Offshore seabirds in the SEA 7 area

Northern Fulmar, at sea
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Report to the DTI

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CORK ♦ ECOLOGY

Claire Pollock & Colin Barton

Long Strand, Castlefreke, Clonakilty, Co. Cork

Telephone 00 353 23 40665 or 00 353 87 2323 623

Website: www.corkecology.net E-mail: info@corkecology.net

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Non-technical Summary

Introduction

- Seabird distribution in offshore waters of the SEA 7 area was reviewed primarily using the European Seabirds at Sea (ESAS) database.

Objectives

The aims of this study were:

- To provide an overview of individual species offshore distribution in SEA 7
- To identify, where possible, offshore areas in SEA 7 that are important for seabirds
- To assess offshore seabird vulnerability to surface pollution in SEA 7
- To provide a brief outline on the potential for offshore SPAs in the offshore waters of SEA 7
- To highlight major gaps in understanding and survey coverage in the offshore waters of SEA 7

Methodology

- Ship-based and aerial survey data for the SEA 7 area collected between 1979 and 2005 were provided by ESAS.
- Offshore waters were defined as greater than 200 m in depth and the offshore distribution of seventeen species of seabirds were reviewed.

Species accounts

- Northern Fulmar, Northern Gannet and Black-legged Kittiwake were the most abundant species recorded on ESAS surveys in offshore waters of the SEA 7 area.
- The SEA 7 area was also important for European Storm-petrel and Leach's Storm-petrel.

Important offshore areas in SEA 7

- Generally seabird densities were low in offshore waters. Important areas were along the shelf break, Rockall Trough and Rockall Bank.
- Species diversity of seabirds was low in offshore waters compared to inshore waters, although more species were recorded during the summer months.

Vulnerability to surface pollution

- Seabird vulnerability to surface pollution in offshore waters of SEA 7 was generally low, although moderate at times along the shelf break.
- The waters around the offshore seabird colonies of St Kilda, Flannan Isles, North Rona and Sula Sgeir were highly vulnerable during the breeding season.
- St Kilda represents the largest concentration of breeding seabirds in the UK and has many conservation designations including SPA status.

Potential for offshore SPA

- Currently there are no SPAs in offshore waters apart from offshore seabird colonies and up to 2 km of water around them. JNCC are to commence work addressing offshore SPAs for feeding and other aggregations of seabirds soon.
- Combining all ESAS data for all months showed that the shelf edge and the Rockall Bank were the areas where highest seabird densities were likely to be encountered in SEA 7. These areas could be a start point for the offshore SPA work.

Survey coverage

- Greatest survey coverage in offshore waters of SEA 7 was achieved during the summer months, with many gaps in winter.
- Overall, coverage in SEA 7 was the lowest of all SEA areas, with only a quarter of the recommended area surveyed.

Conclusions

- Overall, there are large gaps in coverage in the offshore waters of SEA 7, particularly during the winter months. However, seabird density and species diversity is generally low beyond the shelf edge.
- Although the inshore and shelf waters of SEA 7 are of more importance for seabirds and are most vulnerable to surface pollution, seabird surveys in the offshore waters of SEA 7 should be continued to improve existing data and to determine long term trends and short term fluctuations in the offshore distribution of seabirds.

Recommendations

Based on this review, it is recommended that:

- Further studies should be conducted to identify important areas for seabirds in offshore waters in SEA 7, including feeding areas for European Storm-petrel and Leach's Storm-petrel.
- Offshore survey coverage in SEA 7 should be increased throughout the year.

Table of Contents

1. Introduction

At the request of the UK Department of Trade and Industry (DTI), an assessment of seabird data in the offshore SEA 7 area was conducted by Cork Ecology as part of the Strategic Environmental Assessment (SEA) process in the U.K.

SEA is a process of appraisal through which environmental protection and sustainable development may be considered at local and national level and is now a legal requirement of the SEA directive (2001/42/EC) (DTI 2004). In 1999 the DTI began a sequence of sectoral SEAs considering the implications of further licensing of the UK continental shelf (UKCS) for oil and gas exploration and production. The SEAs were in line with the UK's "Greening Government" initiative, including implementing the SEA directive. A map showing the eight SEA areas around the UK is shown in Figure 1.1.

This review attempts to provide a current picture of the numbers and distribution of offshore seabird species in the SEA 7 area primarily using the European Seabirds at Sea (ESAS) database. This follows a previous review which focused on inshore seabirds (Barton & Pollock 2005, Barton & Pollock 2006). Scientific names of all species mentioned in the text are shown in Appendix A.

1.1 Objectives

Using the ESAS database as a basis, the aims of the study were:

1) To provide an overview of individual offshore species distribution, abundance, seasonal and longer term temporal variation.

2) To identify, where possible, offshore areas that are important for activities such as feeding, moulting and overwintering, in relation to associated features such as hydrographic fronts or upwellings.

3) To assess offshore seabird vulnerability to surface pollution.

4) To provide a brief outline on the potential for offshore SPAs in the offshore waters of SEA 7.

5) To highlight major gaps in understanding and survey coverage in the offshore waters of SEA 7.

1.2 Study area

The SEA 7 area includes the west coast of Scotland, the Western Isles and the north coast of Northern Ireland. The SEA 7 study area is shown in Figure 1.2. In this study, the area of interest is the deep waters over the continental slope (greater than 200 m) and beyond west to 25°W.

Figure 1.1 SEA Areas in UKCS waters

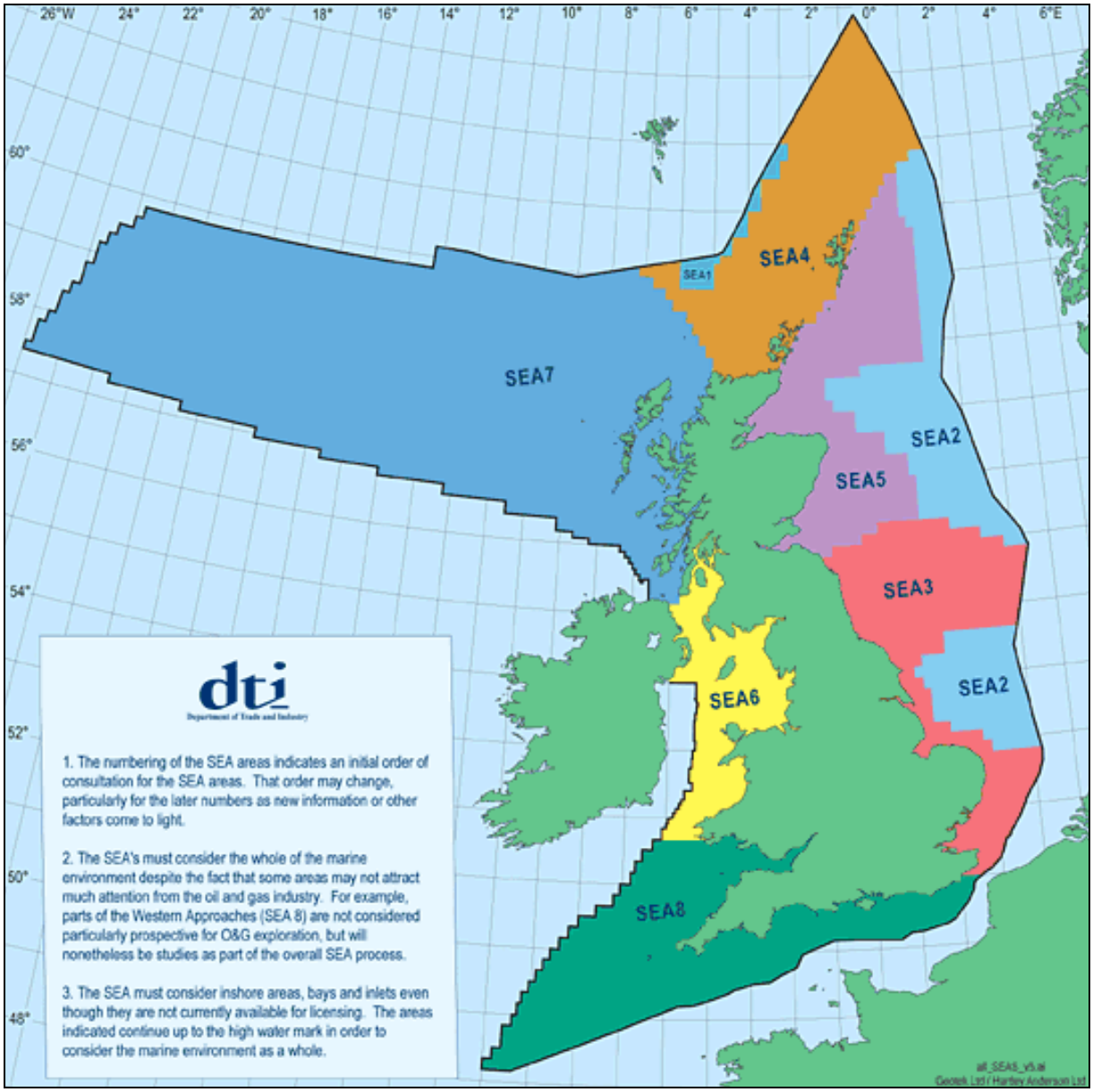
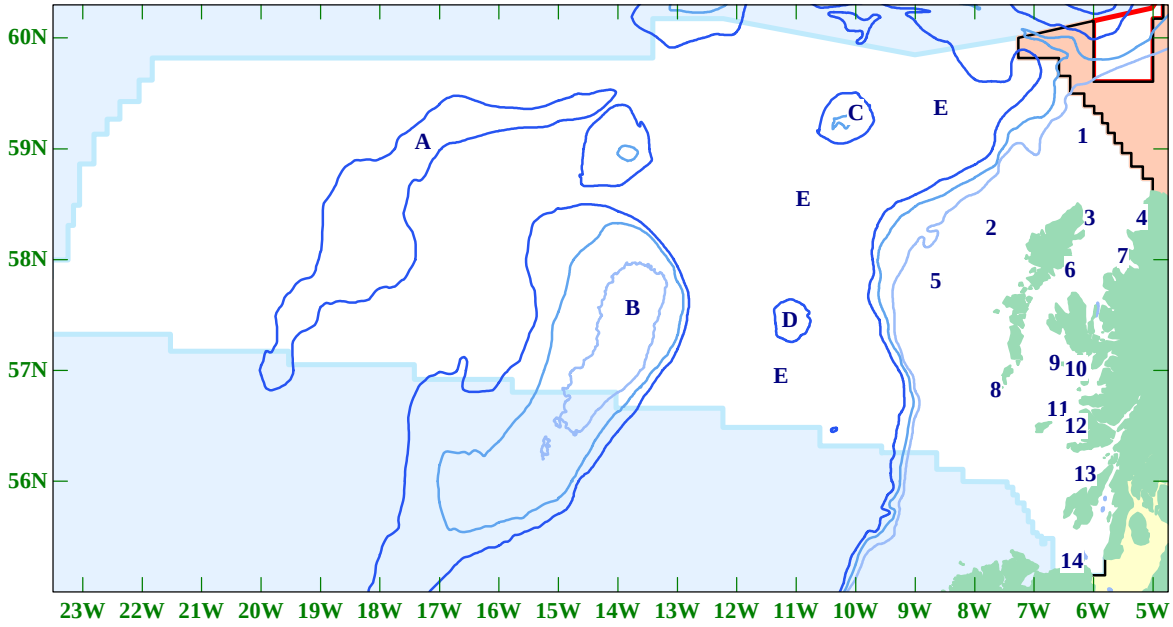


Figure 1.2 Major oceanographic features, bathymetry and seabird colonies in SEA 7 area



Key

Oceanographic features

A	Hatton Bank
B	Rockall Bank
C	Rosemary Bank
D	Anton Dohrn Seamount
E	Rockall Trough

Bathymetry

200 m	
500 m	
1,000 m	

Major seabird colonies

1	North Rona & Sula Sgeir
2	Flannan Isles
3	Cellar Head, Lewis
4	Handa
5	St Kilda
6	Shiant Islands
7	Priest Island
8	Berneray & Mingulay
9	Canna
10	Rum
11	Coll
12	Treshnish Isles
13	Colonsay
14	Rathlin Island

1.3 Offshore species

This review focuses on 17 seabird species regularly found in the offshore waters of SEA 7 (Table 1.1). Some species such as Northern Fulmar are resident throughout the year, while others are seasonal visitors to the area, for example Manx Shearwater occurs in the area between March and October. In addition, species such as Long-tailed Skua migrate SEA 7 in spring and autumn.

Twenty seven species of seabird totalling over one million pairs of birds breed within the SEA 7 area (JNCC, Seabird 2000 data). Of these 27 species, 22 species breed within the SEA 7 area in nationally important numbers (i.e. more than 1 % of the British breeding population). Breeding numbers in a British and biogeographic context for the 17 offshore species considered in this review are shown in Table 1.1. See Barton & Pollock (2005 & 2006) for information on inshore seabird species.

An indication of the at-sea distribution in SEA 7 and the other SEA areas of the 17 offshore seabird species considered in this review is also shown in Table 1.1.

Table 1.1 Overview of importance of SEA 7 area for species considered in this review

Species	Numbers breeding in SEA 7 as % of British population[1]	Numbers breeding in SEA 7 as % of biogeographic population[1]	Important SEA areas based on ESAS data[2]
Northern Fulmar	28.7	3.5 – 5.3	1, 4, 5, 7
Great Shearwater	-	-	7
Manx Shearwater	40.3 – 45.5	30.8 – 37.2	6, 7, 8
Sooty Shearwater	-	-	4, 7
European Storm-petrel	33.9 – 53.9	1.7 – 3.8	7, 8
Leach's Storm-petrel	99.9	1.0	7
Northern Gannet	27.5	18.4	5, 7, 8
Pomarine Skua	-	-	3, 5, 7
Arctic Skua	10.4	0.6 – 1.5	5
Long-tailed Skua	-	-	5, 7
Great Skua	5.7	3.5	4, 5, 7, 8
Lesser Black-backed Gull	2.7	1.7	6, 7, 8
Great Black-backed Gull	25.6	4.0 – 4.5	3, 5, 6, 7, 8
Black-legged Kittiwake	11.2	1.4 – 1.7	3, 4, 5, 6, 7, 8
Arctic Tern	12.1	0.4 – 1.3	5, 6, 7
Little Auk	-	-	3, 5
Atlantic Puffin	41.3	3.6 – 4.4	3, 5, 7

1 JNCC, Seabird 2000 database 2 Based on Stone *et al* 1995 and Mackay & Giménez 2004

Numbers of Manx Shearwater are internationally important with up to 37 % of the biogeographic population breeding in the SEA 7 area. Northern Gannet is also important in an international context in the region.

