non-breeding waterbirds in Regional Sea 8

Site	Species (designated feature)
South Uist Machair and Lochs	Ringed plover, sanderling (site also designated for breeding dunlin, oystercatcher, redshank and ringed plover)
Monach Islands	(Greenland) Barnacle goose
North Uist Machair and Islands	(Greenland) Barnacle goose, purple sandpiper, ringed plover, turnstone (site also designated for breeding dunlin, oystercatcher, redshank and ringed plover)
North Sutherland Coastal Islands	(Greenland) Barnacle goose
Switha	(Greenland) Barnacle goose
East Sanday Coast	Bar-tailed godwit, purple sandpiper, turnstone

Notes: [1]SPA sites for non-breeding waterbirds in the UK as described on the JNCC SPA website. Average numbers of wintering birds can be obtained from the BTO website if the site is included in their site counts.
Source: JNCC website (http://jncc.defra.gov.uk/page-2598)

See Regional Sea 1 area for information on the red-throated diver pro

There is a large sedentary British greylag goose population, and this is thought to be increasing in abundance and distribution in Scotland (Mitchell *et al*. 2014); this is the only native species of goose breeding in Britain. In order to aid goose management, archipelago-wide surveys of greylag geese in Orkney are undertaken. In 2016 24,250 birds were counted a 13.6% increase on the number counted there in 2015 (Mitchel *et al.* 2016).

For wintering and on passage birds, the coastal and nearshore waters and rocky and sandy shorelines along with the machairs and lochs provide for a variety of seaducks, divers and grebes. This area can experience an influx of wintering and passage birds if severe cold weather occurs along the eastern coast.

The regions importance for birds has been recognised in the recent designation of new SPAs, including St Kilda, and the seas off of St Kilda, Scapa Flow and North Orkney; managed by NatureScot with support from Marine Scotland and Orkney Islands Council, digital aerial surveys are being undertaken around the North Orkney and Scapa Flow sites during the winters of 2021/2022 and 2022/2023.

A1a.5.41 Features of Regional Sea 9

This area is to the west of Shetland and mainland Scotland and covers the area including the Faroe-Shetland Channel. There are no land masses in this region.

A1a.5.42 Seabird species and distribution at sea

Seabirds found at sea over the Faroe-Shetland Channel and to the north of Shetland, are likely to originate mainly from major colonies in the Faroe, Shetland and Orkney Islands and more northerly breeding areas such as Iceland. The areas are probably too far to visit during the breeding season for most species and birds will generally move through the area in late summer and autumn on passage to winter breeding grounds, or in spring on route to breeding colonies or over the winter months.

Areas where birds are likely to be found include:

- North of Shetland – Overall the area is relatively unimportant for seabirds. Species likely to be present include northern fulmar, northern gannet, black-legged kittiwake and common guillemot. Greatest densities of birds (but still low numbers) between March and September, birds present during breeding season (May-July) likely to be non-breeders. Some birds can forage >100km from colonies during breeding (e.g. northern gannet, northern fulmar), so may be present in southern part of the area.

- Faroe Shetland Channel – Similar to above, is within maximum foraging range of some species during breeding, but too far for most species during this time and most likely to be used by non-breeders and birds moving through it in late spring/autumn.

- Wyville Thomson Ridge – Increased number of species in moderate densities seen here, a topographic high seabed area where water depths are shallower than those over the channel. Species likely to be present include northern fulmar, European storm petrel, black-legged kittiwake, common guillemot and Atlantic puffin.

Seabird distribution is closely correlated to water depth with more birds found over shallower continental shelves than the deeper oceanic waters. Birds present in the deeper slope and oceanic waters will comprise mainly pelagic species (e.g. northern fulmar, northern gannet, black-legged kittiwake and European storm petrel).

A1a.5.43 Seabird vulnerability to pollution

Figures A1a.5.34 a and b below shows the monthly vulnerability for the Regional SEA 9 area.

Figure A1a.5.34 a: Monthly seabird oil sensitivity index scores for Regional SEA 9 (Jan-Jun)

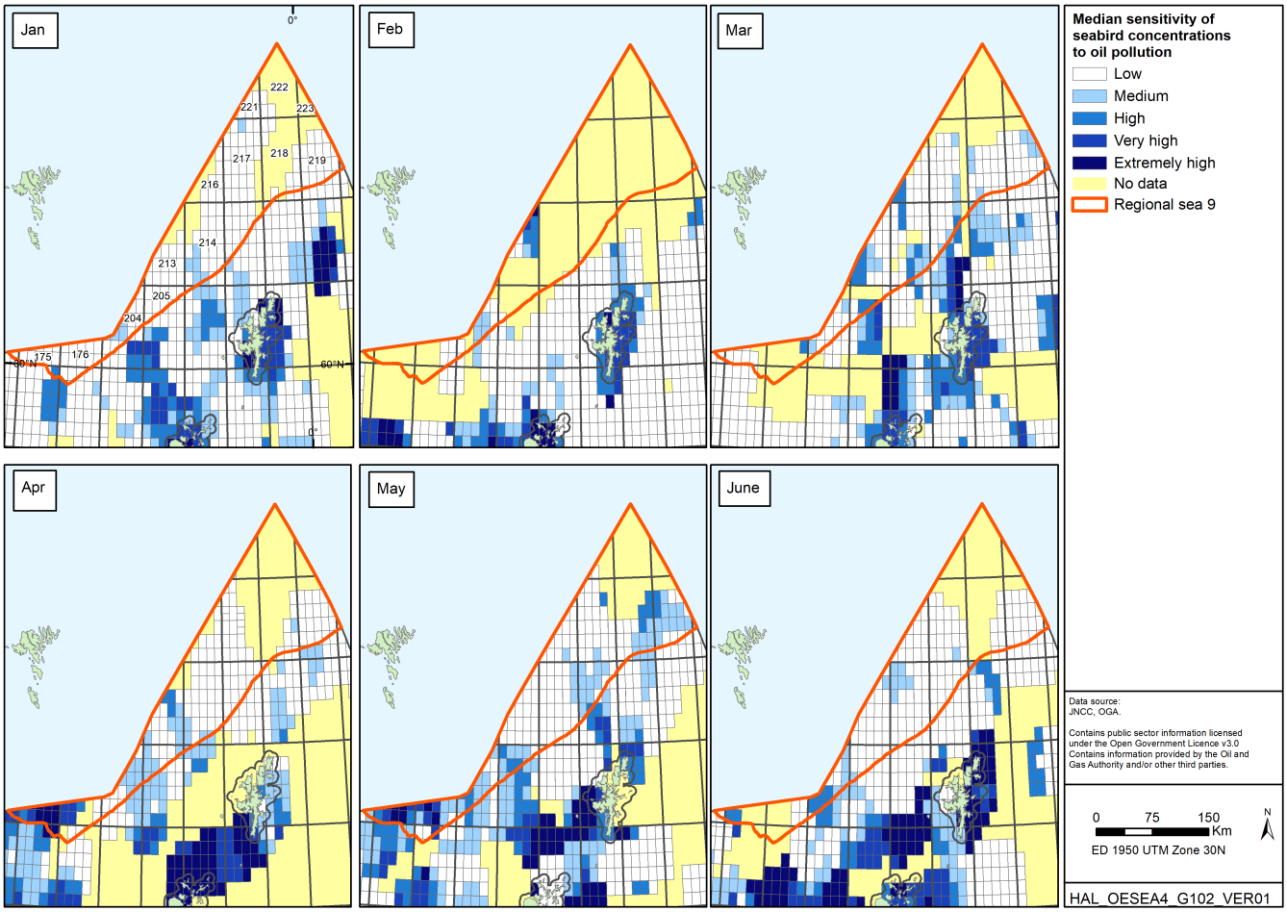
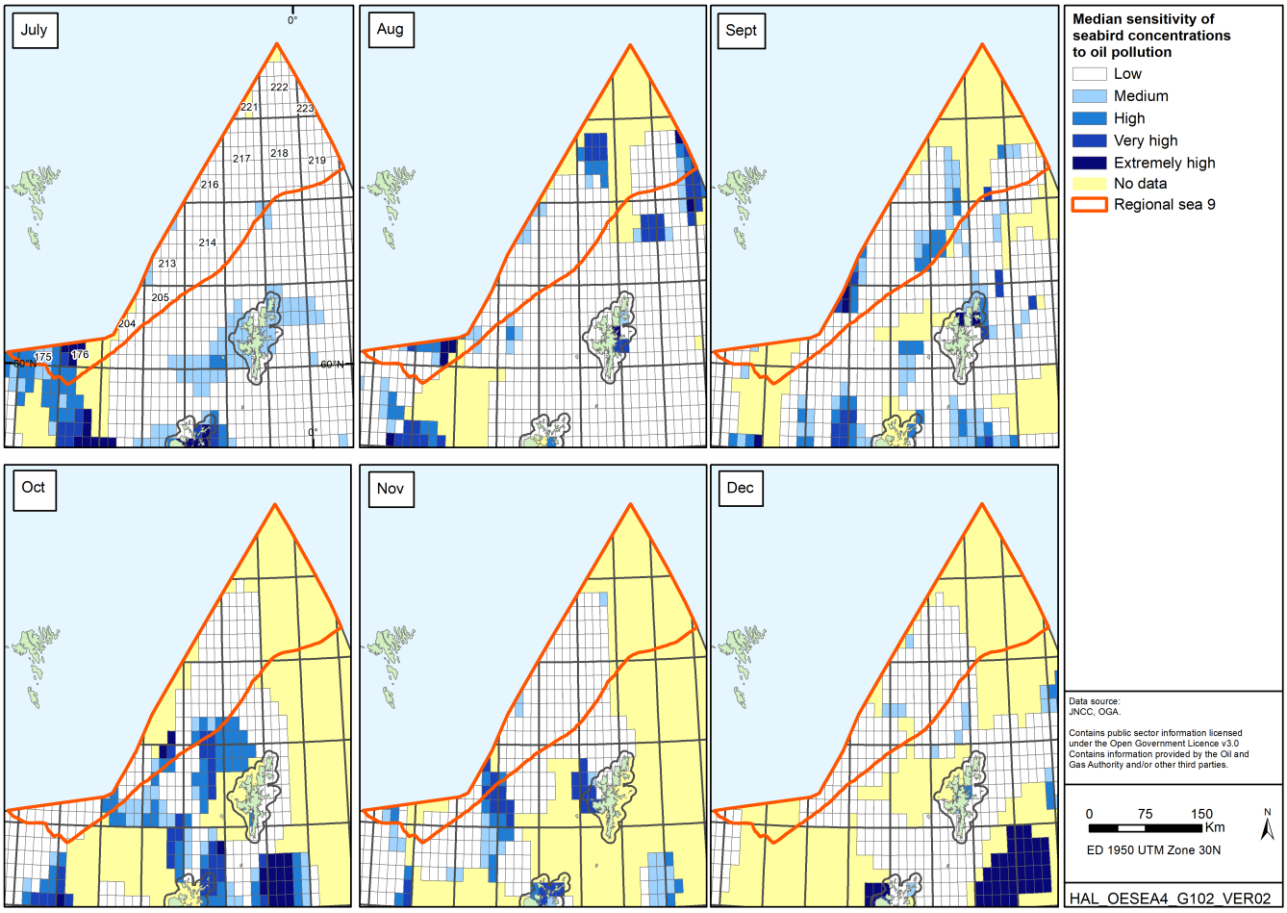


Figure A1a.5.34 b: Monthly seabird oil sensitivity index scores for Regional SEA 9 (Jul-Dec)



Although there are some areas with extremely high and very high sensitivity, Regional Sea 9, overall appears relatively low in sensitivity compared to other areas. This is a wholly marine area and as such would support birds foraging from colonies from Shetland and colonies within foraging range during the breeding season, accounting for the occurrence during these months of the year (i.e. May June); birds can have a more wide ranging distribution in the period prior to egg laying, this distribution becoming more contracting during chick rearing.

A1a.5.44 Waterbird species and distribution (breeding, wintering and migratory)

As all of Regional Sea 9 is open seas, there are no breeding waterbirds. Similarly, there are no areas for wintering waterbirds and any birds within the area are likely to be on passage.

A1a.5.45 Features of Regional Sea 10 & 11

Regional Sea areas 10 and 11 cover the offshore areas of the Rockall Trough and Bank (10) and the Atlantic North West Approaches (11) and do not contain any inshore or coastal areas.

A1a.5.46 Seabird species and distribution at sea

There are large gaps in the ESAS/SAST survey coverage for the area and since the last SEA there have been no new surveys in the region. General seabird distribution in the region was provided in OESEA, based on the surveys that had been conducted, including details from Pollock & Barton (2006) which provided a review of the ESAS data in this offshore area; and the description of seabird distribution has been included in Table A1a.5.27.