In a national context, Leach's Storm-petrel is the most significant with almost 100 % of the breeding population occurring in the SEA 7 area. However internationally, this is only c. 1 % of the biogeographic population. Atlantic Puffin, Manx Shearwater, European Storm-petrel, Northern Gannet, Northern Fulmar and Great Black-backed Gull are also important species with over 20 % of the British population of each species breeding in the SEA 7 area.

2. Methods

2.1 Data sources

This review attempts to collate existing information, to provide a current picture of the numbers and distribution of offshore seabird species in the SEA 7 area. The ESAS database is the most comprehensive source of data for offshore seabirds in European waters and forms the basis for this review. Data from other sources are incorporated where available.

ESAS surveys

The Seabirds at Sea Team (SAST) of the Joint Nature Conservation Committee (JNCC) has conducted both ship-based and aerial surveys in the waters around Britain since 1979 to study seabird and cetacean distribution and abundance (e.g. Tasker *et al* 1987). Data from these surveys, and from other European countries, have been incorporated into the European Seabirds at Sea (ESAS) database (e.g. Stone *et al* 1995). Ship-based and aerial survey data for the SEA 7 area collected between 1979 and 2005 were provided by ESAS.

Several JNCC reports are relevant to the study area (Tasker *et al* 1990; Webb *et al* 1990; Stone *et al* 1995; Webb *et al* 1995; Pollock *et al* 1997; Pollock *et al* 2000). Mackey & Giménez (2004) reported on seabirds in the SEA 6,7, & 8 areas, concentrating on offshore seabird species, while Mackey *et al* (2004) reported on seabird distribution, density and abundance in Ireland's Atlantic Margin.

Seabird 2000

Seabird 2000 was a seabird census of breeding seabirds in Britain and Ireland conducted between 1998 and 2002 (Mitchell *et al* 2004). Data from major colonies are shown in individual species accounts. Additional data for some species for St Kilda, Flannan Isles, North Rona and Sula Sgeir were provided by the JNCC Seabird 2000 database.

Natura 2000 in UK Offshore Waters

Marine SPAs (mSPAs) are currently being considered for all species included in this review. Three types of mSPA around the UK are being considered. They are extensions to SPA breeding colonies, inshore areas used by birds in the non-breeding season (divers, grebes & seaduck), and marine feeding areas (Johnston *et al* 2002). As yet, no offshore SPAs have been designated.

JNCC have conducted aerial surveys of divers, grebes and seaduck in inshore waters of SEA 7 since 2003 (Dean *et al* 2003, Dean *et al* 2004a, Dean *et al* 2004b, Wilson *et al* 2006) as part of the mSPA process. While the data have not yet been added to the ESAS database, JNCC supplied relevant data for SEA 7 for this review and they have been incorporated into the vulnerability maps (see section 5).

2.2 Data analysis

2.2.1 Study area

Although the main objective of this report was to review offshore seabird distribution, all data for the SEA 7 area, including inshore waters are included on species maps, for completeness. The main focus of the review however, is on waters greater than 200 m in depth.

2.2.2 Offshore species

For the purposes of this review, the term "offshore species" was used to describe species with more than 4 % of the total number of birds recorded on ESAS surveys within SEA 7, west of 9° W (this approximates to the 200 m contour). Seabird data for coastal waters of the SEA 7 area are shown to give context.

Coastal species e.g. Common Guillemot, Razorbill and Herring Gull which sometimes occur offshore were excluded if less than 1 % of their total number were recorded in offshore waters. These species are discussed in the Inshore Review of SEA 6, 7 and 8 (Barton & Pollock 2005, Barton & Pollock 2006). Rare species such as Cory's Shearwater and Sabine's Gull, which occurred less than 10 times or where less than 10 birds were sighted on ESAS surveys, were excluded from this report.

2.2.3 ESAS data

The ESAS database contains data from ship-based and aerial surveys using line transect methodology. Birds are counted ahead of the ship and out to the side usually in a 90º arc with a 300m transect width (see Webb & Durinck 1992 for full details of the method). A snapshot method is used for flying birds, which takes the ship's speed into account and prevents overestimation of seabird densities. Recent inshore aerial surveys conducted by JNCC (Dean *et al* 2003, Dean *et al* 2004a, Dean *et al* 2004b, Wilson *et al* 2006) use distance sampling techniques and the data have not been added to the ESAS database. For the purposes of this review, these data were adapted and converted into ESAS format so that they could be incorporated in the maps. The aerial surveys use a larger transect width up to 1.9 km (see e.g. Dean *et al* 2004a for full details of the method). As the plane is travelling very fast relative to seabirds within the transect area, it is not necessary to apply the snapshot technique for flying birds.

2.2.4 Mapping strategy

Two types of maps (density and abundance) were compiled to depict species abundance and distribution, using the mapping package DMAP for Windows (Morton 2001).

ESAS data are generally examined at the scale of ¼ International Council for the Exploration of the Sea (ICES) rectangles which measure 15' latitude by 30' longitude and cover an area of 800 km^2. The ¼ ICES rectangle was used in this report.

Density Maps (birds / km^2)

This type of map was utilised for the most common species, defined as species with more than 1,000 birds recorded 'in transect'. This is defined as birds on the water within the transect area, and flying birds included in snapshot (see Webb & Durinck 1992 for full details). To account for decreased detection rates of birds on the water at increased distance from the ship, correction factors were applied to compensate for those birds missed. The correction factors in Pollock *et al* (2000) were used, as their study area incorporated SEA 7 waters.

Average densities for each ¼ ICES rectangle were calculated by dividing the total number of birds within a 300 m strip by the total area surveyed (See Webb & Durinck 1992 for further details). Monthly density maps were created, and depending on the distribution patterns, seasonal maps were compiled.

Abundance maps (birds/km travelled)

Abundance maps were used for less abundant species. All data including sightings of birds outside the 300 m band transect were utilised. Species with more than 100 birds but less than 1,000 'in transect' were mapped as abundance. To calculate abundance for each ¼ ICES rectangle, the total number of birds was divided by the distance travelled. Again, monthly and seasonal abundance maps were compiled.

2.2.5 Total Seabird Density

As well as individual species maps, seabird data for all species were combined and density maps were produced to show overall species density in the SEA 7 area. These maps attempt to identify important areas for seabirds.

Correction factors were applied to birds on the water 'in transect' from shipboard surveys and to all birds recorded on aerial surveys, as the speed of the plane effectively makes the counts instantaneous. Correction factors for 200 m and 300 m transects followed Pollock *et al* (2000) or Stone *et al* (1995), if the species was not listed in Pollock *et al* (2000).

Aerial surveys in inshore waters since 2003 focussed on divers, grebes and seaduck. The correction factors used above were inappropriate in this case as transect widths of 881 m and 956 m from the survey track line were used. For most species there were insufficient data to calculate correction factors, and so uncorrected density values were used in the analysis. However for Great Northern Diver, Common Eider and Long-tailed Duck, correction factors were calculated (Table 2.1). Correction factors were based on a mean transect width of 919 m, using the following formula:

$$\frac{nA \times 7.8}{nA + nB + nC + nD} = \text{correction factor}$$

Where nA = total number of birds in Band A (i.e. 118 m)

And nA + nB + nC + nD = the total number of birds in Bands A – D i.e. 919 m

If the detection rate is similar in all bands, the number of birds seen in all distance bands (A-D) out to 919 m should be the equivalent of 7.8 times the number of birds seen in Band A, assuming that all birds in Band A (118 m) are detected.

Table 2.1 Correction factors for aerial survey data

Species	Correction Factor [1]
Great Northern Diver	5.03
Common Eider	4.36
Long-tailed Duck	5.26

1 Based on 919 m outer transect width

2.2.6 Vulnerability Analysis

An analysis of the vulnerability of seabirds to surface pollution in SEA 7 was conducted using density data for all seabird species Following the method of Williams *et al* (1995), the relative vulnerability of each ¼ ICES rectangle to surface pollution was calculated using the formula:

$$\text{Area Vulnerability Score (AVS)} = \sum \text{species } \ln(d+1) \times \text{OVI}$$

where d = density of each species after application of correction factor

OVI = the offshore vulnerability index score for each species

The OVI scores from Webb *et al* (1995) were used, although they were modified if the biogeographic populations had changed following more recent surveys (Snow & Perrins 1998, Mitchell *et al* 2004). Common Tern was the only species which was modified (Appendix B).

Species for which an OVI had not previously been calculated in Webb *et al* (1995) or Williams *et al* (1995) and occurred in numbers of less than 100 in the study area, were excluded from the analysis.

Unidentified species groups were allocated the mean OVI of the constituent species. For example, the OVIs for Common Guillemot and Razorbill are 22 and 24 respectively, therefore unidentified guillemot/razorbill records were allocated an OVI of 23.

As in Webb *et al* (1995), ¼ ICES rectangles with survey effort of less than 2 km^2 per month were excluded from the analysis. Monthly vulnerability maps were compiled as well as seasonal (summer and winter) and all year maps. The value of each ¼ ICES rectangle was placed into four categories of vulnerability (from lowest to highest) by dividing the range of AVS values into four equal sized groups. Seasonal and all year scores were calculated by using the average AVS for each ¼ ICES rectangle for the appropriate months and dividing into quartiles for mapping purposes.

Note in this analysis, unlike Webb *et al* (1995), there was no smoothing of the data. Also as the primary objective was to look at seabird vulnerability in offshore waters, additional information from other sources for important inshore areas was not added to the maps. However for the offshore seabird colonies of St Kilda, Flannan Isles, North Rona and Sula Sgeir the increased vulnerability during the breeding season (May to August) was incorporated into the vulnerability maps.

3. Species Accounts

Seventeen species of seabirds were considered in this review. Raw numbers of offshore seabirds recorded in the SEA 7 area on ESAS surveys are shown in Table 3.1. Northern Fulmar, Northern Gannet and Black-legged Kittiwake were the most abundant species recorded.

Table 3.1 Raw numbers of offshore seabirds in SEA 7 from ESAS database, August 1980 to September 2005

Species	SEA 7
Northern Fulmar	278,296
Northern Gannet	97,503
Black-legged Kittiwake	60,364
Manx Shearwater	39,375
Atlantic Puffin	28,464
Great black-backed Gull	14,181
European Storm-petrel	8,103
Lesser black-backed Gull	7,956
Sooty Shearwater	2,638
Great Skua	1,579
Leach's Storm-petrel	1,504
Arctic Tern	876
Great Shearwater	672
Arctic Skua	467
Little Auk	258
Pomarine Skua	243
Long-tailed Skua	201

The following species accounts give a brief outline of distribution and abundance within the SEA 7 area for the 17 offshore species considered in this report.

3.1 Northern Fulmar

Numbers of Northern Fulmars around the UK have increased considerably since the mid-19th century and the distribution of birds has also expanded accordingly. This population expansion began in Iceland in the mid-18th century, spreading to the Faroe Islands by the mid-19th century, before reaching Shetland and the rest of Britain and Ireland (Pennington *et al* 2004). The species is now one of the commonest species of seabird found around northern Britain.

Overall, the Scottish population was estimated at 485,852 apparently occupied sites by Seabird 2000, which represented a 4 % decline on the previous Seabird Colony Register survey between 1985 and 1988 (Mitchell *et al* 2004). An estimated 28.7 % of the British population breeds within the SEA 7 area, (JNCC, Seabird 2000 database). The major colonies for Northern Fulmar in SEA 7 are shown in Table 3.2.

Table 3.2 Major breeding colonies for Northern Fulmar in SEA 7 area (after Mitchell *et al* 2004)

Site	Apparently Occupied Sites (AOS)
St Kilda	68,448
Mingulay	8,424
Shiant Islands	4,387
Cellar Head, Lewis	3,812
Sula Sgeir	3,916 [1]
North Rona	3,520
Handa	3,550

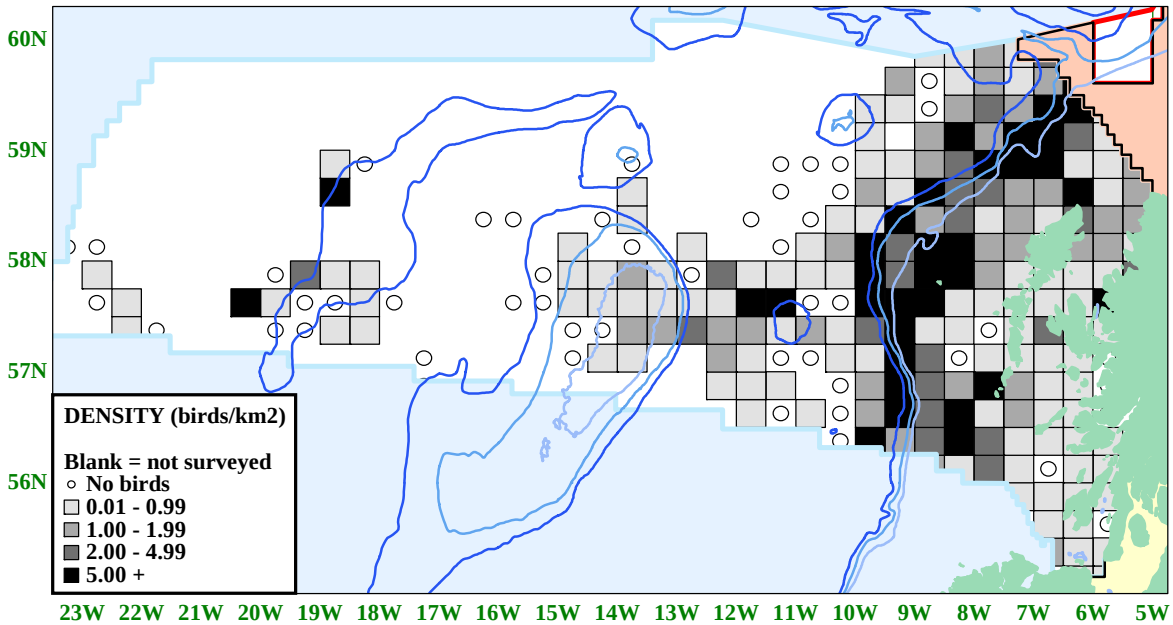
1 Not surveyed during Seabird 2000, count from 1985-88 (Mitchell *et al* 2004)

Distribution within SEA 7

Northern Fulmars were widely distributed throughout the SEA 7 area in all months. Peak densities were recorded in April, with the lowest densities recorded in November. Northern Fulmar accounted for almost 80 % of seabirds in offshore waters in the JNCC Atlantic Frontier project, north and west of Scotland (Pollock *et al* 2000).