Table A1a.5.27: General seabird distribution at sea in the Regional Sea 10 and 11 areas

Species	Distribution
January - April	**Northern fulmar** are widespread at low densities, concentrations along shelf edge, north west of Anton Dohrn seamount & over Hatton Bank. **Northern gannet** also present along shelf edge in high densities, Few birds in deep waters. **Black-legged kittiwakes** widespread in inshore waters, further offshore peak densities recorded along shelf break. Densities lowest over Rockall Trough and Bank. **Great black-backed gull** widespread at low to moderate densities as far west as 10ºW. Patches of moderate to high densities along shelf break. Large influx of **lesser black-backed gull**. Low densities in offshore areas such as the Hatton Bank, Rockall Bank and Rockall Trough, although moderate to high density patches over shelf break. Few **Atlantic puffin,** with numbers increasing in March north of the Western Isles, although densities still low. **Manx shearwater** largely absent from offshore areas, although low densities along shelf break & over Rockall Trough.
May - July	Earliest **common tern** recorded in the area in May, with highest densities recorded in June and July around Western Isles. **Arctic skua** widely scattered in low numbers. Many birds migrating north to Arctic breeding grounds. Highest densities of **Atlantic puffin** recorded around Western Isles. Widely scattered at low densities along shelf break and eastern edge of Rockall Trough and as far west as Hatton Bank. **European Storm petrel** widespread at low to moderate densities over shelf edge to north and west of Western Isles. Highest densities along shelf edge. Occasional **Arctic tern** offshore.
August - October	**Northern gannet** more widespread in offshore waters with low densities as far west as Hatton Bank. Highest densities north and west of Western Isles close to colonies, low densities along shelf edge. Highest densities of **black-legged kittiwake** in inshore waters close to breeding colonies, widespread at low densities over the Rockall Trough and Bank and the Hatton Bank. **Northern fulmar** are widespread at low to moderate densities, with occasional high densities along shelf break and over Rockall Bank. **Manx shearwater** widely scattered in low densities offshore, with occasional high density patches encountered (e.g. Rockall Bank). Birds encountered over Hatton Bank in June. **Atlantic puffins** disperse offshore away from breeding colonies. Low to moderate densities in the north-east Rockall Trough. Low densities over the Rockall Bank in September. Occasional **great black-backed gull** recorded in offshore waters, although very few along shelf break. **European storm petrel** widespread at low to moderate

Species	Distribution
	densities over shelf waters, with low densities over the Rockall Bank and north of the Anton Dohrn Seamount (July through to September). May to August, highest numbers of **Leach's storm petrel** recorded north-west of the Western Isles, beyond the shelf edge, in waters greater than 1,000m deep. A few birds recorded far offshore and very few inshore. Low densities of **lesser black-backed gull** throughout the area. **Great skua** widespread in low numbers throughout offshore waters as well as shelf waters. **Arctic tern** more widespread in offshore areas in low to moderate numbers.
November - December	Limited survey coverage. Highest densities of **northern fulmar** north and west of Western Isles & over shelf edge around 57ºN. **Black-legged kittiwake** in shelf waters north of Western Isles and occasionally further offshore. Highest densities of **northern gannet** along shelf edge, November through to April. Few birds in deep waters. Widespread at low densities over shelf waters. Majority of **European storm petrel** have left the area. Birds primarily restricted to inshore areas. Low densities of **lesser black-backed gull** with a few individuals scattered offshore. Low numbers of **great skua** observed to north and west of Western Isles. Majority inshore of the shelf break.

Source: Pollack & Barton (2006)

Other migrant seabird species which are present within offshore areas in low numbers and at certain times of the year include sooty shearwater, great shearwater, little auk, pomarine skua and long-tailed skua.

A1a.5.47 Seabird vulnerability to pollution

Figures A1a.5.35 a and b and A1a.5.36 a and b below shows the monthly vulnerability for the Regional SEA 10&11 areas respectively. This area is wholly marine and has an overall lower sensitivity relative to other area. There are significant data gaps over several months.

Figure A1a.5.35 a: Monthly seabird oil sensitivity index scores for Regional SEA 10 (Jan-Jun)

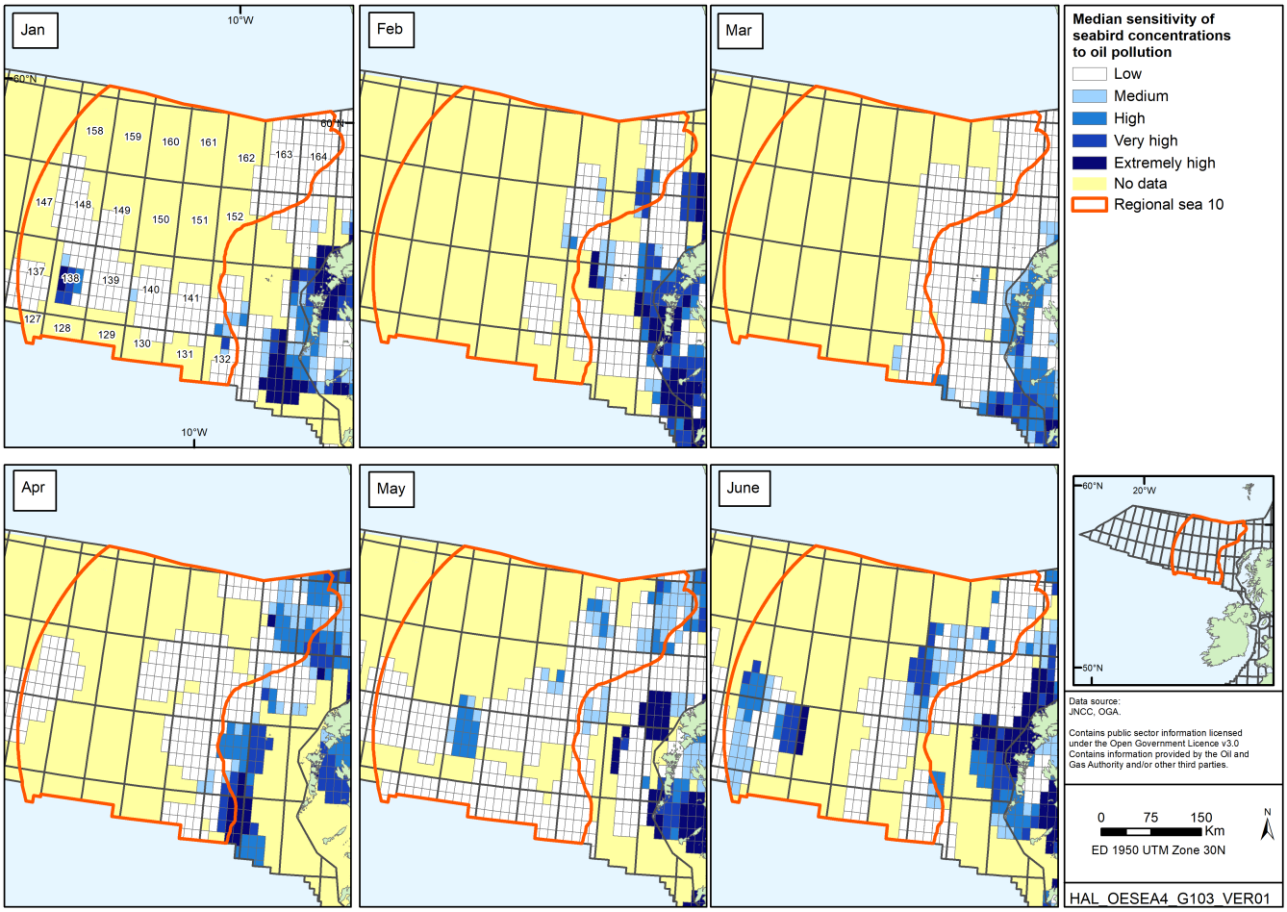


Figure A1a.5.35 b: Monthly seabird oil sensitivity index scores for Regional SEA 10 (Jul-Dec)

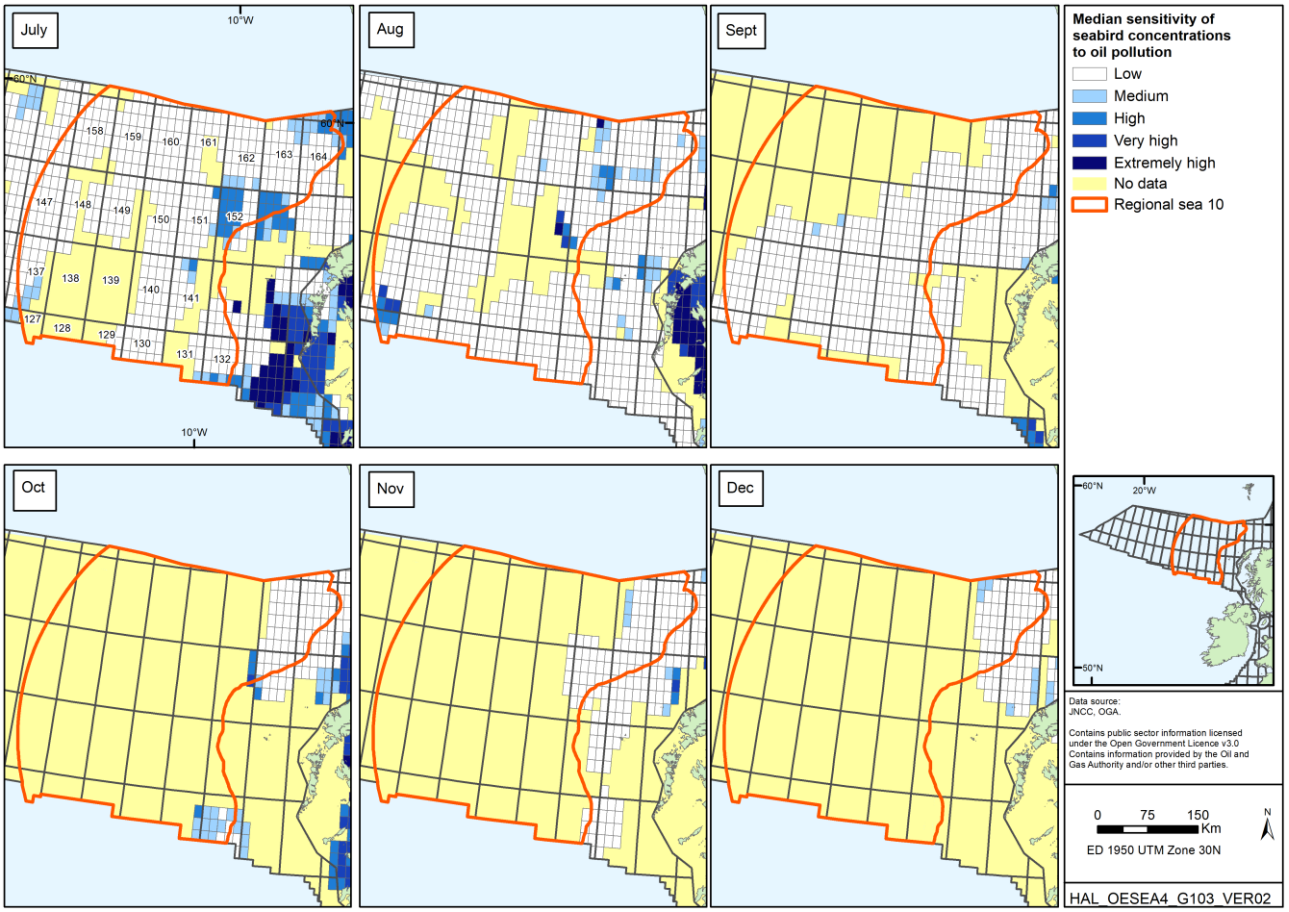
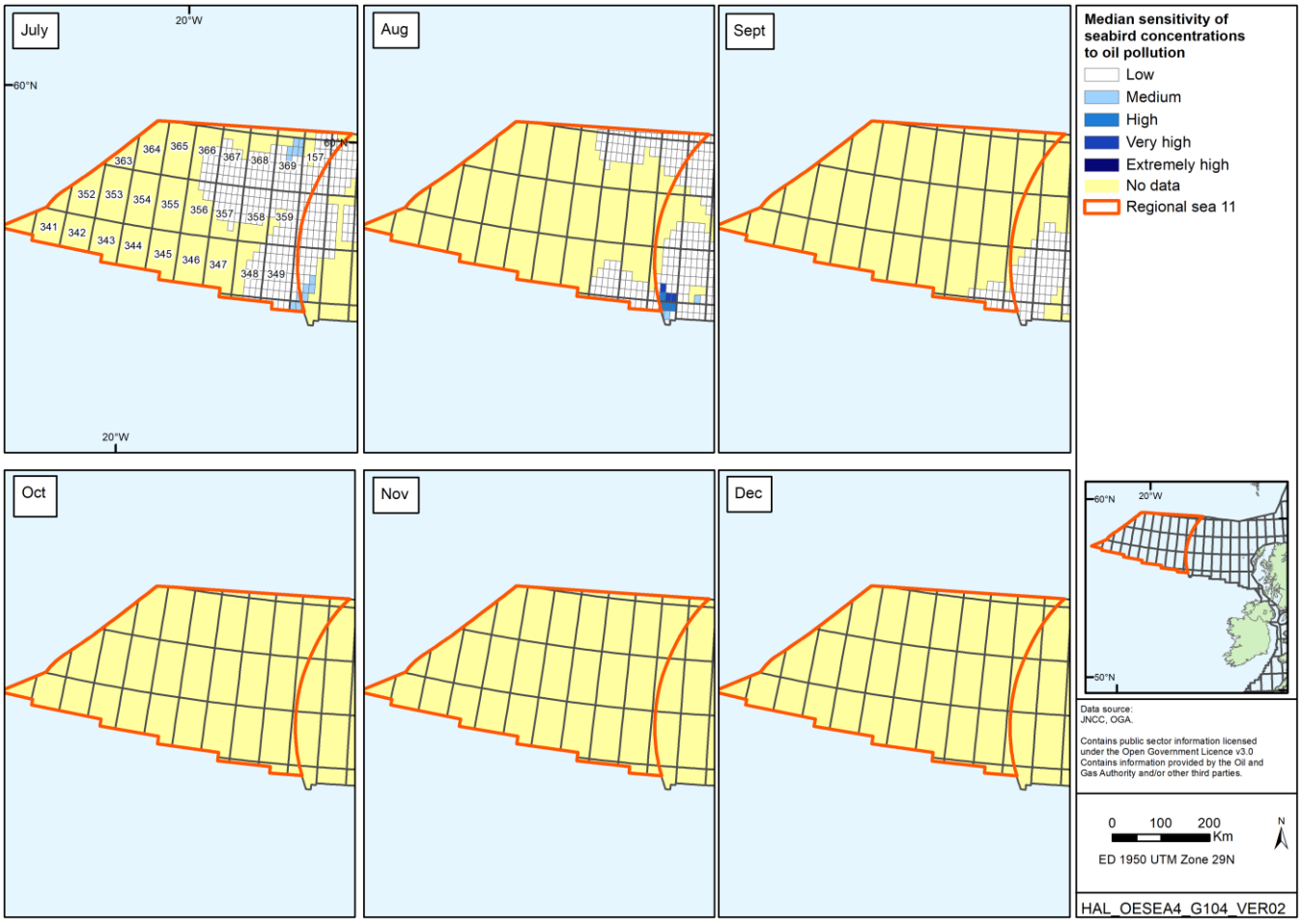


Figure A1a.5.36 a: Monthly seabird oil sensitivity index scores for Regional SEA 11 (Jan-Jun)

Figure A1a.5.36 b: Monthly seabird oil sensitivity index scores for Regional SEA 11 (Jul-Dec)



There is very little data for the Regional Sea 11 area, with poor spatial and temporal coverage.

A1a.5.48 Waterbird species and distribution (breeding, wintering and migratory)

As all of Regional Sea 10 and 11 are open seas, there are no breeding waterbirds. Similarly, there are no areas for wintering waterbirds and any birds within the area are likely to be on passage.

A1a.5.49 Evolution of the baseline

Birds occupy a wide range of habitats and respond to environmental pressures and studying bird populations, including their abundance and productivity, can provide a good indication of the broad state of the environment around them; long term data on changes in bird populations can also help to interpret shorter term fluctuations in number. Trends are used to assess whether environmental management on bird populations is being effective as well as informing policy makers, government agencies and non-government organisations (Defra 2019).

Information from the JNCC online Seabird Population Trends and Causes of Change showing changes to 2019, (JNCC 2021), is shown in Table A1a.5.28.

Table A1a.5.28: Seabird population change up to 2019

Species	Population Change %		
	1969-70 to 1985-1988	1985-88 to 1998-2002	2000-2019
Northern fulmar	+77	-3	-33
Manx shearwater	n/a	n/a	n/a
European storm petrel	n/a	n/a	n/a
Leach's storm petrel	n/a	n/a	n/a
Northern gannet	+39	+39[1]	+34[2]
Great cormorant	+9	+10	+16
European shag	+21	-27	-40
Arctic skua	+226	-37	-70
Great skua	+148	+26	n/a
Black-legged kittiwake	+24	-25	-29
Black-headed gull	+5	0	+26
Mediterranean gull	n/a	+10,900	+327
Common gull	+25	+36	n/a
Lesser black-backed gull	+29	+40	n/a
Herring gull	-48	-13	n/a
Great black-backed gull	-7	-4	-23
Little tern	+58	-23	-28
Sandwich tern	+33	-15	+5[3]
Common tern	+9	-9	-3
Roseate tern	-66	-83	+125
Arctic tern	+50	-31	-5
Common guillemot	+77	+31	+60
Razorbill	+16	+21	+37
Black guillemot	n/a	+3[2]	n/a
Atlantic puffin	+15	+19	n/a

Notes: [1]Change between censuses in 1984-5 and 2003-04. [2]Change between censuses in 2003-04 and 2013-2015 [3]This figure was revised from its initial release on 29th April 2021 to take into account additional data received. n/a = insufficient sample size or extremely wide confidence limits, therefore figure not provided.
Sources: JNCC (2021) https://jncc.gov.uk/our-work/smp-report-1986-2018

Over the period 2000 and 2019, declines have been seen in a number of seabird species, including Arctic skua, European shag, northern fulmar and black-legged kittiwake.

Black-legged kittiwake abundance in the UK has declined rapidly since the early 1990s. In 2013, the UK index was 28% of that recorded in 1986, the lowest value recorded in 28 years of monitoring (JNCC 2015); numbers appear to have been more stable since then (JNCC 2021).

Table A1a.5.29 below shows the counts of black-legged kittiwakes between the Seabird 2000 and recent surveys (from 2016 onwards) at several key colonies, and the rate of change; consideration needs to be given on survey effort, e.g. small colonies surveyed more regularly, could cause bias in trend (JNCC 2021).

Table A1a.5.29: Counts of black-legged kittiwakes[1] from SPAs in the Regional Sea areas

SPA Name	Seabird 2000 Count	Count (year)	Change (%)	% per annum
Regional Sea 1				
Noss	2,395	76 (2019)	-97	-16.6
Foula	1,934	259 (2019	-87	-10
Troup, Pennan and Lion's Head	18,482	10,503 (2017)	-43	-3.5
Buchan Ness to Collieston Coast	14,091	11,265 (2019)	-20	-1.2
Fowlsheugh	18,800	14,039 (2018)	-25	-1.5
Forth Islands	6,632	3,514 (2018)	-47	-3.5
St Abbs Head[2] NNR	11,077	4,651 (2019)	-58	-4.5
Regional Sea 2				
Farne Islands	5,096	4,402 (2019)	-14	-0.8
Flamborough Head and Bempton Cliffs	42,582	45,504 (2017)	7	0.4
Regional Sea 4				
Skomer and Skokholm	2,257	1,336 (2017)	-41	-3.0
Regional Sea 6				
Ailsa Craig	1,675	300 (2019)	-82	-9.1
Regional Sea 7				
Handa	7,013	3,749 (2018)	-47	-3.2
Canna and Sanday	1,274	1,457 (2019)	14	0.7
Regional Sea 8				
Marwick Head	5,573	906 (2018)	-84	-9.1

Notes: [1] Counts of black-legged kittiwake Apparently Occupied Nests (AON) recorded at SPA compared to number recorded during Seabird 2000 along with % change and per annum change. [2] Data for St Abb's Head relate to only part of the SPA. Source: JNCC (2021) https://jncc.gov.uk/our-work/black-legged-kittiwake-rissa-tridactyla/

Similarly, numbers of northern fulmar have also declined at several of these colonies over the same period: Troup, Pennan and Lion's Head, (-37% 2017); Fowlsheugh (-55%, 2018); Handa (-60%, 2017) and Buchan Ness to Collieston Coast (-58%, 2019), where European shag also showed a decline of -10% (2019). European shag also showed declines at Forth Islands (-73%, 2019), St Abbs Head NNR (-61%, 2019) and Farne Island (-63%, 2019).

Conversely, over the same period (i.e. surveys of colonies from 2016), increases have been recorded for northern gannet, with some colonies (Noup Head (+11,271, 2019) and Sule Skerry (+7,970, 2019), showing considerable % changes (JNCC 2021).

Changes between Seabird 2000 and recent (≥2016) surveys for seabirds are available from the JNCC Seabird Monitoring Programme Report[14] and where available, colony counts and breeding success information can also be accessed from the JNCC managed database[15].

From *The State of the UKs Birds 2020* (Burns *et al*. 2020) and *Waterbirds in the UK 2019/2020* (Frost *et al.* 2021), a number of breeding and wintering bird species show significant trends in numbers (Table A1a.5.30 and A1a.5.31). Species like curlew and lapwing are consistently showing a decline in breeding and wintering numbers between surveys. Unfortunately, the reasons for these declines are not fully understood.

Table A1a.5.30: Trends[1] in common breeding waterbirds in the UK

Species (population estimates)[2]	Long-term trend % (1970-2018)[3]	10-year trend % (2008-2018)[3]
Canada goose	-	-9
Common sandpiper	**-51**	-9
Coot	45	**-19**
Curlew*	**-64**	**-13**
Gadwall	-	**129**
Golden plover	-	4
Goosander	-	12
Great crested grebe	-	-15
Greylag goose	-	14
Lapwing	**-64**	**-33**
Little grebe	-	20
Mallard	**86**	**-7**
Mute Swan	**219**	21
Oystercatcher	-	**-11**
Redshank	-	-19
Shelduck*	110	-40
Tufted duck	-	-2

Notes: [1]The long term trends are based on the smoothed estimate of change between 1970 and 2018 in a combined CBC (common Bird Census)-BBS (breeding Bird Survey) analysis. For species with evidence of marked differences in the population monitored by the BBS and its predecessor the CBS (marked with a *), the CBC results until 1994 have been used then the BBS results from 1994 to 2019. [2]Trends in bold are statistically significant at the 0.05 level. Source: Burns *et al.* (2020).

[14] https://jncc.gov.uk/our-work/smp-report-1986-2019/
[15] https://app.bto.org/seabirds/public/data.jsp

Table A1a.5.31: Trends[1] in wintering waterbirds in the UK

Species (flyway population trend[2])	25 year trend % (1993/94-2018/2019)	10-year trend % (2008/09-2018/19)
Avocet (↑)	255	20
Bar-tailed godwit (↑)	-21	-5
Bewick's swan (↓)	-88	-81
Black-tailed godwit (↑)	188	26
British/Irish greylag goose (n/a)	165	21
Canada goose (n/a)	68	14
Canadian light-bellied brent goose (↓)	85	10
Coot (-)	-15	-24
Curlew (↓)	-33	-18
Dark-bellied brent goose (-)	-23	11
Dunlin (-)	-45	-7
Eider[3]	-27	-17
European white-fronted goose (-)	-70	-16
Gadwall (↑)	120	10
Golden plover (-)	-6	-14
Goldeneye (-)	-58	-26
Goosander (-)	-6	14
Great crested grebe (-)	-8	-14
Greenland barnacle goose (↑)	115	23
Greenland white-fronted goose (↓)	-34	-10
Grey plover (↓)	-44	-24
Icelandic greylag goose (↓)	-6	-6
Knot (-)	-13	-3
Lapwing (↓)	-40	-9
Little grebe (-)	71	-3
Mallard (-)	-35	-15
Mute swan (n/a)	25	-4
Oystercatcher (-)	-24	-16
Pink-footed goose (↑)	111	47
Pintail (-)	-25	-22
Pochard (↓)	-69	-39
Purple sandpiper (↓)	-52	-16

Species (flyway population trend[2])	25 year trend % (1993/94-2018/2019)	10-year trend % (2008/09-2018/19)
Red-breasted merganser (-)	-47	-23
Redshank (↓)	-21	-9
Ringed plover (↓)	-50	-19
Sanderling (-)	22	-15
Scaup (↓)	-47	-60
Shelduck (-)	-28	-11
Shoveler (↑)	62	17
Svalbard barnacle goose (↑)	164	32
Svalbard light-bellied brent goose (-)	54	-27
Teal (↑)	24	7
Tufted duck (↓)	-6	-3
Turnstone (↑)	-42	-21
Whooper swan (↑)	239	36
Wigeon (↓)	-1	-6

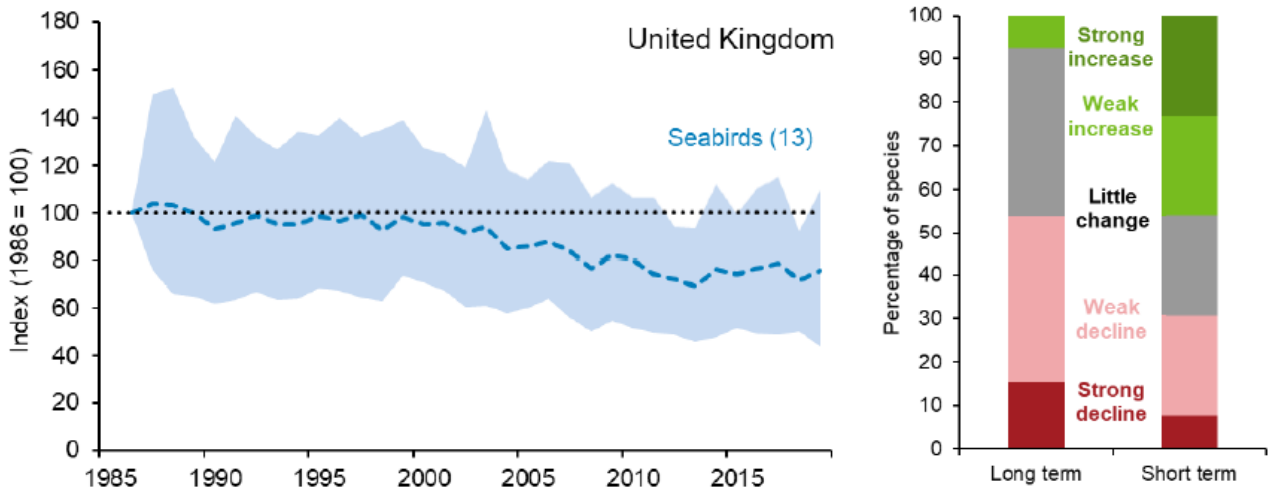
Notes:.[1] Trends are % changes of smoothed population index values for the most abundant waterbirds in the UK. [2] The indication of flyway population trend is indicated by: (↑) increasing, (↓) decreasing, (-) stable and (n/a) not applicable as population is non-native or non-migratory [3]Eider trends excludes birds on Shetland (of foeroeensis race). Source: Frost *et al.* 2021

The UK and England Wild Bird Indicators are annual publications from Defra that takes data from a variety of sources and is compiled in conjunction with the BTO, the RSPB, JNCC and the WWT. The 2020 publication present trends from 1970 to 2019 from bird populations, including seabirds and wetland birds (Defra 2020a,b). Two trends are referred to in the text, unsmoothed[16] and smoothed trends and the assessment references two terms: long-term[17] and short-term. Individual bird species population trends are calculated as an index (the seabird index started in 1986), which relates the population in a given year to a "baseline" (the first year that data are available, which is given a value of 100). Thereafter, the index is expressing the population as a percentage of this "baseline" in different indicators: Strong increase (population increase of ≥100%); Weak increase (>33% but <100% increase); Little change (between a 25% decrease and a 33% increase); Weak decline (<50% but >25% decrease) and Strong decline (population decrease of ≤50%)(Defra 2020a,b).

The population index for UK seabirds and separately for England, are shown in Figures A1a.5.37a and A1a.5.37b respectively and Figures A1a.5.38a and A1a.5.38b for wintering waterbirds in the UK and England.