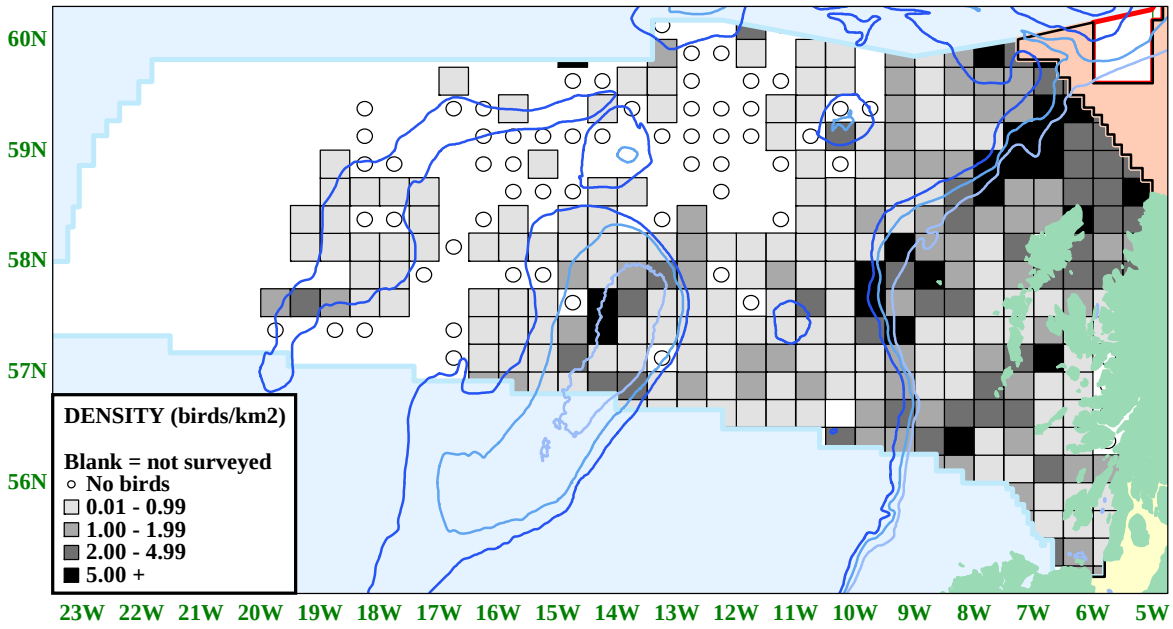
Between January and May Northern Fulmar were widespread at generally low densities in offshore areas, with concentrations along the shelf edge, to the north west of the Anton Dohrn seamount and over the Hatton Bank (Figure 3.1).

Figure 3.1 Fulmar density in SEA 7 area from January to May



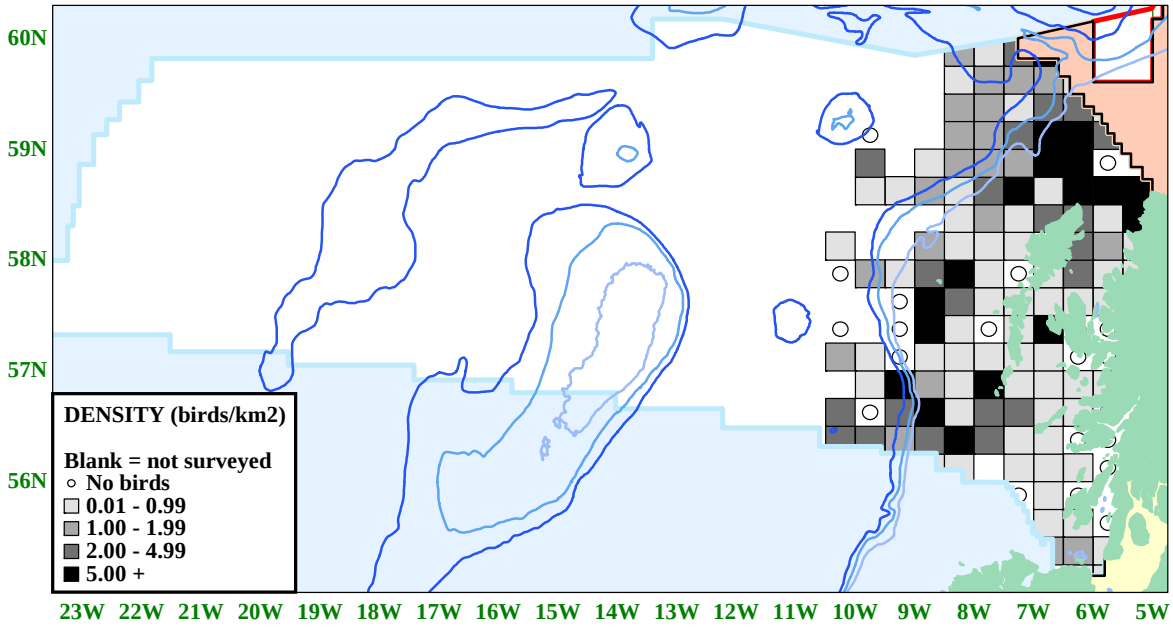
Greatest offshore survey coverage was achieved over the summer months between June and September (Figure 3.2). Northern Fulmars were widespread at low to moderate densities, with occasional high density areas recorded along the shelf break and over the Rockall Bank.

Figure 3.2 Fulmar density in SEA 7 area from June to September



Between October and December, offshore survey coverage was limited and no data were available for offshore areas beyond 10° 30' W in these months (Figure 3.3). Northern Fulmars were widespread throughout the offshore areas surveyed, with highest densities recorded to the north and west of the Western Isles, and over the shelf edge around 57° N.

Figure 3.3 Fulmar density in SEA 7 area from October to December



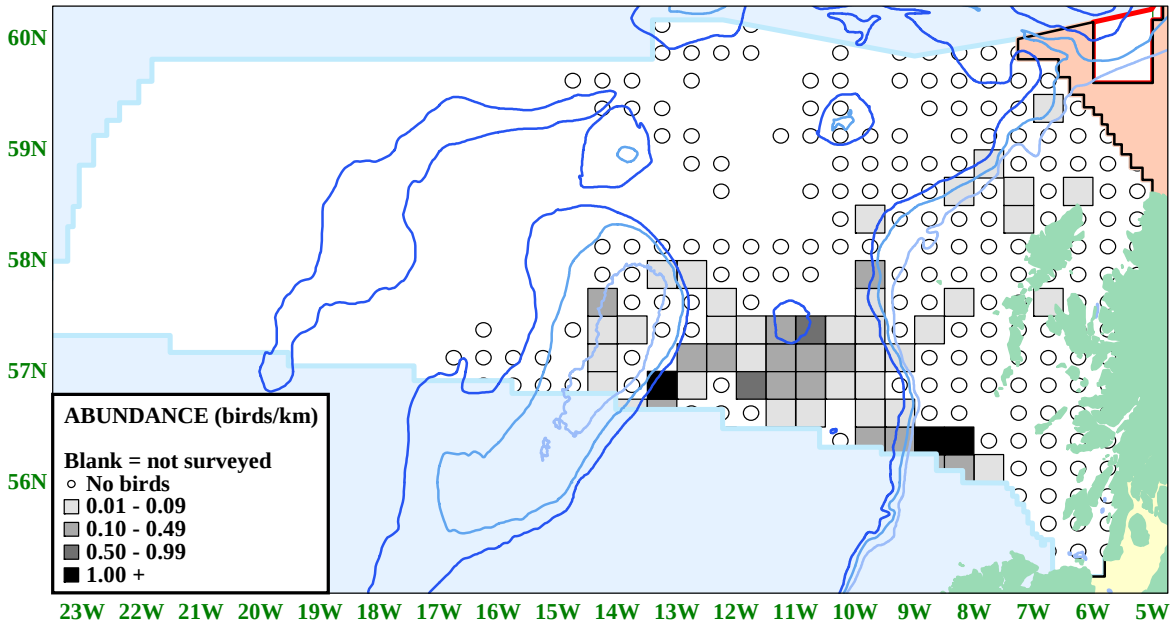
3.2 Great Shearwater

Great Shearwaters breed on islands in the South Atlantic, and occur in highest numbers in waters west of Britain and Ireland during late summer and autumn on migration, with occasional records of birds remaining over the winter months.

Distribution within SEA 7

The majority of Great Shearwaters were recorded between July and October on ESAS surveys, with single birds seen over shelf waters west of Scotland in January and February. Peak numbers were recorded in August and September (Figure 3.4).

Figure 3.4 Great Shearwater abundance in SEA 7 area in August and September



Birds were predominantly concentrated in an area of deep water (> 1,000 m depth) over the Rockall Trough and Bank around 57º N. Highest abundance was over the eastern edge of the Rockall Bank and close to the shelf break, west of Mull.

3.3 Manx Shearwater

Most of the world population of Manx Shearwaters breed around Britain and Ireland, with between 40.3 and 45.5 % of the British population occurring within the SEA 7 (JNCC, Seabird 2000 database). The UK population is thought to be fairly stable, although as Seabird 2000 was the first comprehensive national survey, a direct comparison with previous surveys was not possible (Mitchell *et al* 2004). The majority of Manx Shearwaters that breed in Britain and Ireland winter off the South American coast, and the species is generally absent from UK waters between October and March. The major breeding colonies for Manx Shearwater in SEA 7 are shown in Table 3.3.

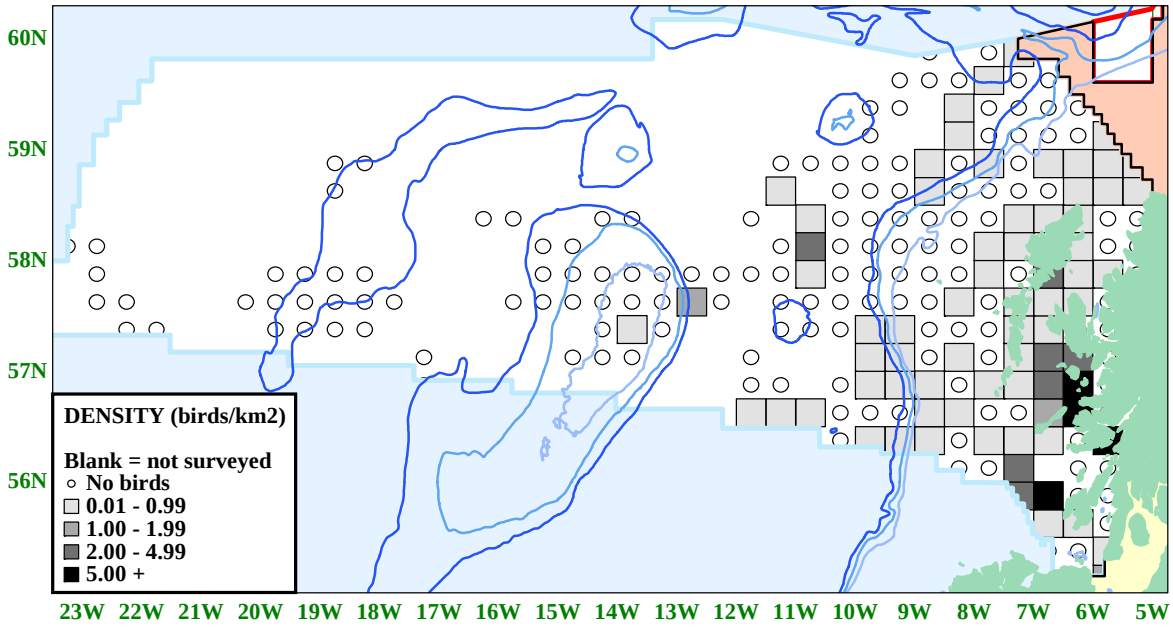
Table 3.3 Major breeding colonies for Manx Shearwater in SEA 7 area (after Mitchell *et al* 2004)

Site	Apparently Occupied Sites (AOS)
Rum	120,000
St Kilda	4,803+
Treshnish Isles	1,283

Distribution within SEA 7

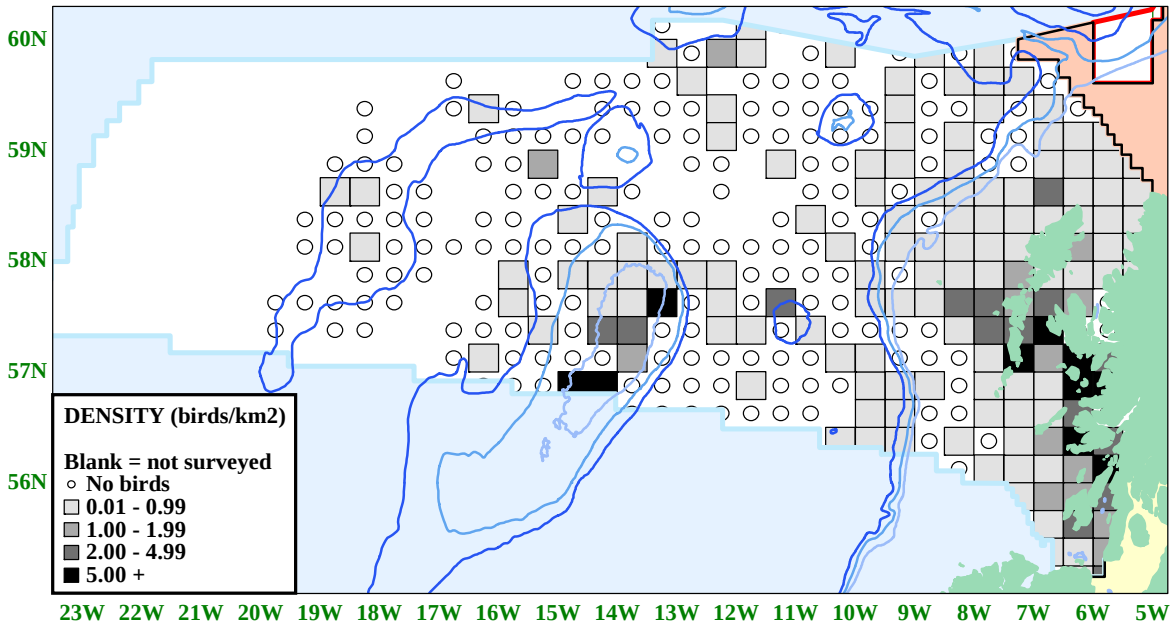
Manx Shearwaters were recorded on ESAS surveys between March and October. Low densities were recorded in March, predominantly in inshore areas but birds were more widespread in April and May (Figure 3.5), following the return of the majority of breeding birds. Highest densities were in inshore areas close to the major breeding colony on Rum. Birds were largely absent from offshore areas, although low densities were recorded along the shelf break and over the Rockall Trough.