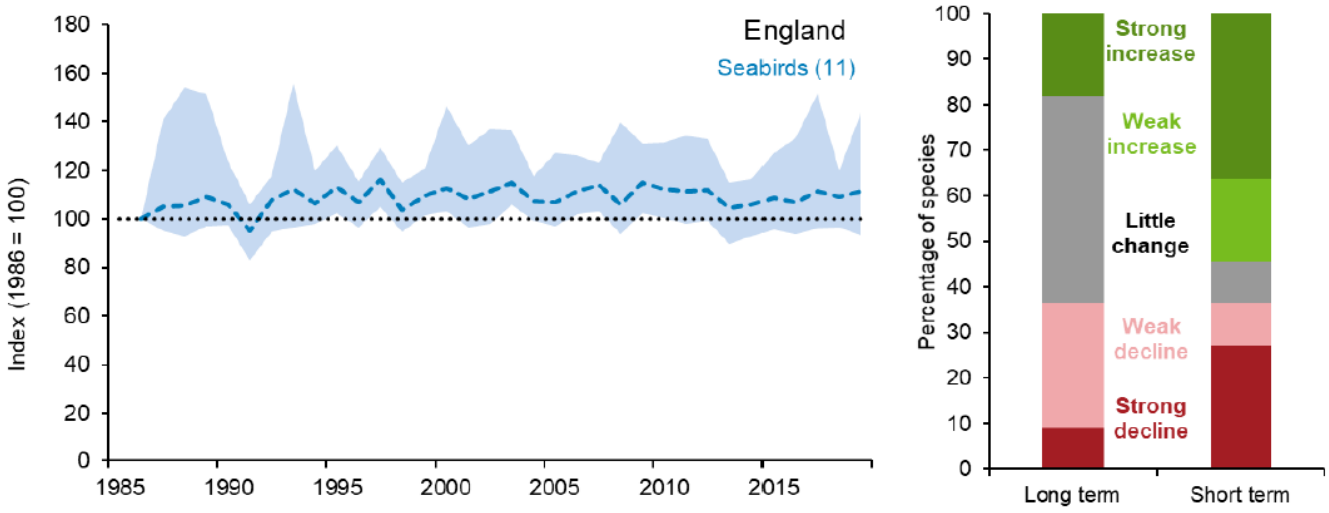
[16] The unsmoothed indices show year-to-year fluctuations in populations, reflecting the observed changes in survey results and smoothed trends are used to formally assess the statistical significance of change over time, and reduce the short=term peaks and troughs resulting from, e.g. good/bad breeding seasons – at time of writing (2021), there are no smoothed trends available for seabirds, (DEFRA 2020).
[17] "Long term" is an assessment of change since the earliest date for which data are available, and "short term" is an assessment of change over the last 5 years for which data are available (DEFRA 2020).

Figure A1a.5.37a: Breeding seabird index in the UK 1986-2019



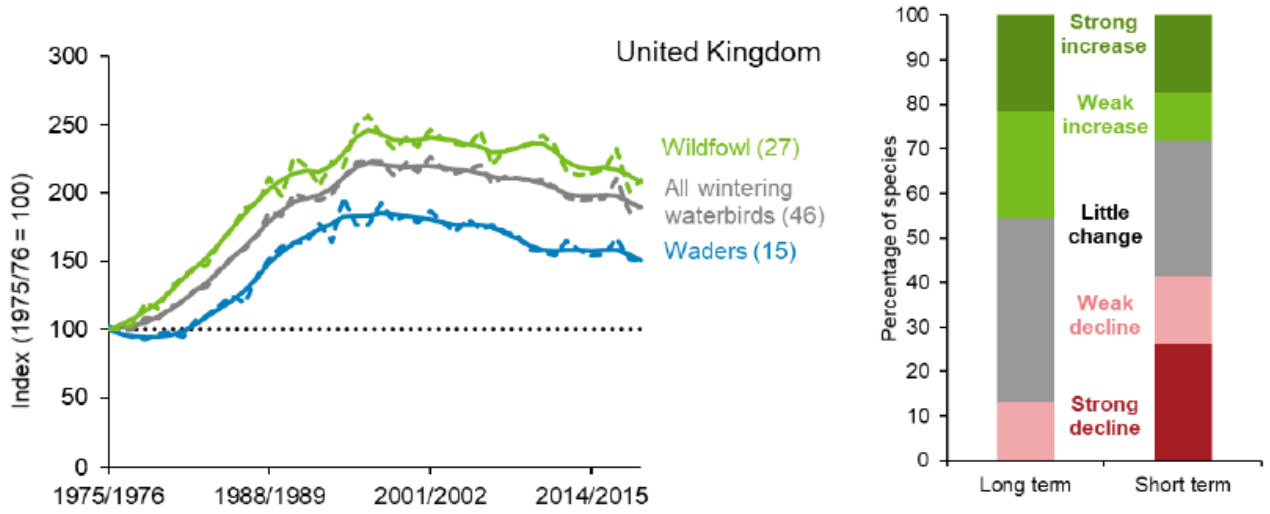
Note: Figure in brackets show number of species. Graph shows unsmoothed trend (dashed line) with its 95% confidence interval (shaded area) – no smoothed trend is available for seabirds (in the 2020 publication, but this will be available in future publications). Source: Defra (2020a).

Figure A1a.5.37b: Breeding seabird index in England 1986-2019



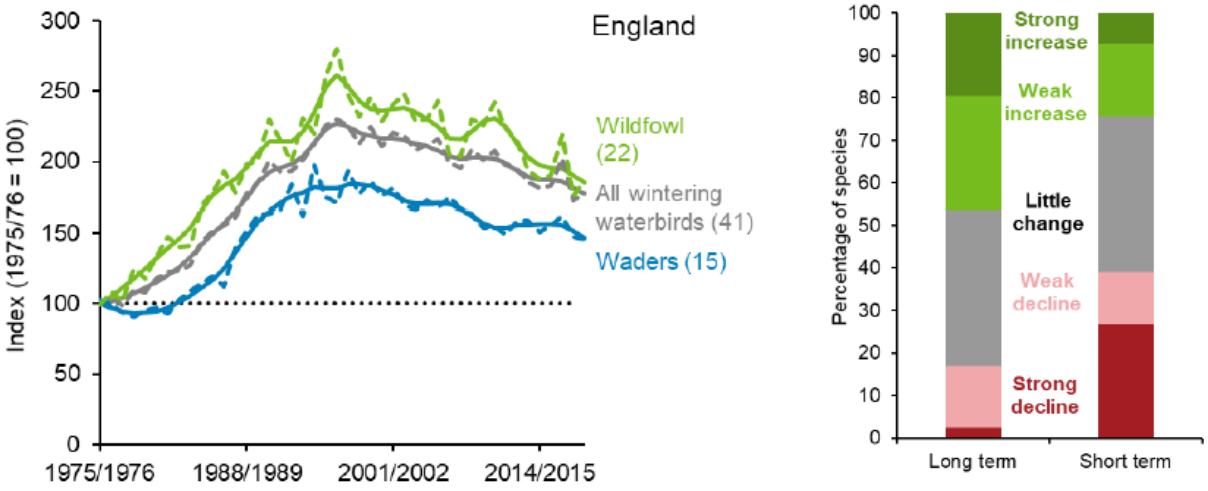
Note: Figure in brackets show number of species. Graph shows unsmoothed trend (dashed line) with its 95% confidence interval (shaded area) – no smoothed trend is available for seabirds (in the 2020 publication, but this will be available in future publications). Source: Defra (2020b).

Figure A1a.5.38a: Population index of wintering waterbirds in the UK, 1975/76 to 2018/19



Note: Figure in brackets show number of species. Graph shows unsmoothed trend (dashed line) and smoothed trend (solid line). Data from wintering waterbirds monitoring schemed are based largely on full counts at colonies or at wetland and coastal sites of markedly varying size. As this means bootstrapping methods cannot be applied reliably, trends for these groups are currently presented without confidence intervals. Source: DEFRA (2020a).

Figure A1a.5.38b: Population index of wintering waterbirds in England, 1975/76 to 2018/19



Note: Figure in brackets show number of species. Graph shows unsmoothed trend (dashed line) and smoothed trend (solid line). Data from wintering waterbirds monitoring schemed are based largely on full counts at colonies or at wetland and coastal sites of markedly varying size. As this means bootstrapping methods cannot be applied reliably, trends for these groups are currently presented without confidence intervals. Source: DEFRA (2020b)

For a number of species (e.g. herring gull, great cormorant) only data for coastal populations (colonies within 5km of the coastline) are used, therefore, this focusses the indicator on changes at the coast and in marine waters; all breeding areas for these species are therefore not included in the measure. Work is underway to improve survey coverage, to include inland coverage, so that a trend based on all breeding areas can be included in the "all-species" indicator (DEFRA 2020). Since the beginning of the index in 1986, razorbill numbers have more than doubled, with both Artic skua (80%) and black-legged kittiwake(64%) declining strongly over this period. There has been some improvement in the short term for black-legged kittiwakes, with this species showing a strong increase of 20% between 2013 and 2018; the decline in this species has been linked to climate change impacts on marine food webs and fishery pressures (DEFRA 2020). Between 2013 and 2018, razorbill and sandwich tern have

also both increased strongly by 35% and 26% respectively, whilst great black-backed gulls are decreasing strongly by 32% in the short term, although the long-term trend is a weak decline (DEFRA 2020). Predation by invasive non-native mammals such as rats and mink, have also impacted some seabird species, however, successful eradication programmes implemented in areas have seen populations undergo local recoveries as a result.

The online WeBS Alerts System[18] has site accounts for SPAs and Sites of Special Scientific Interest (SSSI) identifying changes in numbers of wintering waterbird species, for which the site was designated for, over short (5 years), medium (10 years) and long-term (up to 25 years) periods, with comparisons made between site-specific regional and national trends. An alert is issued when a species has undergone a major decline in numbers; *alerts are advisory and should be used (subject to interpretation) as a basis on which to direct research and subsequent conservation efforts if required* (Woodward *et al*. 2019). As an example, a snapshot of the Montrose Basin SPA is shown below, showing the species for which the site is designated; % change for non (designated) features of the site are also shown on the site page, but not shown below.

WeBS Alerts: Montrose Basin SPA

Help

7 species evaluated: Shelduck; Wigeon; Eider (except Shetland); Oystercatcher; Knot; Dunlin; Redshank

High Alerts	Eider (except Shetland) [MT,LT,SB]; Knot [MT,LT,SB]; Dunlin [LT,SB]
Medium Alerts	Oystercatcher [LT,SB]; Redshank [LT,SB]
Key	**ST**: short-term (5 years) **MT**: medium-term (10 years) **LT**: long-term (up to 25 years) **SB**: since baseline

2 species not evaluated: Greylag Goose (Icelandic); Pink-footed Goose

Alerts have been triggered for five of the seven species assessed for Montrose Basin SPA, and also for the waterbird assemblage as a whole. For two species, comparison of site trends with broadscale trends suggests that the declines underpinning Alerts status may be driven or exacerbated by site-specific pressures.

Alerts status for designated features

Species	Info	First Winter	Ref Winter	Short-term % Δ	Med-term % Δ	Long-term % Δ	Baseline Winter	% Δ since baseline
Greylag Goose (Icelandic)	i	–	–	–	–	–	89/90	–
Pink-footed Goose	i	–	–	–	–	–	93/94	–
Shelduck	–	91/92	16/17	100	100	100	07/08	100
Wigeon	–	91/92	16/17	64	13	6	89/90	-9
Eider (except Shetland)	–	91/92	16/17	-21	-58	-51	89/90	-65
Oystercatcher	–	91/92	16/17	43	-16	-37	89/90	-46
Knot	–	91/92	16/17	-4	-76	-82	89/90	-82
Dunlin	–	91/92	16/17	166	-11	-50	89/90	-58
Redshank	–	91/92	16/17	55	25	-37	89/90	-37
Waterbird assemblage	–	91/92	16/17	37	-13	-25	89/90	-31

Source: Woodward *et al.* (2019)

WeBS has recorded that over the last three decades, many species have increased in numbers, however, declines are beginning to be detected in some species including offshore seaducks, divers and coastal birds, with counts continuing to indicate declines in eider, long-tailed duck and velvet scoter (Holt *et al*. 2015). The reasons for these declines is not discussed in the WeBS report, but suggestions are given, including changes in winter distribution and migration patterns, thought to be caused by climate change (e.g. turnstone, purple sandpiper) (Frost *et al.* 2021), and shifts in the sex balance of the population, to a male dominated population (eider) (Holt *et al*. 2015); an increased mortality of breeding female eiders in the western Gulf of Finland, mainly

[18] https://www.bto.org/our-science/projects/wetland-bird-survey/publications/webs-alerts

due to predation by white-tailed sea-eagle and American mink has been suggested as a contributory factor in this shift in the sex ratio in eiders (Lehikoinen *et al.* 2022).

In 2020, the Natural Resources Wales (NRW) published the Second State of Natural Resources Report (SoNaRR2020), which included a chapter on the Welsh marine environment, as part of their assessment of the achievement of sustainable management of natural resources series (NRW[19]). This included looking at past trends and future prospects of seabirds in Wales, with the indicative assessment showing a mixed picture; auks, gannet Manx shearwater and terns showing population increases over the period 2000-2019, however, gulls, cormorant, shag and black guillemot declining, with future prospects unclear. The past trends for wintering waders was assessed as mixed, whilst that for wintering wildfowl was assessed as improving. The future prospect for wintering wader and wildfowl was also assessed to be mixed, with populations expected to vary due to climate change. This is already evident through shifts in wintering populations, first to the east of the UK, then to continental Europe as winter temperatures have increased, making previously inhospitable areas close to their breeding grounds more accessible with the change in temperatures. There has also been evidence of little and cattle egret moving into the UK, both for wintering and breeding.