Figure 3.5 Manx Shearwater density in SEA 7 area in April and May



In contrast, birds were more widely scattered in low densities offshore between June and September, with occasional high density patches encountered (Figure 3.5). Highest densities offshore were concentrated over the Rockall Bank in August and September.

Figure 3.5 Manx Shearwater density in SEA 7 area from June to September



Birds were encountered over the Hatton Bank during offshore surveys in June. Overall, highest densities were recorded during August, with numbers of birds recorded decreasing rapidly into September. Very low densities were recorded in October, in inshore waters.

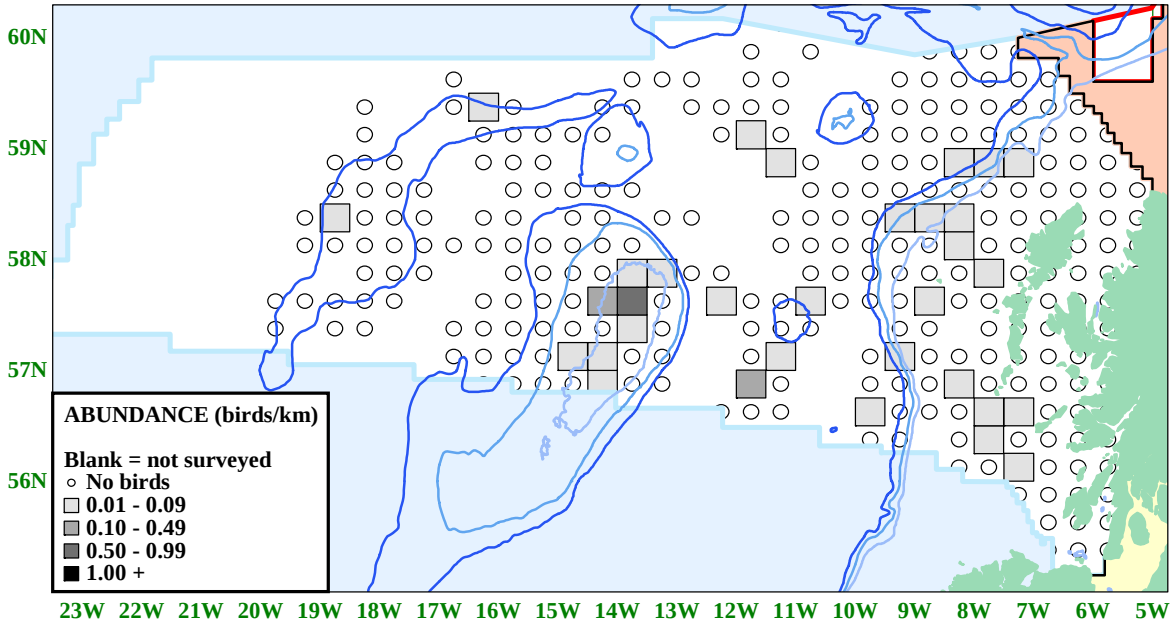
3.4 Sooty Shearwater

Sooty Shearwaters are passage visitors to the North Atlantic during their non-breeding season. The first birds tend to arrive in British waters in July, with most birds leaving again by November.

Distribution within SEA 7

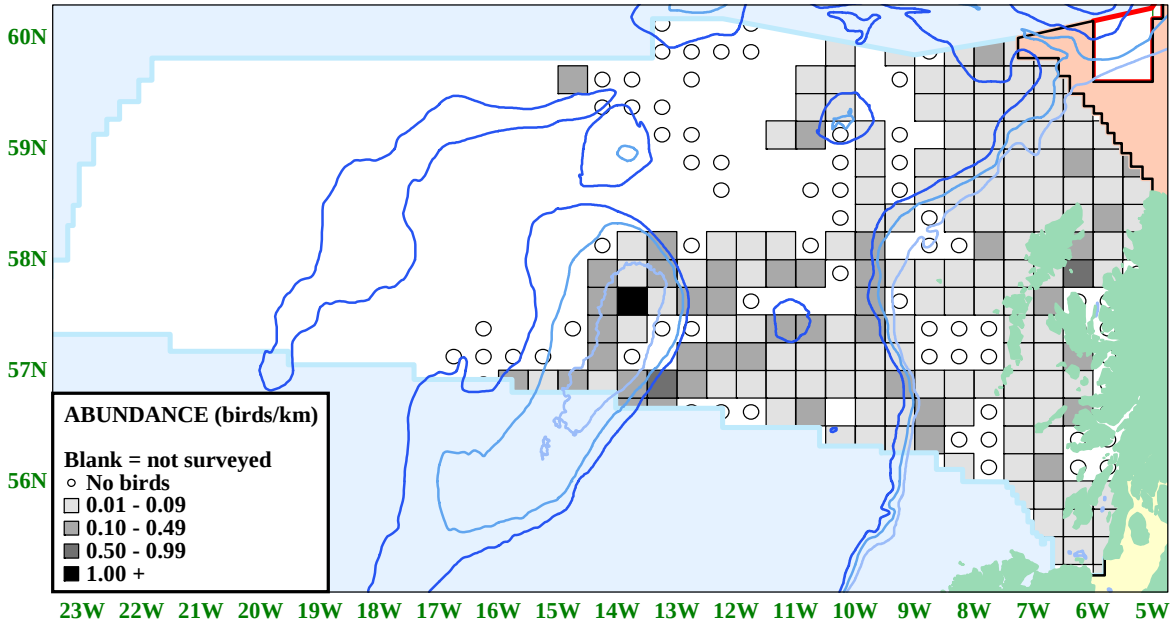
On ESAS surveys, the majority of Sooty Shearwaters were recorded between June and October. Two birds were seen to the west and south-west of St Kilda in March, and a single bird was recorded west of St Kilda in May. Birds were distributed widely in low numbers in June and July over shelf waters to the west and south-west of the Western Isles. Further offshore, birds were concentrated particularly over the Rockall Bank and around the Anton Dohrn Seamount (Figure 3.6).

Figure 3.6 Sooty Shearwater abundance in SEA 7 area in June and July



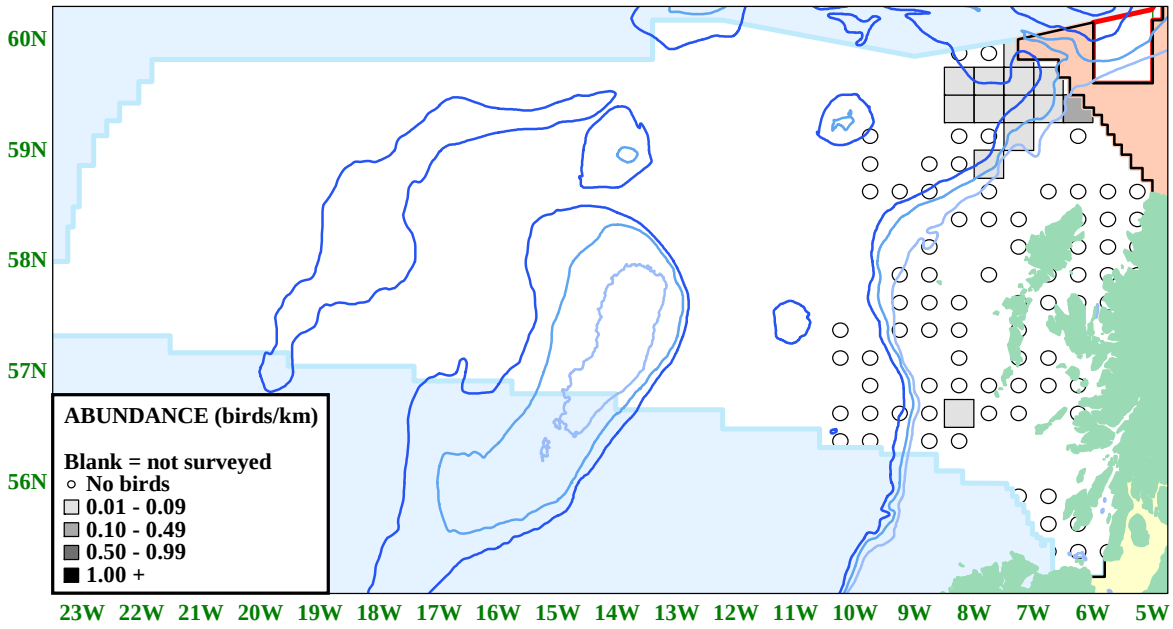
Sooty Shearwaters were more widespread in all areas in low to moderate numbers between August and October (Figure 3.7). Low to moderate numbers were recorded over the shelf edge out to the Rockall Bank, where highest numbers were seen. Few birds were recorded on surveys in the north-west of the SEA 7 area at this time, although survey coverage was not complete.

Figure 3.7 Sooty Shearwater abundance in SEA 7 area from August to October



By November, the abundance of Sooty Shearwaters was much lower, with the majority of records over the shelf break north of the Western Isles (Figure 3.8). Coverage was limited at this time of year.

Figure 3.8 Sooty Shearwater abundance in SEA 7 area in November



3.5 European Storm-petrel

The European Storm-petrel is a pelagic species, only coming ashore to breed on remote offshore islands. Accurate censusing of their breeding numbers is very difficult due to the remoteness of these colonies, and the fact that they nest in burrows. The first comprehensive survey of breeding European Storm-petrels in Britain and Ireland was only achieved during Seabird 2000, between 1999 and 2002. An estimated 33.9 – 53.9 % of the British breeding population breeds within the SEA 7 area (JNCC, Seabird 2000 database). The major breeding colonies for European Storm-petrel in SEA 7 are shown in Table 3.4.

Table 3.4 Major breeding colonies for European Storm-petrel in SEA 7 area (after Mitchell *et al* 2004)

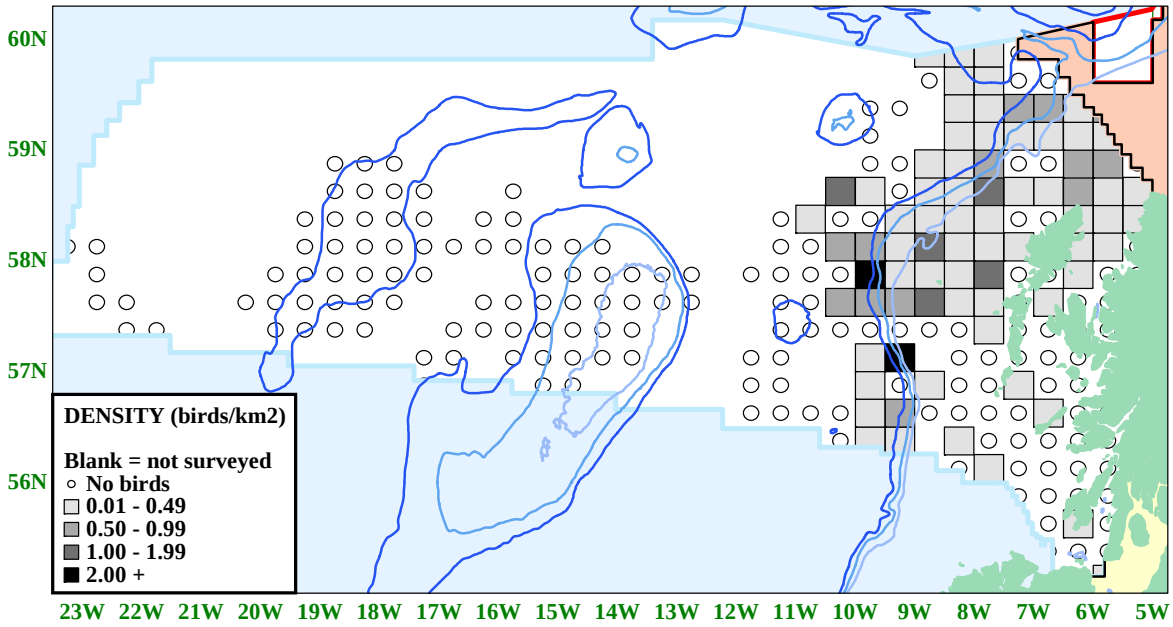
Site	Apparently Occupied Sites (AOS)
Treshnish Isles	5,040
Priest Island	4,400
St Kilda	1,121

Distribution within SEA 7

European Storm-petrels were recorded on ESAS surveys between April and November, with the majority of records between June and September.

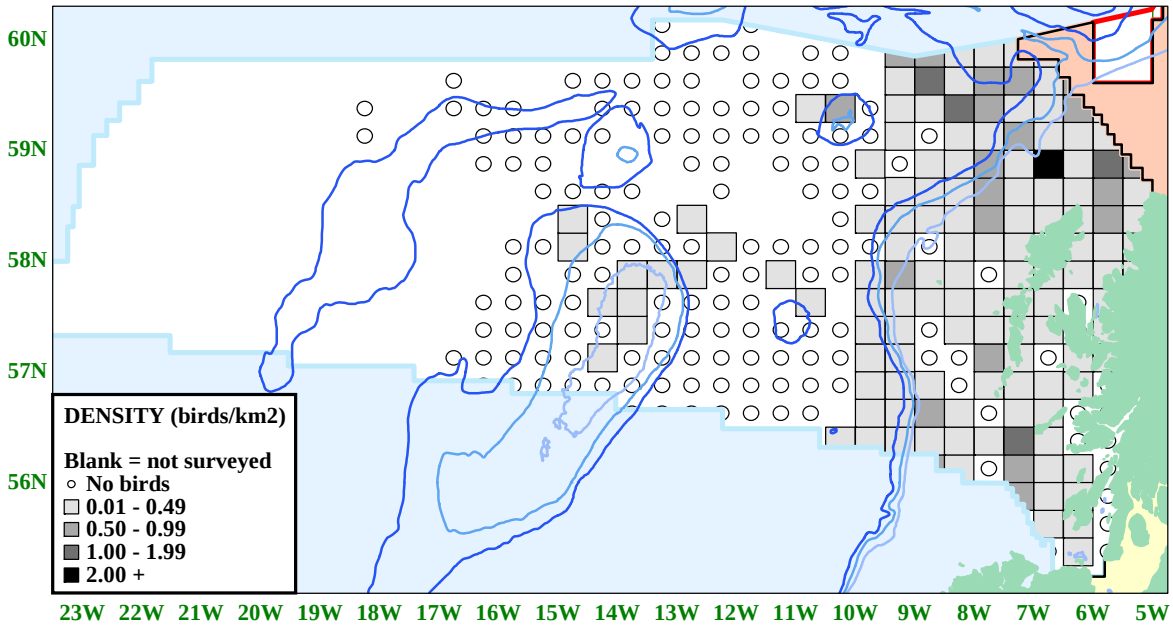
Very few were recorded in April as birds only begin to return from wintering grounds off Africa at this time. Birds were widespread at low to moderate densities over the shelf edge to the north and west of the Western Isles in May and June (Figure 3.9). Highest densities were along the shelf edge west of the Western Isles, (58° N, 9° W). No sightings were recorded in deep waters west of 11° W at this time, despite reasonable survey coverage.