NRW have also compiled two reports (Marine and Coastal High Priority Evidence Needs [20]and Marine and Coastal Collaborative Research Ideas) as par of their Marine and Coastal Evidence Programme. The first of these has identified productivity and survival of seabirds at colonies as a data gap with high priority, data to be gathered through a combination of ringing and resighting studies and camera traps, some of which is already underway. The second report looking at collaborative research identified three key areas: identifying and understanding seabird diet (focus species include shags, cormorants and puffins); tracking of seabirds to identify and understand areas of use throughout the Welsh sea areas (focus species being diving birds such as auks, cormorants and shags) and research into understanding how to increase resilience in seabird populations by restoring Welsh Islands for seabird colonisation. The latter of these involves looking at different management techniques on different islands, particularly with regards to management after predator eradication programmes have been carried out; after predator eradication, populations of ground or burrow nesting birds may not increase, due to lack of management, e.g. grazing.

A new 5 year programme on Rathlin Island, which includes two predator (ferret and rat) eradication programmes, is also including follow up studies looking at not only the response of seabirds to the removal of predators, with the hope that ground and burrow nesting bird populations will improve and birds which previously bred on the island (storm petrels and Manx shearwater) will return, but also other bird species and mammals that inhabit the island.

A1a.5.50 Environmental issues

In general, seabird population dynamics differ from those of most landbirds: annual adult survival rates are high and generally exhibit a relatively low variability among years; productivity is comparatively low due to small clutch sizes; juvenile survival is lower than adult survival and tends to be more variable between years and maturity is delayed, with some birds waiting several years before recruitment into the breeding population (e.g. *ca*. 2-3 years for

[19] See https://cdn.cyfoethnaturiol.cymru/media/693277/sonarr2020-ecosystem-marine.pdf for further details, with other ecosystem reports found here: https://naturalresources.wales/evidence-and-data/research-and-reports/state-of-natural-resources-report-sonarr-for-wales-2020/sonarr2020-our-assessment/ecosystems/?lang=en

[20] https://naturalresources.wales/evidence-and-data/research-and-reports/marine-biodiversity-collaborative-research-priorities/?lang=en

great cormorants, 3 years for terns, 4-5 years for gulls, northern gannets and 9 years for northern fulmar). The rate of recruitment in seabirds is low due to factors such as low productivity, immature survival and delayed age of first breeding, therefore the rate at which seabird populations can increase is relatively slow compared to most landbirds (Mitchell *et al*. 2004).

Variability in demographic patterns occurs across taxonomic groups of seabirds. Cormorants, terns and gulls have relatively low survival and high recruitment rates while the converse is the case in families such as petrels, auks, gannets and great skuas. Seabird species with high survival rates/low recruitment are sensitive to changes in adult mortality, while those with low survival rates/high recruitment will be sensitive to parameters that determine recruitment rates (the rate at which immature birds join the breeding population for the first time).

Seabirds and waterbird populations can also decline due to external factors including food and habitat availability, predation, disease, exploitation and pollution – with many of these factors interlinked.

In their assessment on the threats facing the World's seabirds, Dias *et al.* (2019) concluded that the top three threats, in terms of number of species affected, and average impact, were invasive alien species, incidental bycatch in fisheries and climate change or severe weather.

Invasive alien species

Typically, in the UK, the alien species impacting seabirds are rats (brown and black), American mink, and also feral cats, these establishing on islands and predating ground nesting birds and their chicks. There have been a number of projects on islands around the UK, e.g. Shiant Isles (e.g. RSPB-EU LIFE Shiant project[21]), Isles of Scilly, Lundy etc. where rat eradication programmes have been carried out and others where for example American mink have been removed, e.g. Outer Hebrides (Hebridean Mink Project[22]). Whilst success of these may not fully be seen for several years (seabirds being long lived and take several years to reach maturity) early signs have been positive, with for example, Manx shearwater and puffin numbers increasing on Lundy, storm petrels being recorded on the Shiants for the first time (2017 – RSPB website) and Manx shearwater and puffin successfully breeding on the Scilly Isles. In 2018, and through a partnership between the RSPB, National Trust, and National Trust for Scotland, and the nature agencies for Scotland (NatureScot), England (Natural England), Wales (Natural Resources Wales) and Northern Ireland (Department for Agriculture, Environment and Rural Affairs), the Biosecurity for Life project[23] was set up. Focusing on 42 specially protected islands designated for breeding seabirds, this aims to raise awareness of invasive predators and provide advice to prevent their accidental introduction to islands.

Incidental by-catch

The second of these threats to seabird populations is incidental bycatch, within this context, being the accidental capture/entanglement of seabirds in fishing gear (during normal fishing practices), leading to the death of the bird. Whilst almost all types of fishing gear used in areas

[21] https://ww2.rspb.org.uk/our-work/conservation/shiantisles/work/index.aspx
[22] https://www.nature.scot/professional-advice/land-and-sea-management/managing-wildlife/hebridean-mink-project
[23] https://biosecurityforlife.org.uk/

where seabirds feed could potentially catch birds (Tasker *et al.* 2000) and all diving bird species are potentially affected by bycatch (e.g. Žydelis *et al*. 2009), the two gear types in the UK that pose a particular risk to seabirds are longlines (which can ensnare birds as they attempt to take bait from the hooks) and gillnets (which can trap diving species as they forage) (DEFRA 2020c). Longline fishing occurs along the shelf edge off Norway, Scotland and Ireland, as well as round the Faeroes.

In 2018, JNCC were asked to develop a UK marine bird bycatch Plan of Action (PoA) and as part of the development of this, work to provide an initial assessment of the likely scale of seabird bycatch mortality by UK vessels in UK and adjacent waters was commissioned. Northridge *et al*. (2020), provides the first preliminary assessment of this from bycatch rates sampled by the UK Bycatch Monitoring Programme (UKBMP). The analysis does not include non-UK vessels fishing in the same area. Potential sampling biases is acknowledged in Northridge *et al*. (2020) who state that mortality estimates should be viewed as one component of total mortality from the area and the gear types under consideration and that specific fisheries operating at a small spatial scale may not have been sampled. In their analysis, Northridge *et al*. (2020) included data from three gear types, static gear (or gillnets), midwater (or pelagic) trawl fisheries and longline, these being the main gear types the BMP focus on. Figure were found to be very imprecise and, for northern fulmar, numbers were thought to lie between 2,200 and 9,100 birds per annum for longline fishery, 1,800-3,300 common guillemot per annum, mainly from static net fisheries, cormorant (predominately inshore static – 200-550) and northern gannets(static and longline – 10-700) each numbering in the hundreds with other species in the analysis (great black-backed gull, great northern diver, herring gull, kittiwake, razorbill and shag) caught in the dozens per year (Northridge *et al*. 2020). The study also showed there is a higher diversity of species bycaught in static nets (eight), and a lower diversity of species caught in pelagic trawls (four) and longlines (three).

Mitigation for seabird bycatch already exists, particularly for longline, including heavier weighting on longlines, night setting, bird scare lines and discard management (Crawford R, from DEFRA 2020). Work continues looking at bycatch through an ICES working group (e.g. ICES 2020), and also work undertaken to try and assess impacts of fisheries on birds, and population responses to bycatch (e.g. Miles *et al*. 2020, Anderson *et al.* 2018, Genovart *et al*. 2017).

Climate change and adverse weather

Climate effect can impact bird through two main processes: indirect impacts via change in food supply, i.e. from change in sea temperatures, and direct impacts, of mortality due to severe weather events (Duant *et al.* 2017, Mitchell *et al*. 2020, Burton *et al*. 2020). Impacts of climate change can be seen through changes in biological event timings (e.g. breeding/migration), distribution and population changes, with northward and eastward shifts in distribution already evident and also increases in abundance of the UK's non-breeding waterbirds (Burton *et al*. 2020, Pearce-Higgins *et al*. 2021).

Rising sea temperatures and sea levels, as a result of climate change, can lead to a change in species composition and abundance at lower trophic levels (e.g. Luczak *et al*. 2012 Frederiksen *et al*. 2013), which then affects the prey distribution for seabirds, resulting in a reduction in food availability, or loss of habitat e.g. for those shoreline nesting species. Adult seabird survival rates tend to be less sensitive to reduction in food availability, however seabird breeding success can be significantly affected by a relatively small reduction in food availability, i.e. when food availability is low, seabirds will fail to breed or young will starve.

As reproduction is costly in terms of energy expenditure, seabirds will not exert high breeding effort in years of poor food supply, thereby improving their chances of surviving to breed in subsequent years. Reduction in adult survival will occur in years of exceptionally poor food availability when there is insufficient food available for self-maintenance. The relationship between breeding success and annual survival and rising sea-surface temperatures (SST) is apparent in several seabird species, including northern fulmar, Atlantic puffin, Artic tern, common guillemot and European shag (Burthe *et al*. 2014, Cook *et al*. 2014, Reed *et al*. 2015), with black-legged kittiwake the most-studied species in this context (Mitchell *et al*. 2020), with many studies focusing on the North Sea environment. However, other studies did not find a significant relationship between SST and kittiwake breeding success (e.g. Eekes-Medrano *et al*. 2017, as cited in Mitchell *et al*. 2020).

The effects of prey abundance on seabird reproduction success and adult survival will vary depending on the seabird species. Species with large foraging ranges, and low foraging costs, including being able to exploit a range of prey species at a range of depths, will be somewhat buffered against a reduction in food abundance – as these species can switch prey. Effects will be greater on those species that are for example restricted to feeding close to colonies, or unable to dive and have instead to rely on prey at or close to the sea surface, e.g. black-legged kittiwake. This species is restricted to prey at or near the sea surface and is vulnerable to food shortages. A simplistic view; unable to provide for chicks results in lower productivity, leading to fewer chicks being recruited to the breeding population, resulting in a decline in abundance at breeding colonies. A reduction in their main prey species, the sandeel, has been a well documented factor in the long-term decline in black-legged kittiwake numbers; this predominately from the UK east coast and North Sea, with fewer studies done on the west coast/Northern Ireland and Irish Sea.

Prey availability has also been cited as a potential cause of declining numbers of black guillemot at Northern Ireland sites (BTO 2015). At these sites, the black guillemot feeds almost exclusively on butterfish and the distribution and abundance of this prey will likely influence the population and distribution of the birds.

Those species with shorter foraging distances will be affected by food distribution, as seabirds need to nest on suitable habitat that is within foraging range of sufficient prey. If prey distribution changes, for example moving out with current foraging ranges, alternative nesting sites may not be found.

Intra and inter-specific competition will also affect food availability; thereby playing an important role in density dependant regulation of seabird population size. This can occur during winter when there is a widespread depletion of food resources, or during summer, when there could be a local depletion within the foraging range of a colony.

Morality can be caused by severe weather events. Adverse weather, such as an increased frequency of extreme storms, also attributed to climate change, have, in recent years, caused wrecks of seabirds, such as Atlantic puffin, common guillemot, razorbill and European shag; resulting in either the washing ashore of dead birds, or the arrival at colonies of severely emaciated and near starving birds. Other effects seen have been delayed breeding, and reduced productivity, with fewer chicks fledged. As these and other bird species caught up in wrecks may not breed until their fifth year, the impact these have at a species population level may take several years to be fully determined.

Started in 2018, (completion March 2022), the Marine Protected Areas Management and Monitoring (MarPAMM) project, is a cross border project to develop tools for monitoring and managing a number of protected coastal marine environments in Ireland, Northern Ireland and

Western Scotland, including the Argyll and Outer Hebrides regions and North Coast Ireland-North Channel Region. As part of the MarPAMM project, work is undertaken, including using a new modelling approach to estimate how vulnerable breeding seabird species in the INTERREG VA region[24] (an area covering western Scotland and Northern Ireland) are to future climate change (i.e. out to 2050), with the information presented in a series of reports (Johnston *et al*. 2021, Davies *et al*. 2021, Cleasby *et al*. 2021, Pearce-Higgins *et al*. 2021), along with factsheets produced for 19 species of breeding seabird including northern fulmar, lesser black-backed gull, Arctic skua and black-legged kittiwake.

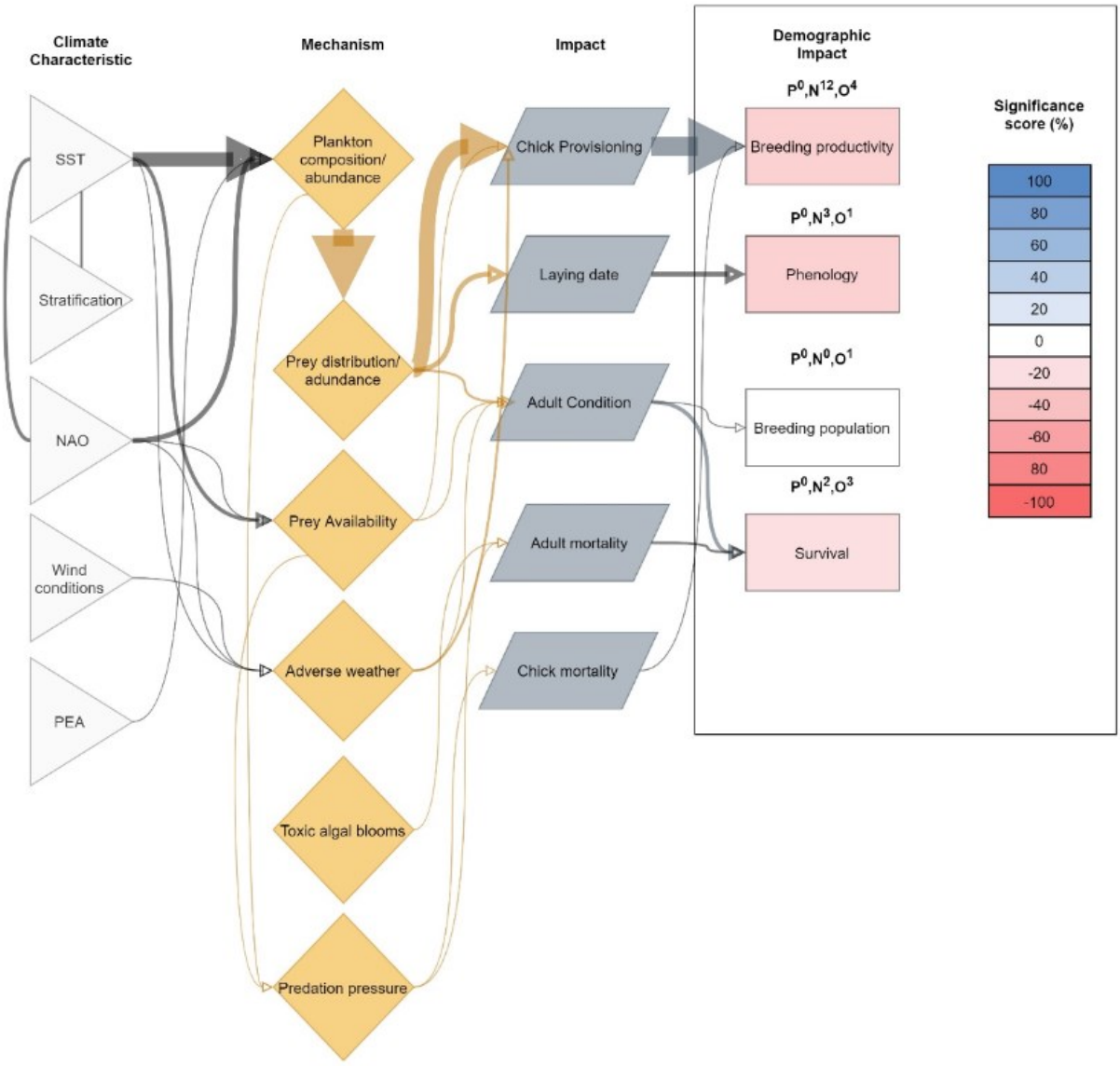
Johnston *et al*. (2021) undertook a review of studies looking at climate change and birds and synthesised these into a single account for each of the 19 seabird species, or taxonomically similar group of species, with each account detailing ecological and demographic impacts of climate change, and the underlying mechanisms. Impacts were characterised by the climate drivers identified (e.g. sea surface temperature, stratification) and the demographic parameters affected (breeding productivity, breeding population size, survival and phenology). Flow charts were used to visualise mechanisms linking climatic variables to demographic impacts (see Figure A1a.5.39 for black-legged kittiwake).

Although the review sought to focus on the INTERREG VA region, the authors acknowledged that many of the studies reviewed were from the UK east coast focusing on some key colonies of breeding seabirds and the adjacent North Sea, where the oceanographic and physical features differs significantly from that of the west coast and Irish Sea; therefore, generalising to the INTERREG VA area mechanisms identified/evident from other colonies/regions, should be done with caution (Johnston *et al*. 2021). Notwithstanding this limitation, the review identified substantial evidence for climate change impacts on seabird population, the strongest support for which were for long-term, indirect bottom-up mechanisms, through changes in prey populations (i.e. caused by temperature mediated changes). There was also evidence, to a lesser extent, of short-term direct mechanisms such as extreme weather events, often resulting in catastrophic demographic consequences (e.g. wrecks of birds); the severity and frequency of these predicted to increase, which may lead to them having a greater impact (i.e. long term change) in population abundance, or breeding distribution.

Foraging range was also found to be an important determinant of species/species group response (Johnston *et al*. 2021). Broad scale climate factors, such as the North Atlantic Oscillation (NAO) had the greatest influence on long range species (e.g. northern fulmar) demography, this in contrast to species with a more restricted range, where local conditions (e.g. sea surface temperature) had a more determinant influence on demography. Differences were also evident on species with different foraging strategies. The demography of surface feeders, such as black-legged kittiwake, were generally linked to variation in prey abundance (i.e. from temperature mediated changes on prey populations) whereas, for diving species such as common guillemot, demography was more commonly affected by adverse weather on foraging ability and prey availability/accessibility (Johnston *et al*. 2021).

[24] An overview of the INTERREG VA programme can be found here: https://www.seupb.eu/iva-overview

Figure A1a.5.39: Black-legged kittiwake related mechanism flow chart



Notes: Lines sized by number of respective studies. NAO = North Atlantic Oscillation; SST = sea surface temperature; PEA = potential energy anomaly; P = number of studies where a significant positive effect was found; N = number of studies where a significant negative effect was found; O = number of studies where non-significant effects were found. Demographic impacts coloured according to the "significance score" indicating the cumulative direction of effect as evidenced through the available studies (negative values per each negative effect (-20 to -100), positive values for a positive effect (20 to 100), 0 values for a non-significant effect). Significance scored calculated through the equation: significance score = P-N/(P+N+O). Source: Johnston *et al.* (2021)

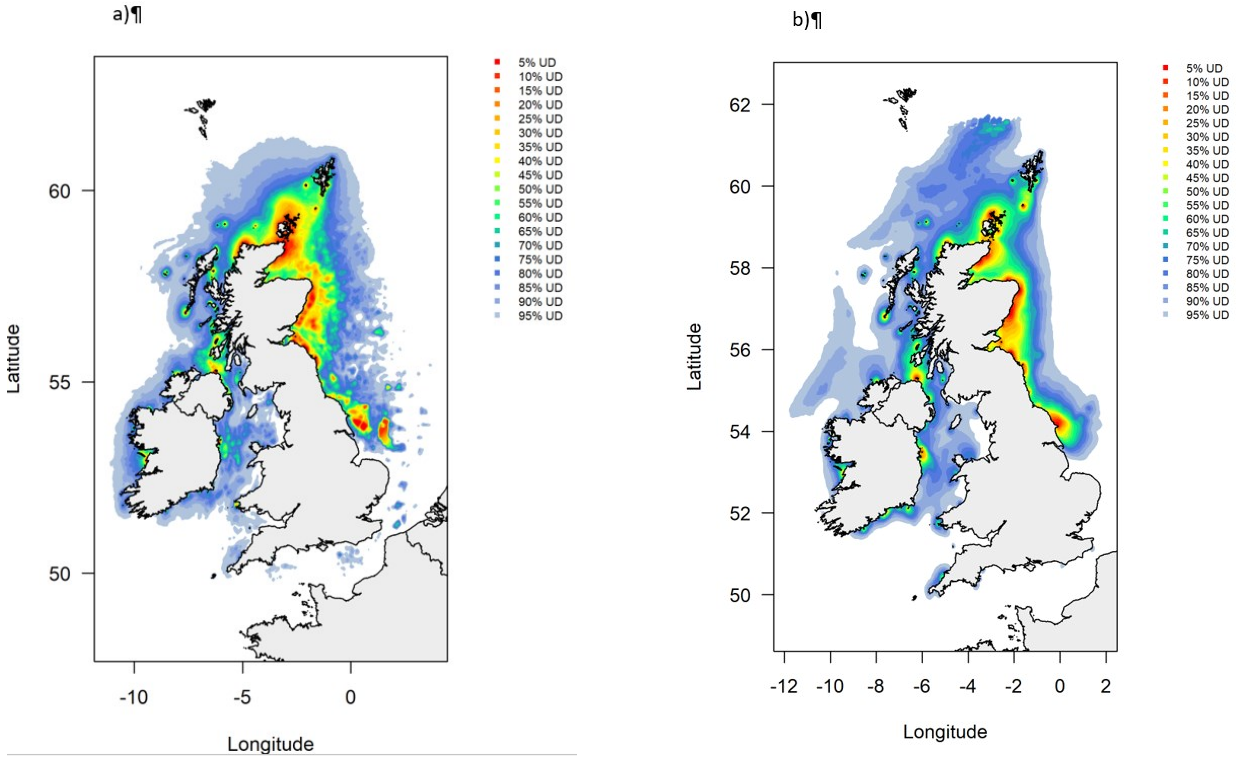
Several studies have made future projections of seabird population size, distribution, or productivity (e.g. Huntley *et al.* 2008; Johnston *et al*. 2013, Russell *et al*. 2015) and assessed the vulnerability of seabird species (e.g. Pearce-Higgins *et al*. 2017; Wheatly *et al*. 2017), to climate change.

Using terrestrial climate (e.g. air temperature, precipitation) and oceanographic variables (sea surface temperatures, potential energy anomaly (PEA, the energy required to fully mix a column of water (i.e. related to index of stratification) and bathymetry, which might influence seabird abundance through productivity and mortality, future (in 2050) climate change projections of the abundance of 19 species of seabird were investigated by Davies *et al.* (2021). Fourteen of the nineteen species were predicted to decline in abundance in the INTERREG VA area, with Artic skua and storm petrel projected to decline to extinction or

virtually to extinction respectively; it was acknowledge that there were several caveats (i.e. abundance data from the most recent seabird census (Seabirds Count) were not available, and limitations to the projections (i.e. some species had too few data to fit the models successfully), including the projections for these two species, which were based on poor and very poor model fits respectively. It was also identified that there was high uncertainty in the predictions, potentially indicating that variation in seabird abundance is not explained by climate alone (Davies *et al*. 2021).

Taking the predicted changes in abundance as estimated by Davies *et al*. (2021) and the species distribution for seven species of seabird, as modelled by Wakefield *et al* 2017 (black-legged kittiwake, common guillemot, razorbill and European shag) and Wilson *et al* 2014 (Arctic tern, common tern and Sandwich tern), Cleasby *et al*. (2021) attempted to estimate the changes in at sea distribution in the MarPAMM area, under changing climatic conditions by conditioning on projected values of relevant oceanographic variables (e.g. SST, PEA, thermal front gradient density) that were included in the original models and for which climate projections were available[25]. Updated at sea distribution maps under future climate change predictions were then compared to maps under current/historic conditions to determine the nature an extent of shift – see Figure A1a.5.40 for black-legged kittiwake for comparison between Wakefield et al (2017) and distribution under future climate change (Cleasby *et al*. 2021).

Figure A1a.5.40: Predicted black-legged kittiwake distribution for breeding birds throughout the UK and Ireland



Notes: Maps show Utilisation Distribution (UD) contours in 5% bands from 5% to 95% for current (Wakefield *et al.* 2017) (a) and projected (b) climate conditions. Source: Cleasby *et al.* (2021)

[25] For full details of methodology, see Cleasby *et al* 2021: https://www.mpa-management.eu/wp-content/uploads/2021/10/Predicting-seabird-distributions-in-response-to-climate-change-using-habitat-modelling.pdf

At a UK scale, (see Cleasby *et al.* 2021 for details in the MArPAMM area and also suggested explanation regards to differences in 50% and 95% UD seen between species), declines in razorbill, guillemot and black-legged kittiwake abundance were predicted. Razorbill distribution were most evident in the southern part of the species range, covering a smaller area of English and Welsh waters. Guillemot density also declined across most of their range with increases concentrated in Northern Scotland. Increases in black-legged kittiwake density at coastal areas, in the vicinity of breeding colonies, were evident on the east coast of the UK, and along a stretch of eastern coast of Ireland, centred around Dublin Bay (Cleasby *et al*. 2021).

In contrast, the abundance of European shag was predicted to increase under the climate projections and, whilst more difficult to visualise due to their more restricted foraging range, distribution of European shag did appear to increase closer to breeding colonies, as expected. However, there was also a decline in the size of 50% and 95% UDs, which was less expected, given the predicted population abundance increase – it was suggested that distribution may be strongly influenced by values for the potential energy anomaly (PEA[26]) (Cleasby *et al*. 2021).

The results also indicated a contraction in the range (95% UD) of Arctic terns, largely in the southern part of their range, at colonies located around the Welsh and Irish coasts, whilst no such range contraction was predicted at colonies from the Northern Isles or the Outer Hebrides. Increases tended to occur in more northern and eastern areas of the UK for common terns, suggesting a northward shift, and corresponding decline along the southern and south eastern coasts of England, whilst Sandwich tern distribution shifted northwards, alongside a general decline in abundance (Cleasby *et al*. 2021).

This has potential implications for conservation and management. If northward shifts in distribution represent a general latitudinal shift as a result of climate change, then northern colonies will become increasingly more important for breeding seabird populations, with a corresponding decline in importance of southern colonies.

Collision risk and displacement

There are potential effects/concerns, synonymous with wind farm developments, in relation to birds, these include displacement, leading to effective habitat loss, associated with exclusion from ecologically important (e.g. feeding, breeding) areas, barrier effects and disturbance of regular movements (e.g. foraging, migration), potentially increasing flight energy demands and collision risk.

Assessments are undertaken at the project level and a robust information base is essential to inform collision and displacement assessments and several other elements of information, in addition to distribution, are required. Understanding the spatial and temporal distribution of birds is particularly important for understanding connectivity with and apportioning impacts to, relevant Special Protection Areas (SPAs).

Tagging studies carried out on species such as lesser black-backed gull, northern gannet, great skua, and tern species, from various important seabird colonies around the UK, and continuations of pre-existing studies, aim to identify, amongst other things, the sea area usage

[26] PEA provides a measure of the amount of energy per unit volume, required to make the density of stratified water column vertically homogenous (fully mixed) i.e. the amount of energy required to fully mix the water column. For a fully mixed water column, PEA is zero, while it becomes increasingly positive as stratification increases.

of these species, flight heights and migration routes to see connectivity with areas of existing or proposed renewable development and to inform collision risk modelling.

Work has and continues to be undertaken to produce distribution maps for seabird species, particularly those considered most sensitive or vulnerable to impacts (e.g. see Figures A1a.5.41a, b and c below from Waggit *et al*. 2020), with distribution maps aiding in the assessment of potential impact. This builds on extensive survey and data collection that has been conducted over many years, including to identify important UK offshore areas used by seabirds (e.g. see Kober *et al*. 2010, 2012). See also Wilson *et al*. (2014), which used spatial distribution models (SDM) looking specifically at tern species from breeding colony SPAs throughout the UK, to identify marine "hotpots" for this group.