Figure 3.9 European Storm-petrel density in SEA 7 area in May and June



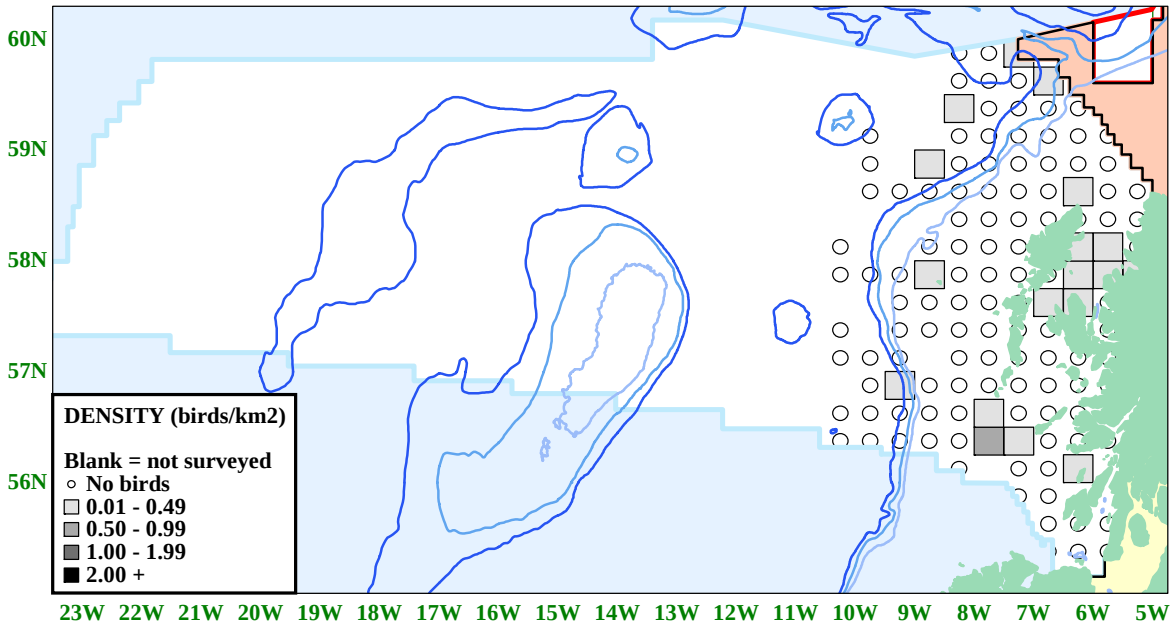
Between July and September, European Storm-petrels were widespread at low to moderate densities over shelf waters, with low densities also recorded further offshore over the Rockall Bank and north of the Anton Dohrn Seamount at this time (Figure 3.10). Numbers of birds peaked in August and had declined considerably in September.

Figure 3.10 European Storm-petrel density in SEA 7 area from July to September



Few European Storm-petrels were recorded in October and November, as the majority of birds would have left the area for the winter at this time (Figure 3.11). Birds were primarily restricted to inshore areas such as the Minch and shelf waters, although limited offshore survey coverage was achieved in these months.

Figure 3.11 European Storm-petrel density in SEA 7 area in October & November



In general, European Storm-petrels were under represented on ESAS surveys because of their small size and their habit of flying low over the water (Pollock *et al* 2000).

3.6 Leach's Storm-petrel

Like European Storm-petrels, Leach's Storm-petrels are also pelagic, only coming ashore to breed on remote offshore islands. Surveys of breeding birds have been virtually impossible due to the nocturnal nature of the species, combined with the remoteness of the breeding colonies. An accurate census of breeding colonies was a major aim for Seabird 2000. Three colonies in the SEA 7 area hold 99.9 % of the British breeding population of Leach's Storm-petrel (Table 3.5) (Mitchell *et al* 2004).

Table 3.5 Major breeding colonies for Leach's Storm-petrel in SEA 7 area (after Mitchell *et al* 2004)

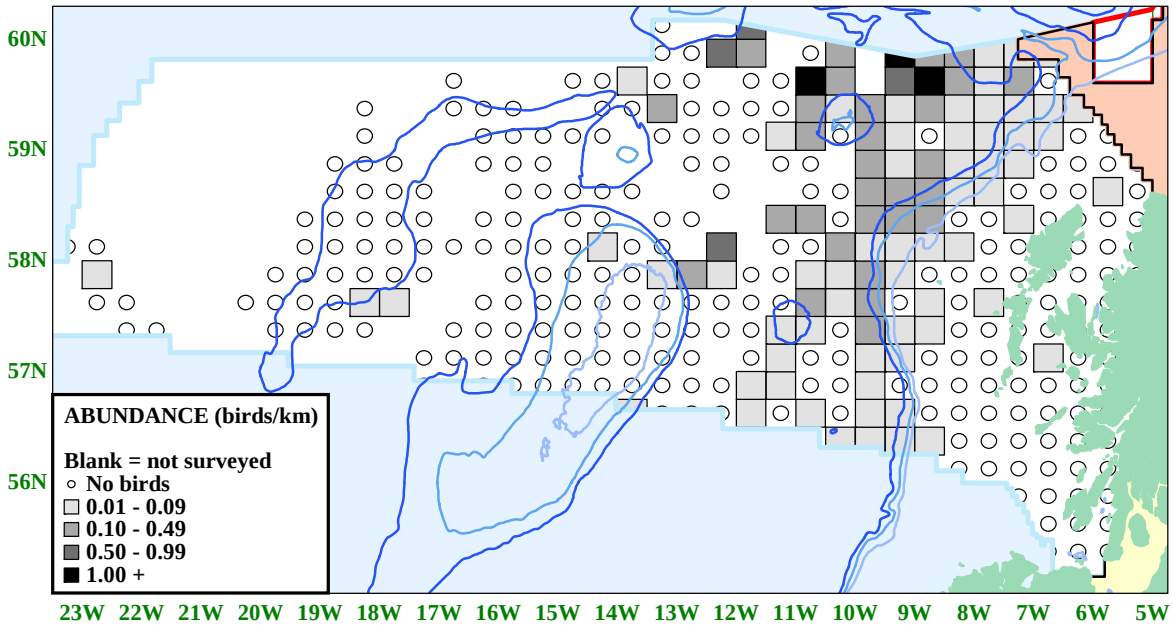
Site	Apparently Occupied Sites (AOS)
St Kilda	45,433
Flannan Isles	1,425
North Rona	1,132

Distribution within SEA 7

ESAS surveys recorded Leach's Storm-petrels between April and November. There were no winter records as the species spends the winter months in the tropics.

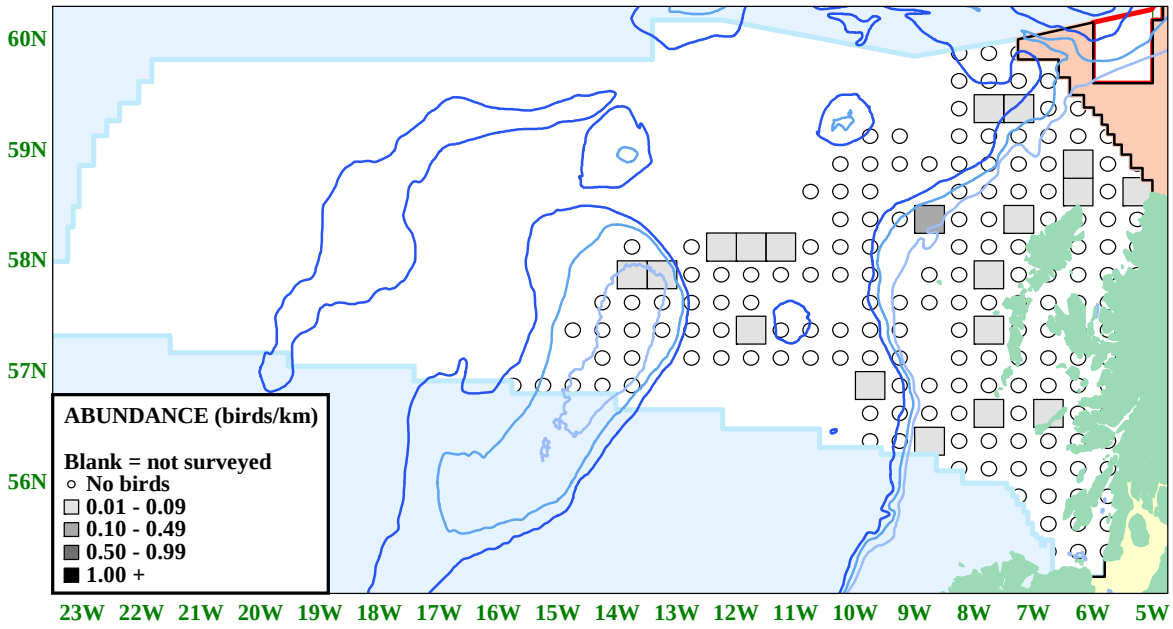
Few birds were recorded in April, with numbers increasing in May and June, and peaking in August (Figure 3.12). During this time, highest numbers were recorded north-west of the Western Isles, beyond the shelf edge, in waters greater than 1,000 m deep. A few birds were recorded far offshore at this time, and very few records came from inshore waters.

Figure 3.12 Leach's Storm-petrel abundance in SEA 7 area from May to August



Numbers decreased considerably in September and October, with birds being widely scattered throughout the area of survey (Figure 3.13). Birds were more frequently encountered in low numbers in shelf waters, and also over deeper water in the Rockall Trough and over the Rockall Bank. Only two birds were recorded in November, north of the Western Isles.

Figure 3.13 Leach's Storm-petrel abundance in SEA 7 area in September & October



Like European Storm-petrels, Leach's Storm-petrels were under represented on ESAS surveys because of their small size and their habit of flying low over the water (Pollock *et al* 2000).

3.7 Northern Gannet

Northern Gannets breed at several colonies around the coasts of Britain and Ireland, and tend to migrate south after the breeding season. Northern Gannets are currently censused every 10 years, with the most recent census in 2003/04 (Wanless *et al* 2005). There are three breeding colonies within the SEA 7 area, the largest of which is St. Kilda, with smaller colonies on Sula Sgeir and the Flannan Isles. These three colonies support an estimated 27.5 % of the British population, based on data from Wanless *et al* (2005).

Numbers at St Kilda increased by 19 % on the previous 1994/95 survey, while numbers at Sula Sgeir decreased by 12 %. The Flannan Isles showed the largest increase, with numbers up 92 % in 2004 compared to 1994/95 (Mitchell *et al* 2004). Recent counts from the colonies of Northern Gannet in SEA 7 are shown in Table 3.6.

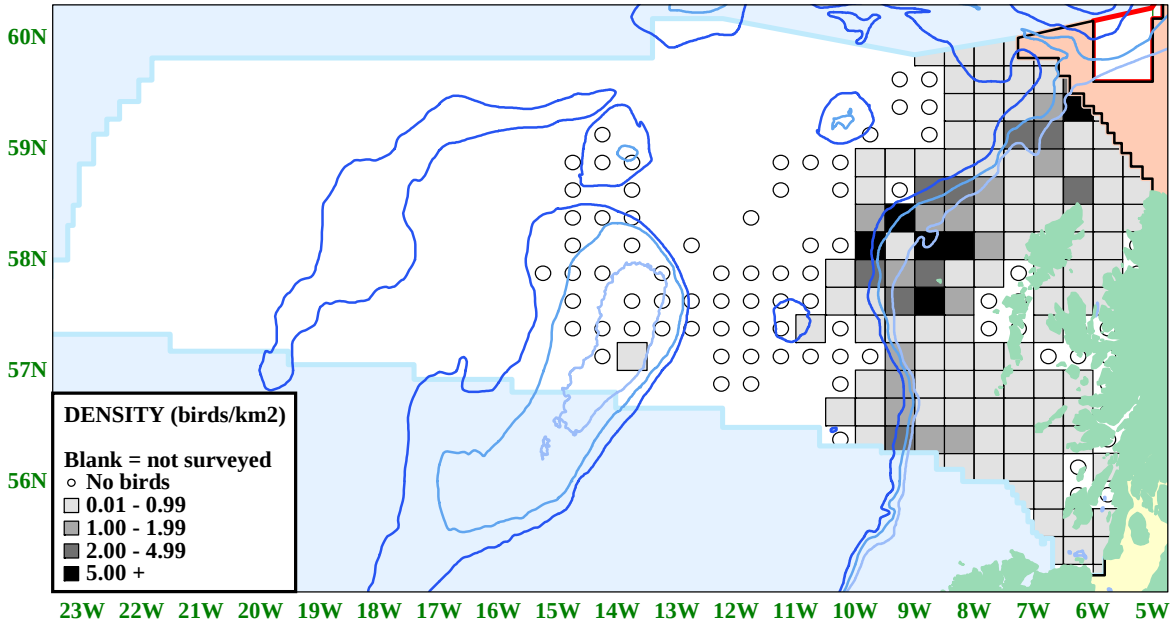
Table 3.6 Major breeding colonies for Northern Gannet in SEA 7 area in 2004 (after Wanless *et al* 2005)

Site	Apparently Occupied Sites/Nests (AOS/AON)
St Kilda	59,622 AOS
Sula Sgeir	9,225 AOS
Flannan Isles	2,760 AOS