Figure A1a.5.41 a: Spatial variation in predicted densities (animals per km^2) of black-legged kittiwake

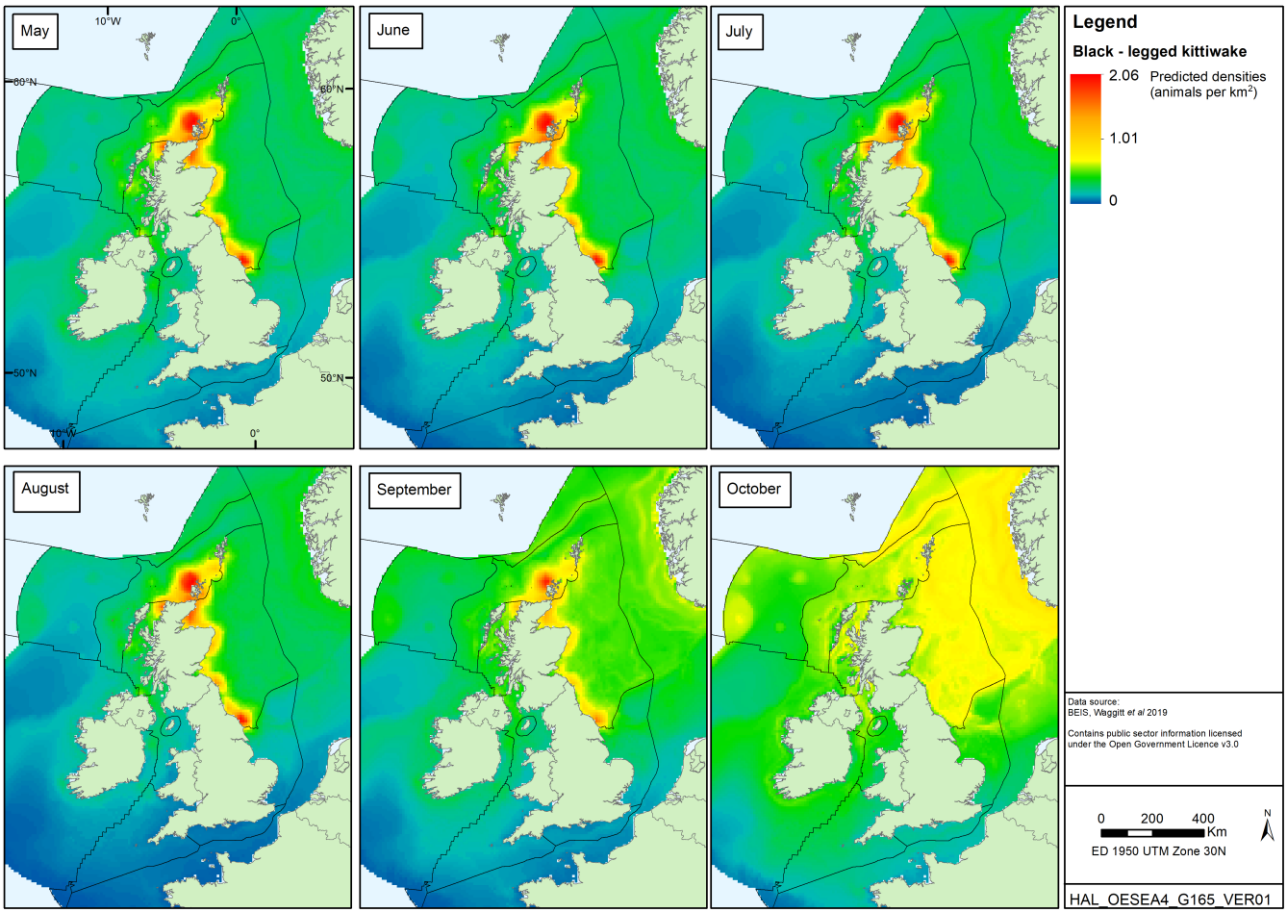


Figure A1a.5.41 b: Spatial variation in predicted densities (animals per km^2) of northern gannet

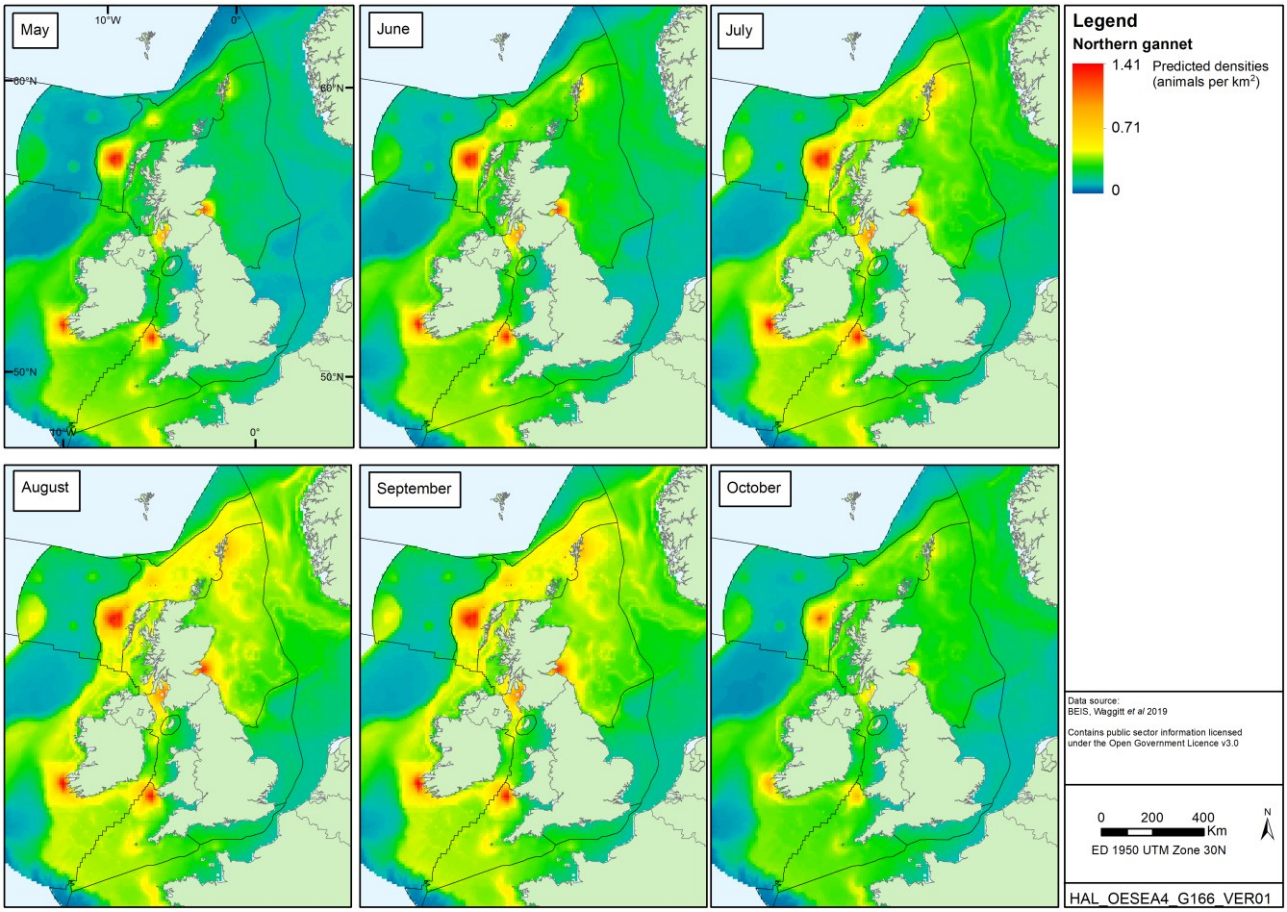
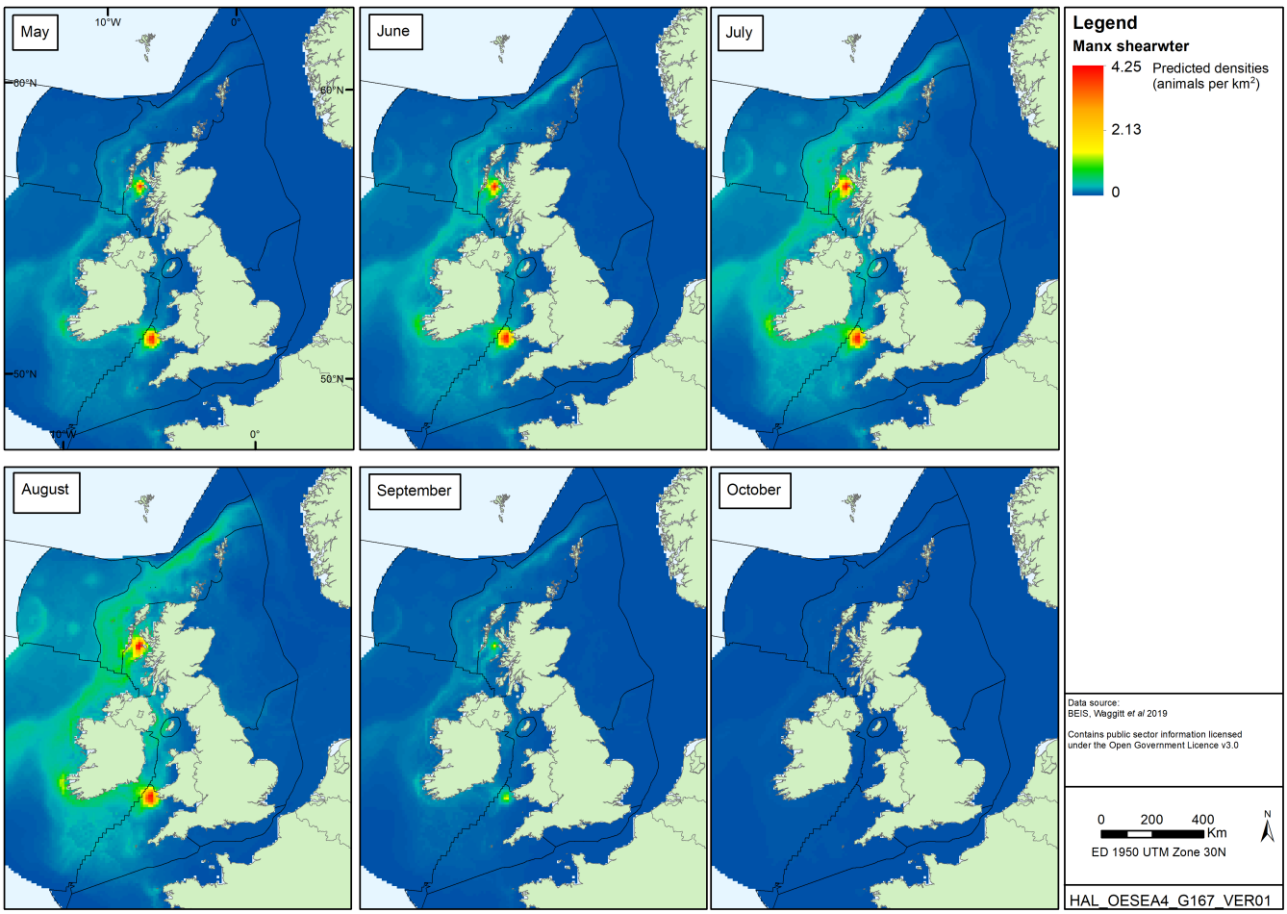
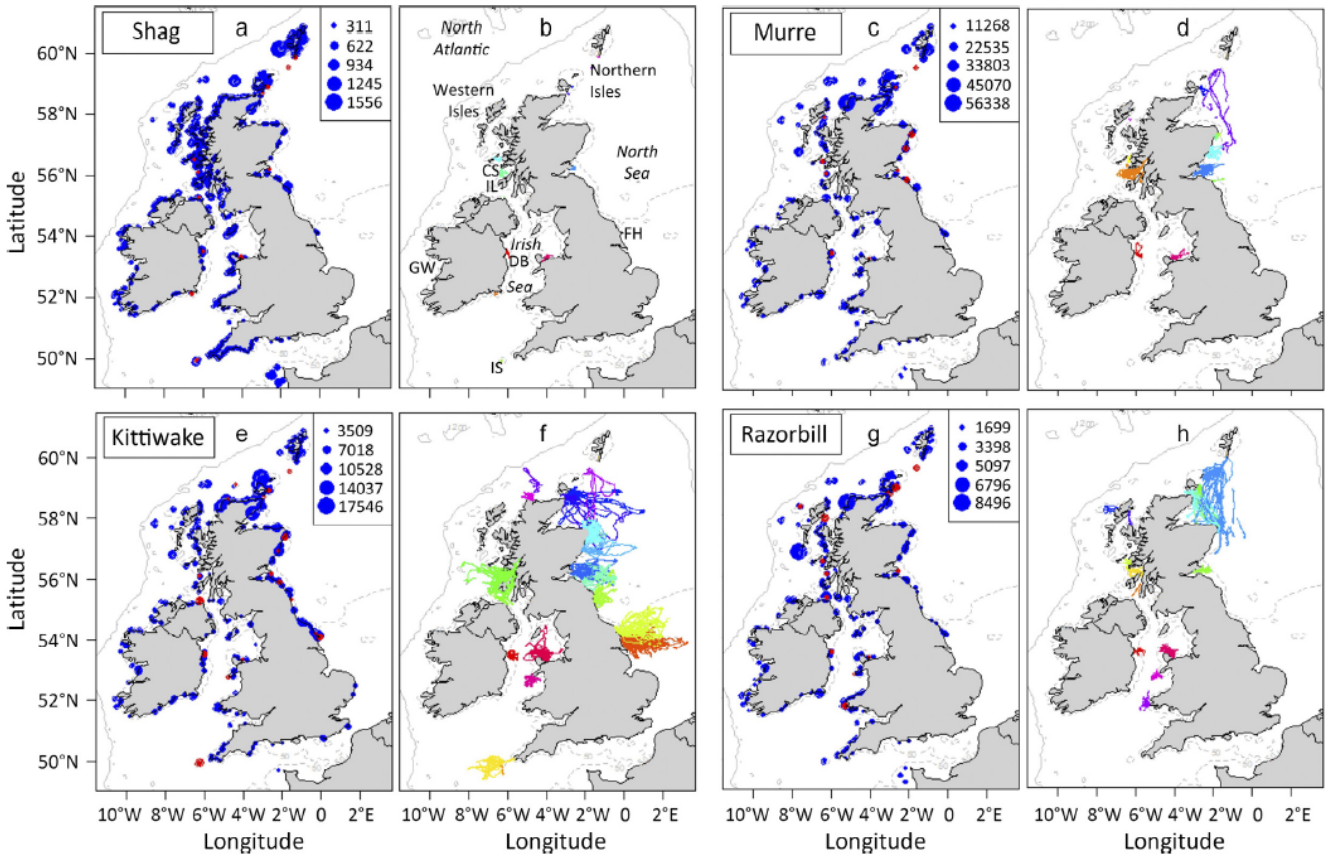


Figure A1a.5.41 c: Spatial variation in predicted densities (animals per km^2) of Manx shearwater



Wakefield *et al*. (2017), used telemetry data from 4 species of seabird (black-legged kittiwake, common guillemot (called common murres in the study), razorbills and European shag), from multiple breeding colonies (designated as SPAs) to model space use as functions of environmental covariates, intra-specific competition and accessibility, in order to establish the extent, and intensity of marine area usage (Figure A1a.5.42). Birds were tracked during the breeding season (approaching the end of the incubation period, or raising small chicks), between 2010 and 2014.

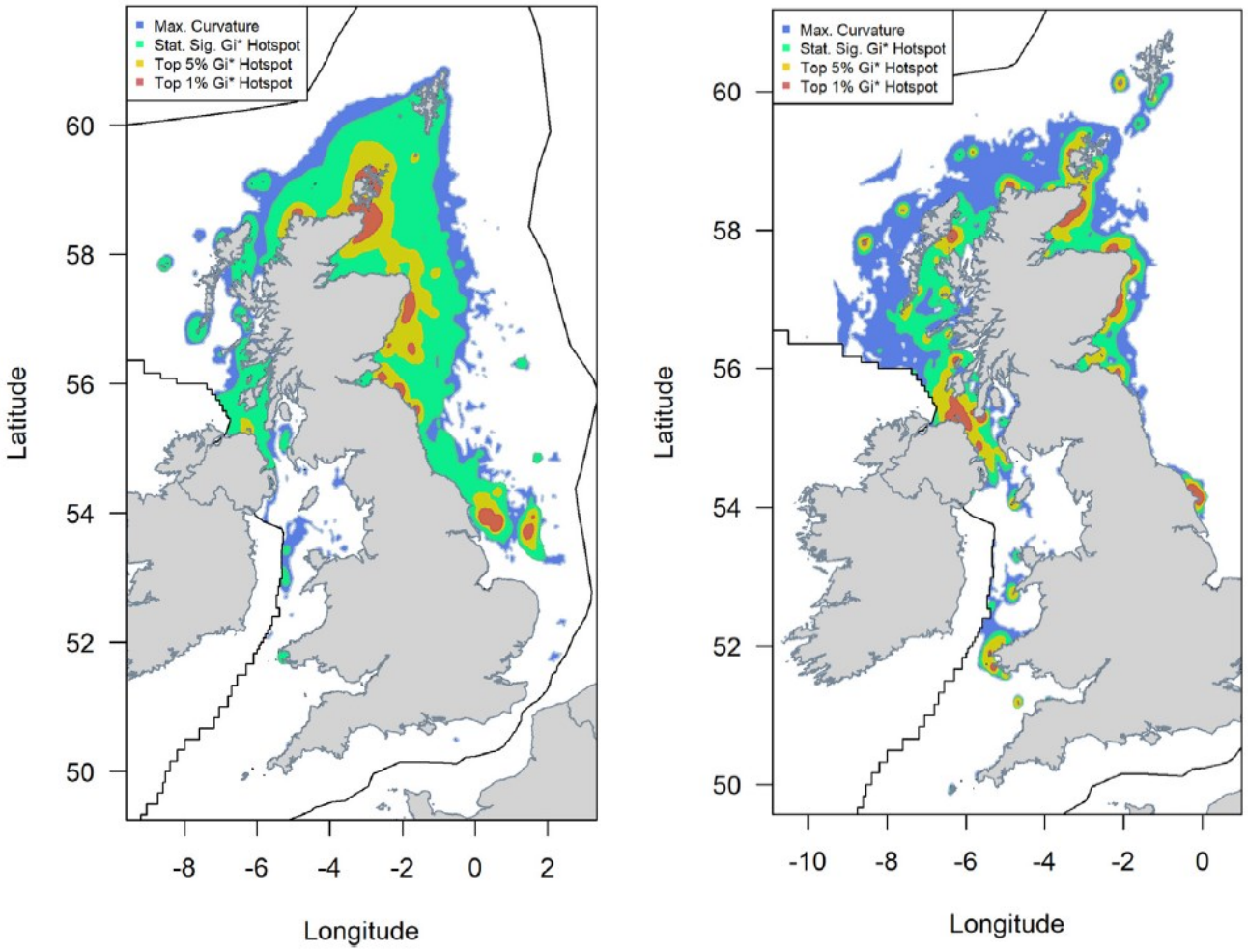
Figure A1a.5.42: Breeding distribution and individual movement data for four bird species



Notes: Breeding distribution and individual movement data used to estimate the distribution at sea of seabirds foraging from UK colonies. Source: Wakefield *et al.* (2017)

Building on the SDM data from Wakefield *et al.* (2017), Cleasby *et al*. (2020) used Maximum Curvature and Getis-Ord hotspot mapping techniques, to delineate important high density sites for each of the four seabird species (see Figure A1a.5.43 for black-legged kittiwake (left) and razorbill (right).

Figure A1a.5.43: Hotpots identified at the UK-scale for black-legged kittiwake (left) and razorbill (right)



Notes: Hotspots identified using Getis-Ord hotspot analysis with a neighbourhood size of d=10km (kittiwake) and 7km (razorbill) based on FPT analysis or Maximum Curvature. Getis-Ord hotspots defined in all cells with the top 1% of calculated Gi* scores; all cells within the top 5% of Gi* score; all cells in Gi* scored were deemed statistically significant at the $\alpha < 0.01$ level. Source: Cleasby *et al.* (2020)

The potential displacement/disturbance and barrier effects of offshore wind farms and associated shipping traffic (i.e. during construction and maintenance during the operational life of the development) have been extensively recognised, with definitions of these shown in Table A1a.5.32.

Table A1a.5.32: Definitions of disturbance, displacement and barrier effects

Disturbance	Displacement	Barrier
When a bird's normal pattern of activity is interrupted by an anthropogenic activity. Birds may choose to sources of disturbance (e.g. by swimming or flying away during the disturbance event to continue their activity elsewhere) and may not return until some time later – the duration of return time coupled with frequency of disturbance event, may combine to result in longer term and potentially	In relation to offshore wind farm development, following Furness *et al.* (2013) displacement definition (see below). Displacement, as an effect, may occur both in the area of the disturbance or development and to some distance beyond it. The degree of displacement, both in terms of length of time and proportion of the original source population affected, may vary seasonally and between species.	A barrier is a physical factor that limits the migration, or free movement of individuals or populations, thus requiring them to divert from their intended path in order to reach their original destination. Barrier effects are more likely to result in individual/population level impacts, if they occur during the breeding season (and at colonies close to an OWF).

Disturbance	Displacement	Barrier
continual reductions of numbers in an area of impact (displacement) which may be partial or total.	Birds that would have previously passed through the footprint of the disturbance area to a more distant feeding, resting or nesting area, but now choose either to stop short or detour around the location are said to be affected by barrier impacts.	

Source: NE-JNCC (2017) definitions

Collision, displacement and barrier impacts and evidence of these is fully described in Section 5.6 of the Environmental Report.

Hydrocarbon spills

The vulnerability of seabird species to surface pollution at sea varies throughout the year and is dependent on a number of factors: the amount of time spent on the water; total biogeographical population; reliance on the marine environment and the potential rate of population recovery. Mechanisms of impact on seabirds include oiling of plumage and loss of insulating properties, and ingestion of oil during preening causing liver and kidney damage (Furness & Monaghan 1987). Indirect effects associated with bioaccumulation of contaminants from prey, and reduced prey availability, are also possible, whilst metabolic, endocrine and cardiotoxic effects from inhalation/consumption may also be emerging (King *et al.* 2021).

Studies looking at the impact of the Deepwater Horizon spill on birds, looked at the impact of oiling on wings and tail feathers on birds and what impact this had on flight behaviour, from the perspective that hindered flight could reduce escape performance leaving the bird more vulnerable to predation (Maggini *et al.* 2017a). It was found that feather damage through oiling could affect flight performance by decreasing lift and thrust, increasing drag, imbalance and cause difficulties to take off. Whilst a complimentary study also looked at the potential effects of oil on feathers could have on the energy cost of flight and migration ability of birds (Maggini *et al*. 2017b). This found that the energy cost of transport was 0.26±0.04 kJ km^{-1} in controls, and increased by 22% when the trailing edges of the wing and tail were oiled (<20% of body surface; considered light oiling). Additional crude oil on breast and back feathers (~30% total surface; moderate oiling) increased the cost of transport by 45% above controls. Trace-oiled birds which had access to clean water for bathing, were found to return to a flight performance comparable to that of control birds after a two week recovery period. The authors suggested that this additional energy cost could have implications for birds undertaking migration, particularly if birds did not have access to clean water (Maggini *et al*. 2017b).

Regulatory requirements (e.g. requirement to have oil pollution emergency plans) and control measures are in place with the risk of spill assessed at a project specific level. Part of this requirement is for suitable resources to be in place, before activities are undertaken offshore, to ensure for an effective response in the event of a spill occurring. Given the controls in place, the risk from future oil and gas licensing is considered low.

Other Issues

Offshore areas not only support seabirds during winter, with some species, e.g. northern gannet, herring gull, black-legged kittiwake and great black-backed gull distributed throughout these areas at this time, but as the UK lies on a main migratory flyway, a significant number of birds migrate through the region at least twice a year. Birds, sometimes in great numbers, can be attracted to offshore infrastructure light sources, with attraction increased in adverse weather, e.g. low visibility, fog, drizzle). This can potentially result in mortality, through for e.g. collision, or exhaustion (birds can circle installation, depleting important fat reserves). While there is insufficient quantitative data available to determine if this has a significant effect at a species population level, there is evidence this has an impact on a large number of birds (e.g. OSPAR 2007, 2015, Ronconi *et al.* 2015, NatureScot 2020, Rebe *et al*. 2019).

In recognition of the potential impact of offshore infrastructure lights on birds, OSPAR published voluntary guidelines to reduce this impact in the OSPAR maritime area[27]. Following the precautionary principle, in the absence of definitive quantitative data, Best Available Techniques (BAT) should be used, including assessing all lighting on installations, identifying if all are essential for safety or not, whether there is potential for reducing external emissions and minimising the number and intensity of lights to avoid or minimise impacts of lighting on birds crossing or using the Greater North Sea region.

Historically, declines in breeding waterbirds, in particular waders, have resulted from land management changes, such as drainage, grassland management and the conversion of coastal and floodplain grazing regimes. Where populations persist in small fragmented pockets of high quality habitat, nests and young are vulnerable to predation. Wintering waterbirds are affected by factors including conditions of breeding grounds, persecution in these areas, quality and quantity of wintering coastal and wetland habitat and changes in migratory patterns (Defra 2015).

Conservation framework

Six of Britain and Ireland's 25 species of breeding seabird are on the UK Birds of Conservation Concern Red list, with a further 18 Amber listed; 3 and 19 respectively are on the equivalent Birds of Conservation Concern Ireland.

Of the 11 species added to the Red list for the first time in 2021, with an association to the marine environment, purple sandpiper has been added due to worsening declines in the breeding population, Bewick's swan, goldeneye, smew and dunlin have been added due to worsening declines in non-breeding wintering populations, and one, Leach's storm petrel, because it is assessed (according to IUCN criteria) as globally vulnerable and the severe declines since 2000 of the population on St. Kilda, which holds more than 90% of the UK's population (BTO website).

The Habitats Regulations, and Offshore Habitats Regulations[28], provide for the classification of sites for the protection of rare and vulnerable birds and for regularly occurring migratory

[27] In 1994, the OSPAR Commission subdivided the maritime area into five regions: Region I (Arctic waters); Region II (Greater North Sea); Region III (The Celtic Sea), region IV (Bay of Biscay and Iberian Coast) and Region V (Wider Atlantic).

[28] These Regulations, which transpose the requirements of Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ("the Habitats Directive") and Council Directive 2009/147/EC on the

species within the UK and internationally (Special Protection Areas ("SPAs")) and form part of the UK's national site network.

In 2003, the UK signed the Convention on Biological Diversity and the OSPAR Convention, international agreements to establish an ecologically coherent network of well-managed Marine Protected Areas (MPAs). The Marine and Coastal Access Act 2009, Marine (Scotland) Act 2010 and Marine Act (Northern Ireland) 2013 contain provisions for Marine Protected Areas in inshore and offshore waters within England, Wales, Scotland and Northern Ireland. These sites are known as Marine Conservation Zones (MCZs) in England, Wales and Northern Ireland and Marine Protected Areas (NCMPAs) in Scotland. There are several NCMPAs and MCZ designated for birds, including black guillemot.

Work continues in managing existing sites and identifying new potential sites important for bird species, including marine areas.

conservation of wild birds ("the Birds Directive"), aim to ensure the long-term conservation of certain species and habitats by protecting them from possible adverse effects of plans and projects. Note that the European Union (Withdrawal) Act 2018 confirms that the body of EU law transposed into UK legislation at the time that the UK exits the EU has been retained, such that it will continue to have effect in domestic law after the end of the Implementation Period as defined in the European Union (Withdrawal) Act 2018.

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