Distribution within SEA 7

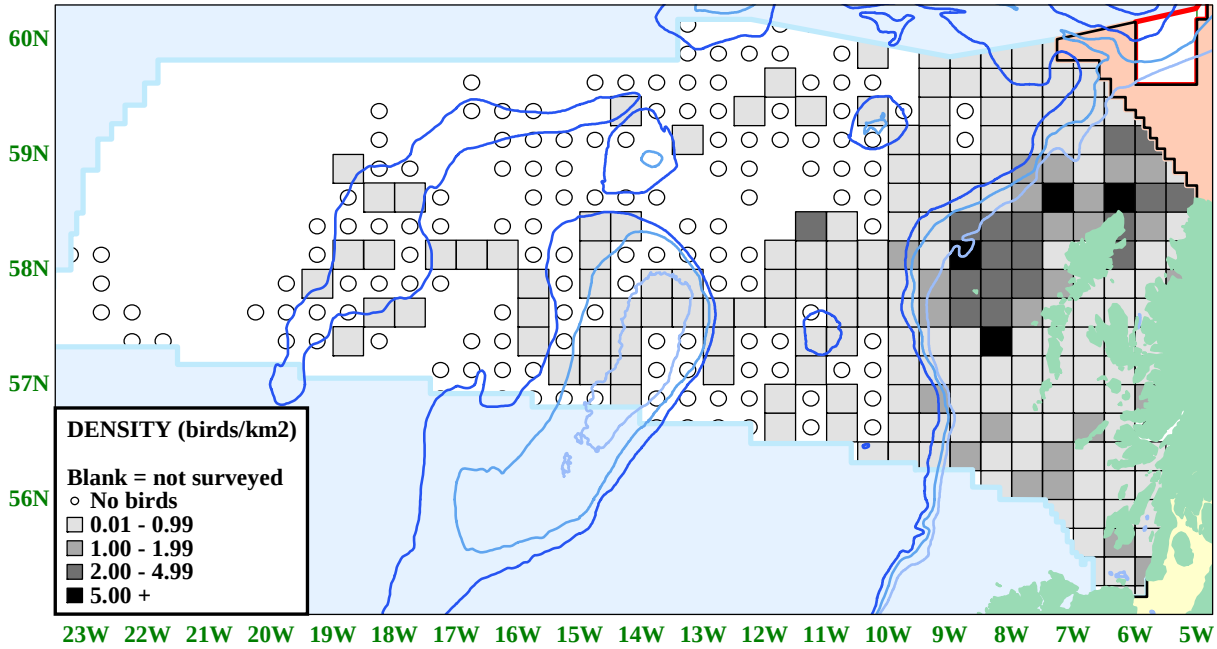
ESAS surveys recorded Northern Gannets in all months of the year. Peak densities were recorded in August, with lowest densities in November. Between November and April, highest densities were recorded along the shelf edge (Figure 3.14). Although survey coverage in offshore areas was not extensive, few birds were recorded in deep waters away from the east of the Rockall Trough. Northern Gannets were widespread at low densities over shelf waters at this time.

Figure 3.14 Northern Gannet density in SEA 7 area from November to April



Northern Gannets were more widespread in offshore waters between May and October, with birds recorded at low densities as far west as the Hatton Bank (Figure 3.15). Highest densities were recorded north and west of the Western Isles, close to colonies, with low densities along the shelf edge at this time.

Figure 3.15 Northern Gannet density in SEA 7 area from May to October



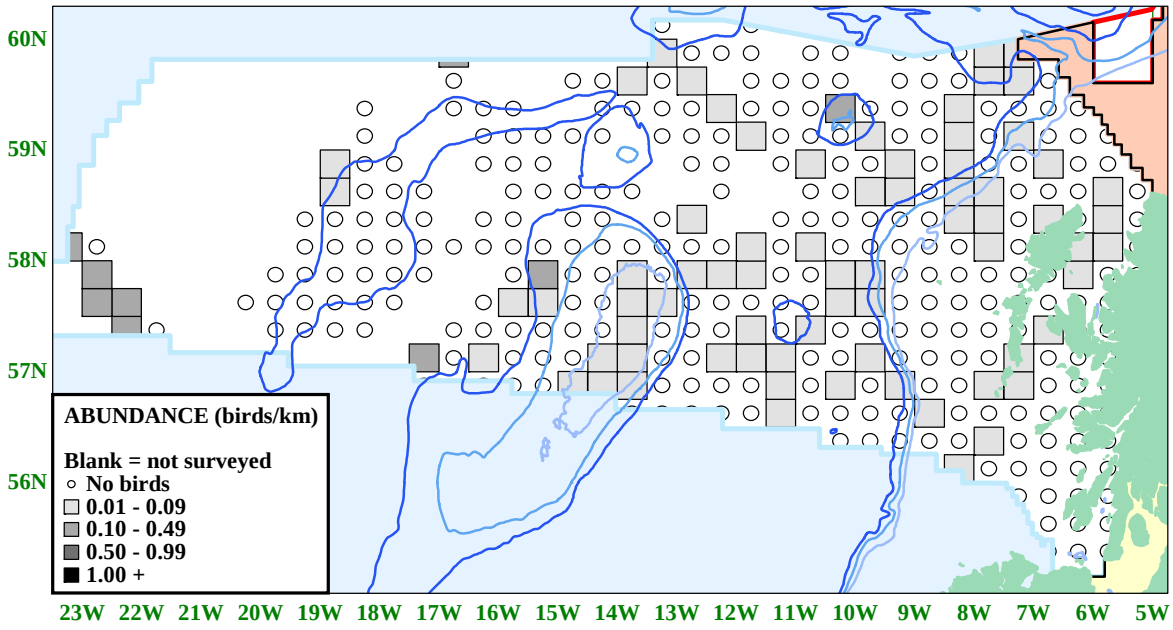
3.8 Pomarine Skua

Pomarine Skuas breed in the Arctic and winter at sea in the tropics. In spring, birds move north off the Western Isles, with varying numbers seen from land each year. Returning birds in autumn are more widespread, with some birds travelling down the east coast of Scotland.

Distribution within SEA 7

Pomarine Skuas were recorded on ESAS surveys between March and December, although peak numbers occurred between May and November (Figure 3.16).

Figure 3.16 Pomarine Skua abundance in SEA 7 area from May to November



Single birds were recorded in March and April, with the main spring passage in May. Individuals were very widely scattered throughout the SEA 7 area, with birds seen as far offshore as 23° W. Almost all records were west of the Western Isles at this time.

Numbers were much lower between June and August. Again, records were widely scattered, with most from offshore waters.

A more obvious pattern was recorded in September, as autumn birds headed south through the area. The majority of records were in the Rockall Trough, west of the Western Isles. A few individuals remained in inshore areas in October, November and December.

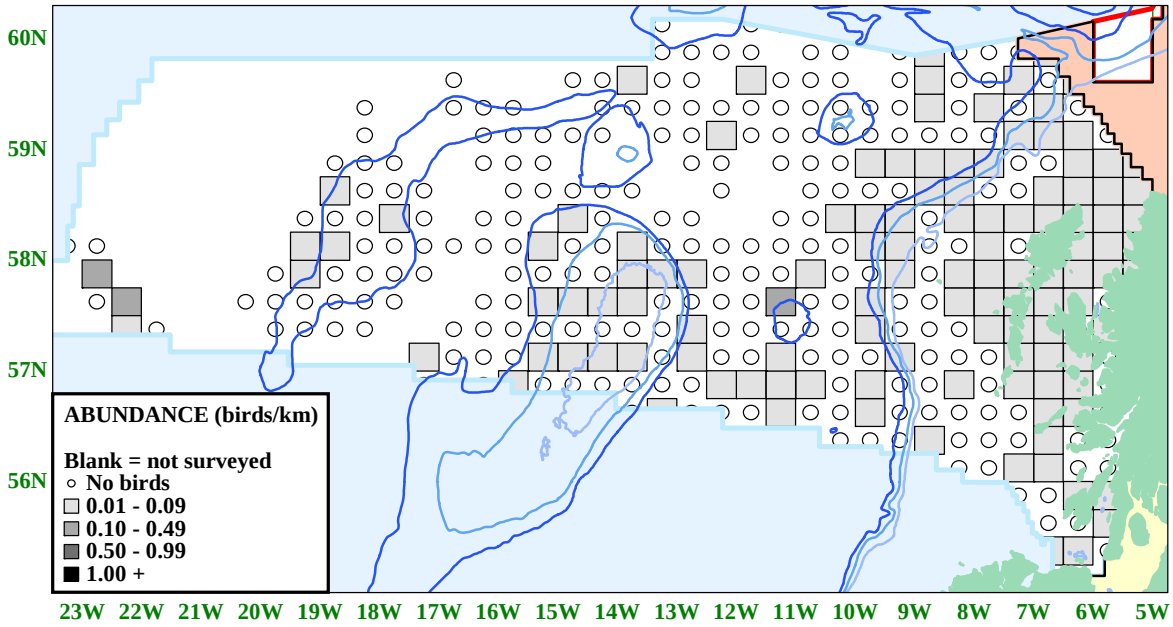
3.9 Arctic Skua

Arctic Skuas nest in the high Arctic, with a small population breeding in north and west Scotland, at the southern limit of the breeding range. Within Britain, the bulk of the breeding population is found on Orkney and Shetland, with an estimated 10.4 % of the British population found within the SEA 7 area, on the Western Isles and a few islands in Argyll (JNCC, Seabird 2000 database). The most recent estimate for the Western Isles was 156 Apparently Occupied Territories recorded during Seabird 2000, an increase of 160 % over the previous 1985-88 survey (Mitchell *et al* 2004).

Distribution within SEA 7

Arctic Skuas were recorded on ESAS surveys between April and November, with the majority of records between May and October (Figure 3.17).

Figure 3.17 Arctic Skua abundance in SEA 7 area from May to October (after Mitchell *et al* 2004)



In May, birds were widely scattered in low numbers throughout the SEA 7 area, including offshore areas. Many of these birds would be migrating north to breeding grounds in the Arctic. Distribution in June and July showed more of a bias towards inshore areas, particularly around the Western Isles, although low numbers were still recorded in offshore areas.

Numbers of Arctic Skuas recorded on ESAS surveys peaked in August, with the majority of records from inshore waters of the Minch and close to the west coast of Scotland. Low numbers were also recorded offshore over the Rockall Bank and Trough. Some of these birds would have been returning from the northern breeding grounds. Records from September were fewer and widely scattered. Few birds remained in October and November.

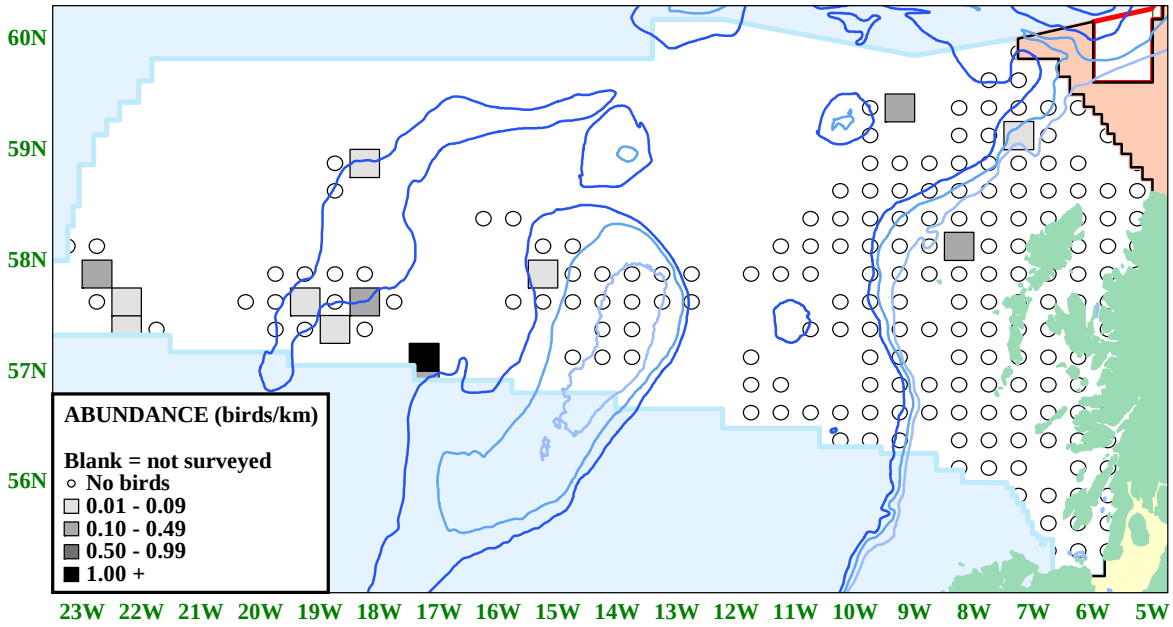
3.10 Long-tailed Skua

Long-tailed Skuas show a similar migration pattern to Pomarine Skuas, with a marked spring passage off the west coast of Scotland to the high Arctic breeding grounds, concentrated in May and early June. In autumn, returning birds are also seen off the west coast of Scotland but greater numbers are recorded off the east coast of Scotland in some years.

Distribution within SEA 7

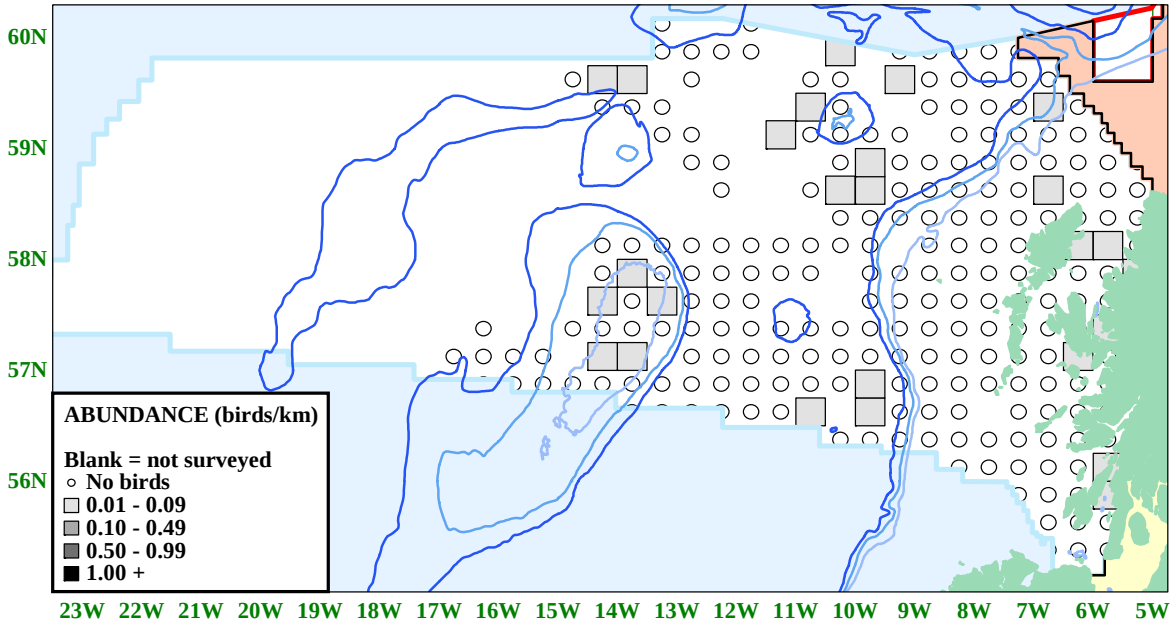
On ESAS surveys, Long-tailed Skuas were recorded between May and September, with obvious peaks in May, August and September. The species shows a similar distribution pattern to Pomarine Skua and Arctic Skua, with widely scattered records throughout the SEA 7 area, including far offshore (Figure 3.18). Over 270 Long-tailed Skuas were recorded during a five week survey of the Hatton-Rockall region in May 2002 (Mackey *et al* 2004).

Figure 3.18 Long-tailed Skua abundance in SEA 7 area in May



Low numbers were recorded in June and July, with an increase in August and September due to birds returning from the breeding grounds in the Arctic (Figure 3.19). Several sightings were noted in the Minch at this time, in contrast to May, when there were no inshore records.

Figure 3.19 Long-tailed Skua abundance in SEA 7 area in August and September



3.11 Great Skua

The majority of the world's Great Skua population breed on Shetland, Orkney and Iceland, although the breeding range has expanded in recent years (Mitchell *et al* 2004). The SEA 7 area holds an estimated 5.7 % of the British breeding population (JNCC, Seabird 2000 database), with new small colonies discovered on the Western Isles and the west of Scotland in recent years. The major breeding colonies for Great Skua in SEA 7 are shown in Table 3.7.

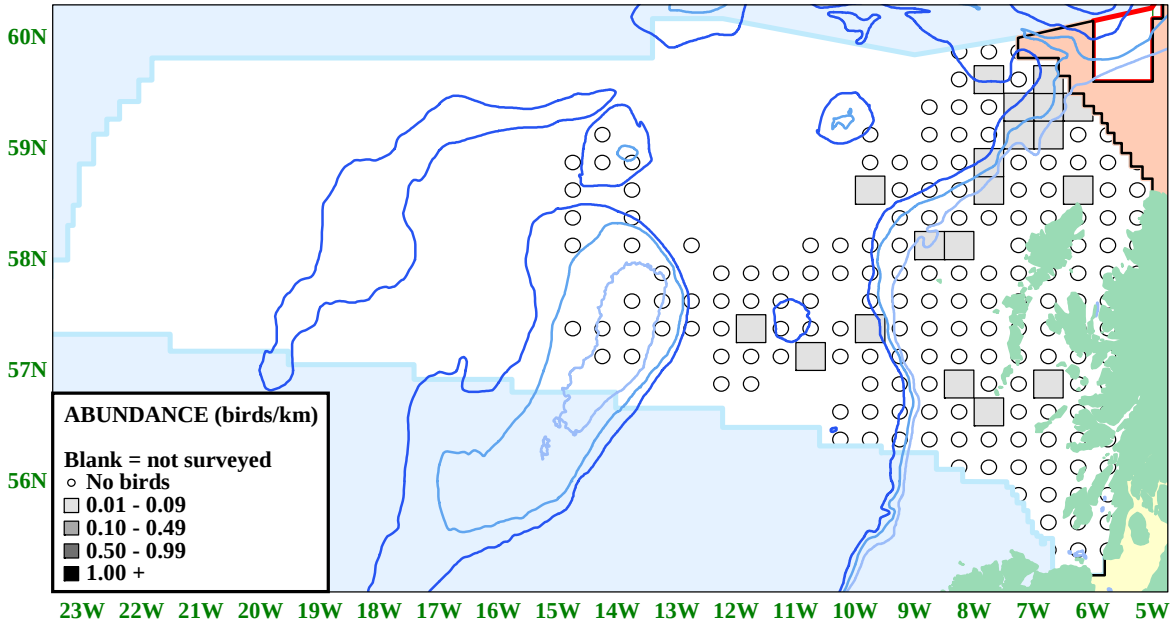
Table 3.7 Major breeding colonies for Great Skua in SEA 7 Area (after Mitchell *et al* 2004)

Site	Apparently Occupied Territories (AOT)
St Kilda	240
Handa	195

Distribution and abundance within SEA 7

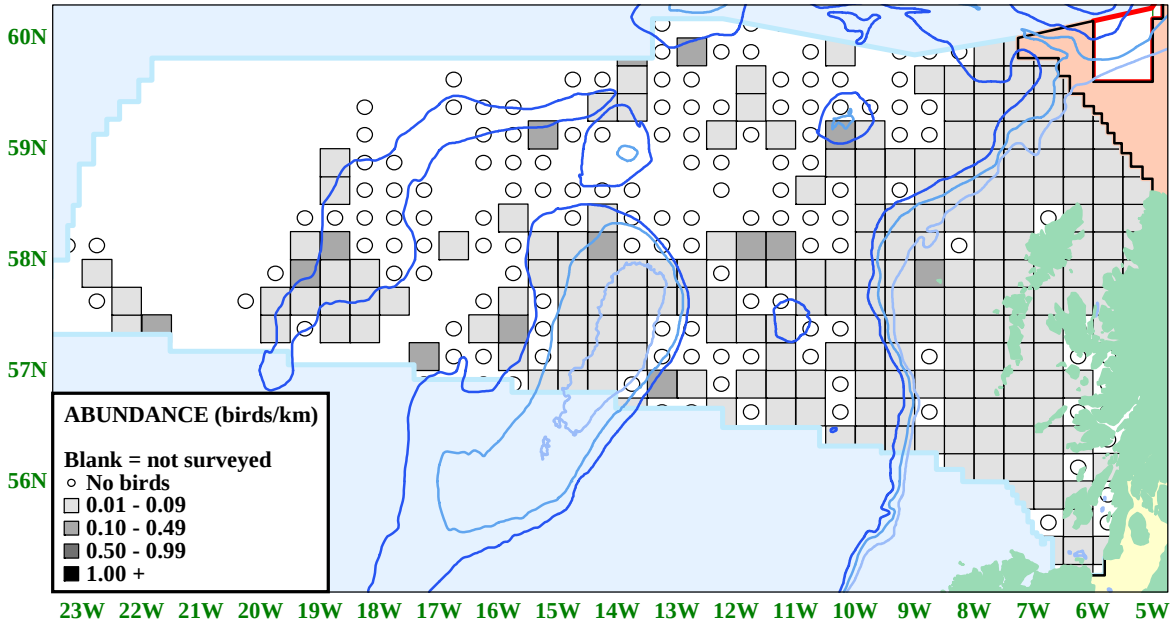
Great Skuas were recorded on ESAS surveys in all months except January. Few birds were recorded between November and March (Figure 3.20), with low numbers observed to the north and west of the western Isles and a few birds scattered to the south. The majority of birds occurred inshore of the shelf break at this time.

Figure 3.20 Great Skua abundance in SEA 7 area from November to March



Great Skuas were much more abundant between April and October (Figure 3.21), with a total of 1,526 individual birds recorded. Numbers started to increase from April, reached a peak in August, and decreased again in September. Birds were widespread in low numbers throughout offshore waters as well as in inshore shelf waters.

Figure 3.21 Great Skua abundance in SEA 7 area from April to October



3.12 Lesser Black-backed Gull

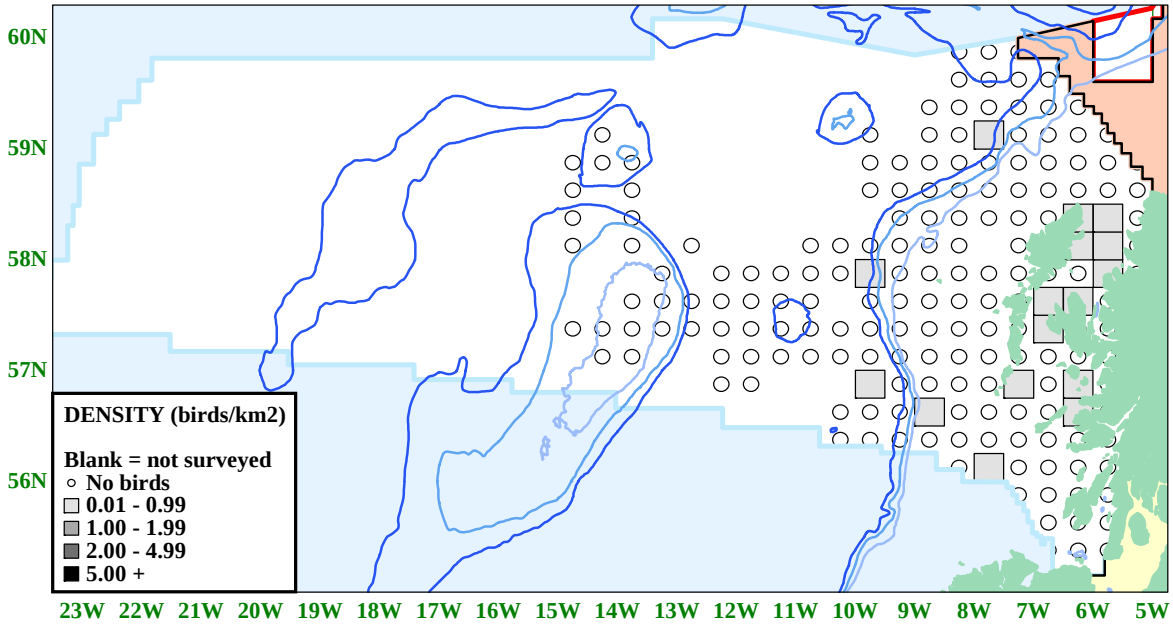
Lesser Black-backed Gulls were once considered a complete migrant to Britain, with only occasional birds present in winter, but increasing numbers now over-winter, predominantly in the southern half of Britain. Within the SEA 7 area, the species is a partial migrant, with most birds moving south during the winter months.

Although the overall UK breeding population has expanded in recent years, numbers of breeding birds around north west Scotland have showed a decline e.g. Lochaber –47 % decline, Skye & Lochalsh –88 % decline, Western Isles –5% decline (Mitchell *et al* 2004). The SEA 7 area holds an estimated 2.7 % of the British population in small, scattered colonies (JNCC, Seabird 2000 database).

Distribution within SEA 7

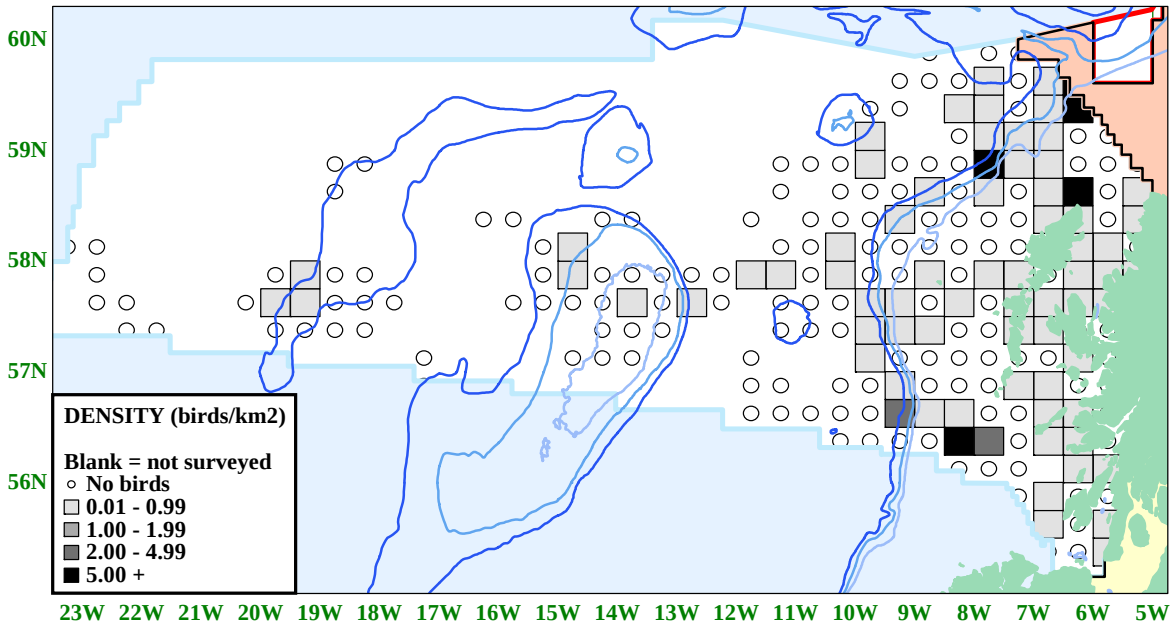
Lesser Black-backed Gulls were recorded in all months on ESAS surveys, with lowest densities in November, and highest densities in April. Between November and March, low densities were recorded in the Minch and in inshore waters west of Scotland, with a few individuals scattered further offshore (Figure 3.22).

Figure 3.22 Lesser Black-backed Gull density in SEA 7 area from November to March



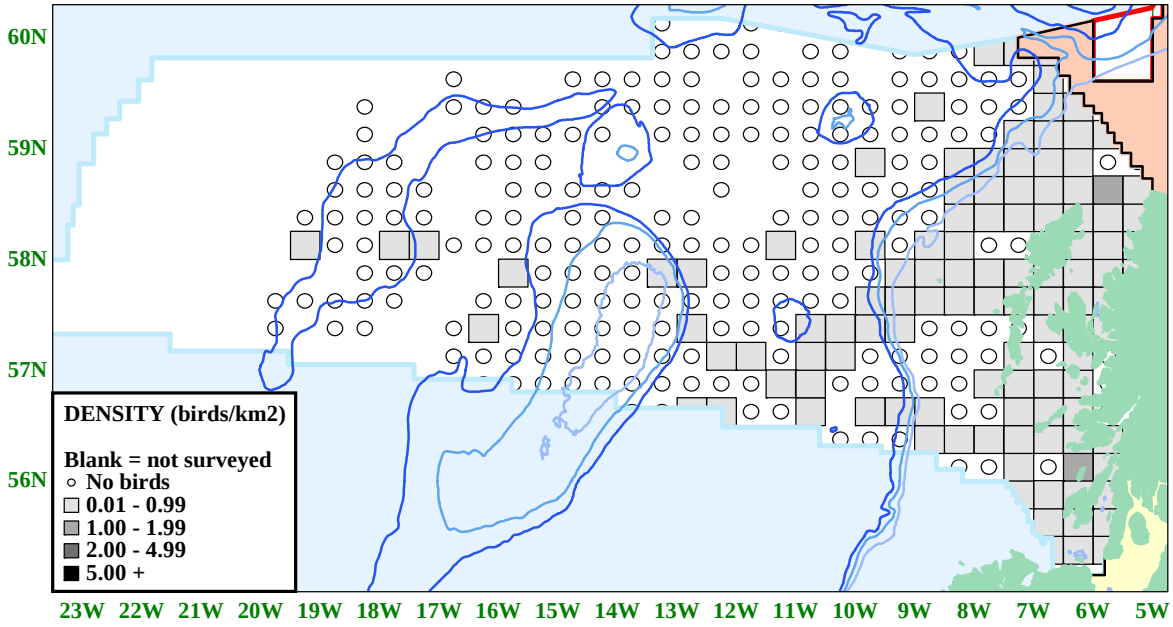
There was a large influx of birds recorded in April and May. Generally low densities were recorded in offshore areas such as the Hatton Bank, Rockall Bank and Rockall Trough, although some moderate to high density patches were recorded over the shelf break (Figure 3.23).

Figure 3.23 Lesser Black-backed Gull density in SEA 7 area in April and May



Low densities were recorded offshore between June and September, but survey coverage was not available for offshore areas in October (Figure 3.24). Low densities were also recorded along the shelf break and in inshore waters (see also Barton & Pollock 2005).

Figure 3.24 Lesser Black-backed Gull density in SEA 7 area from June to October



3.13 Great Black-backed Gull

During the 20th century numbers of Great Black-backed Gulls increased dramatically. Great Black-backed Gulls are more marine than Lesser Black-backed Gulls, and nest almost exclusively in coastal habitats. In Britain, the species breeds mainly on the west coast of Scotland, the Inner and Outer Hebrides, and in the Northern Isles although numbers counted during Seabird 2000 showed a slight decline on a national scale compared to the last survey in 1985-88 (Mitchell *et al* 2004).

The SEA 7 area holds an estimated 25.6 % of the British breeding population (JNCC, Seabird 2000 database), with important breeding concentrations on the Western Isles and the Inner Hebrides. Declines were noted in these areas during Seabird 2000 e.g. Skye & Lochalsh –56 % decline, Western Isles –23% decline (Mitchell *et al* 2004). The major breeding colonies for Great Black-backed Gull in SEA 7 are shown in Table 3.8.

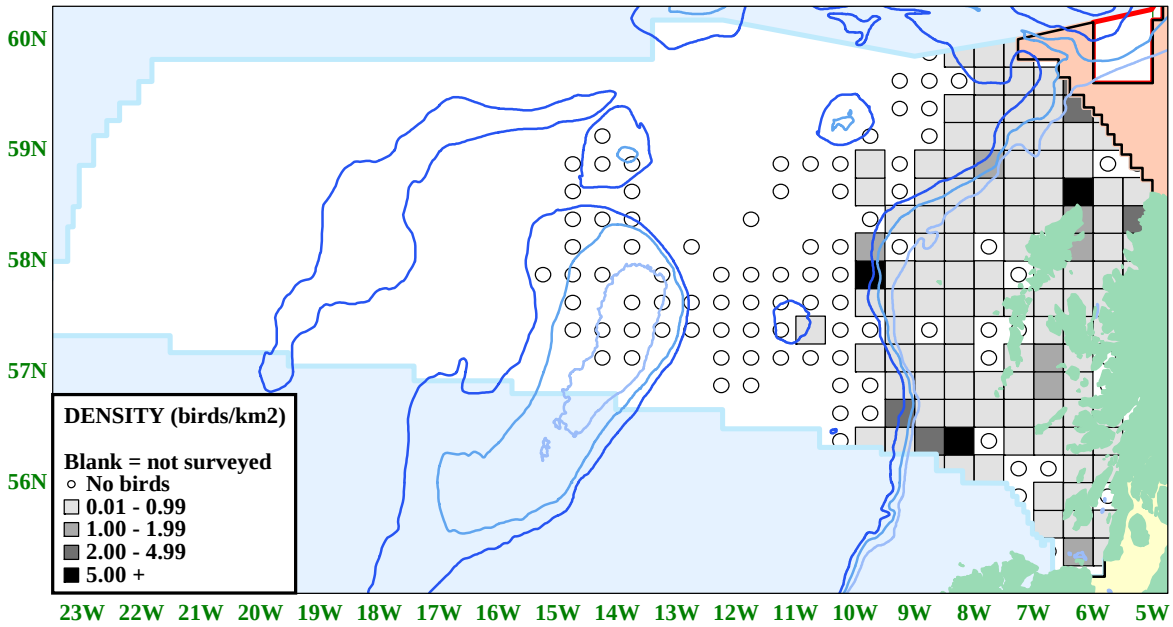
Table 3.8 Major breeding colonies for Great Black-backed Gull in SEA 7 area (after Mitchell *et al* 2004)

Site	Apparently Occupied Nests (AON)
North Rona	983
Treshnish Islands	342
Shiant Islands	310
Coll	177

Distribution within SEA 7

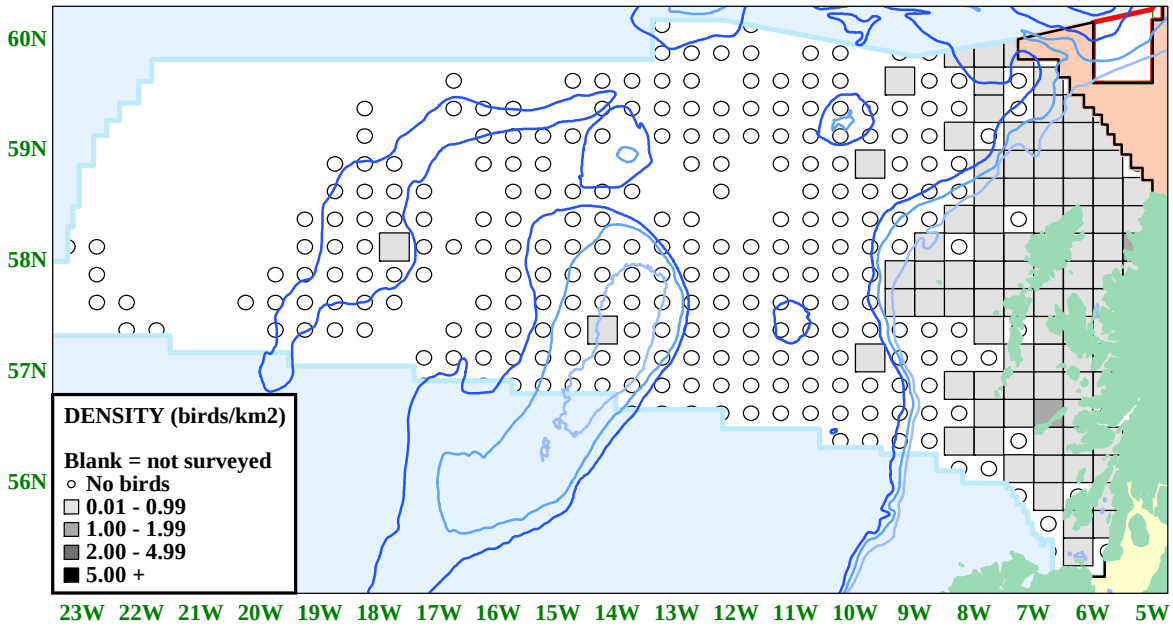
ESAS surveys recorded Great Black-backed Gulls throughout the year, with peak numbers in January and April, and lowest numbers in July. Between November and April, birds were widespread at low to moderate densities as far west as 10° W, although records further offshore were scarce (Figure 3.25). Patches of moderate to high density were found along the shelf break.

Figure 3.25 Greater Black-backed Gull density in SEA 7 area from November to April



The distribution pattern between May and October was broadly similar to the winter distribution, although densities were generally lower. Occasional birds were recorded in offshore waters, although there were very few along the shelf break (Figure 3.26). This species was also considered in a recent review of inshore waters (Barton & Pollock 2005, Barton & Pollock 2006).

Figure 3.26 Greater Black-backed Gull density in SEA 7 area from May to October



3.14 Black-legged Kittiwake

Black-legged Kittiwakes are largely oceanic in nature, only coming to shore during the breeding season. Although a small proportion of birds occur around British and Irish coasts in winter, the majority of the population spends the winter in the North Atlantic and North Sea.

Seabird 2000 recorded a 23 % decline in the Black-legged Kittiwake population in Britain and Ireland, with many colonies bordering the SEA 7 area showing a decline e.g. Lochaber –36 %, Skye & Lochalsh –37 % decline, Western Isles –29% decline (Mitchell *et al* 2004). Breeding colonies within the SEA 7 area hold an estimated 11.2 % of the British population (JNCC, Seabird 2000 database). The major breeding colonies for Black-legged Kittiwakes in SEA 7 are shown in Table 3.9.

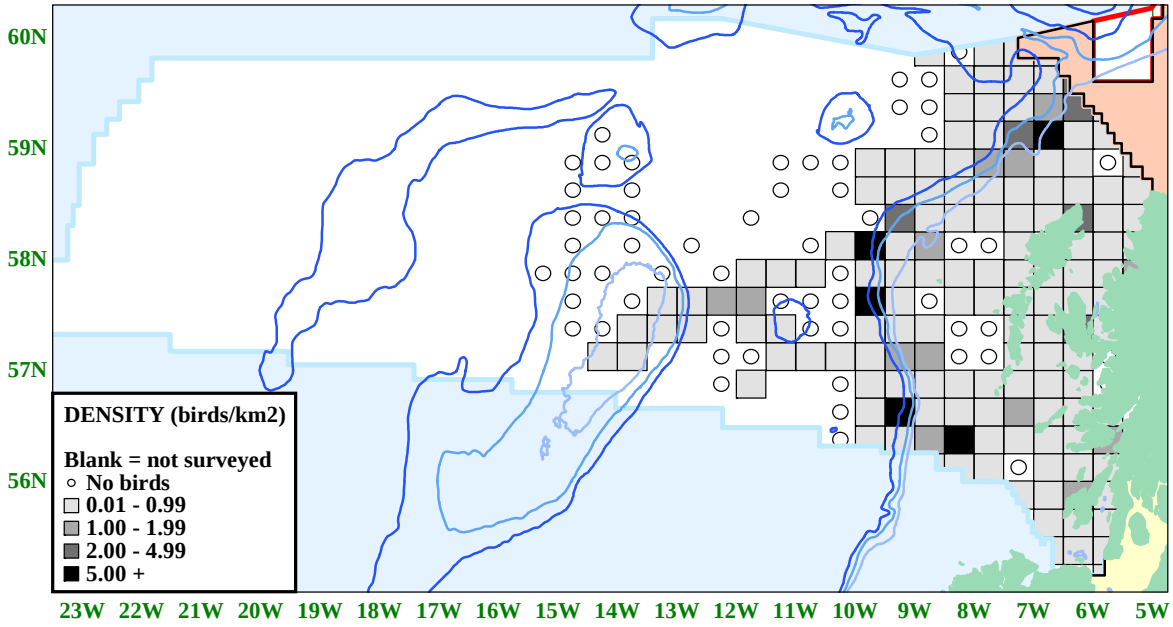
Table 3.9 Major breeding colonies for Black-legged Kittiwakes in SEA 7 area (after Mitchell *et al* 2004)

Site	Apparently Occupied Nests (AON)
Rathlin Island (N Ireland)	9,917
Handa	7,013
Colonsay	6,485
St Kilda	3,886
Berneray	2,613

Distribution within SEA 7

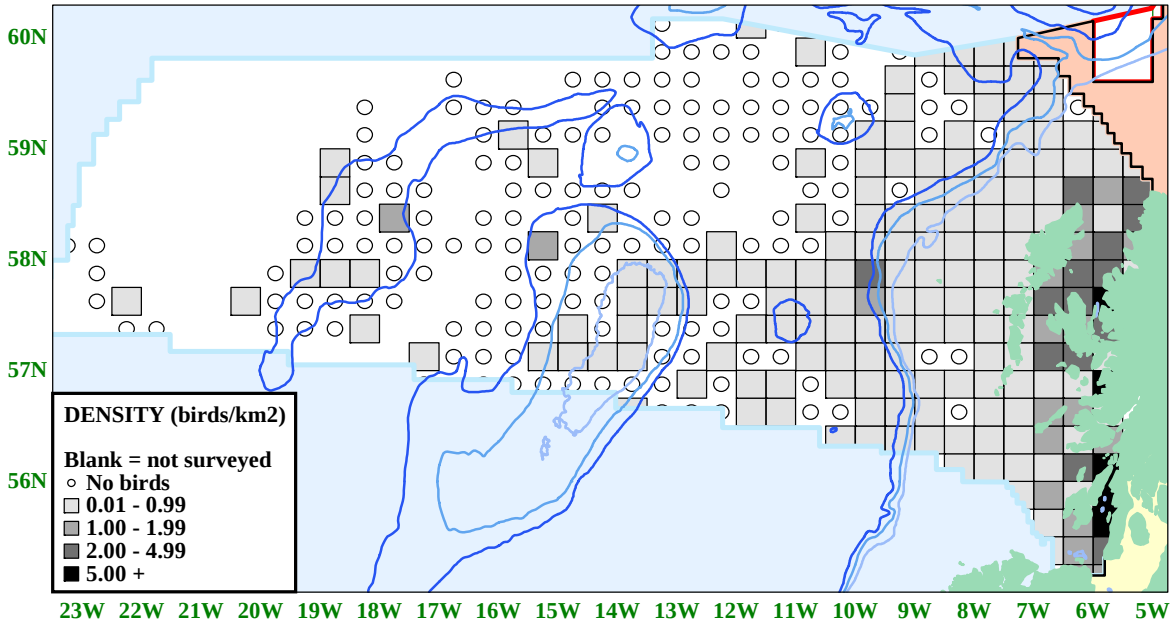
ESAS surveys recorded Black-legged Kittiwakes throughout the year, with peak numbers in August, and lowest numbers in March. Between January and April, birds were widespread in inshore waters. Further offshore, peak densities were recorded along the shelf break (Figure 3.27). Densities were lower in waters greater than 1,000 m deep and were mostly distributed over the Rockall Trough and Bank.

Figure 3.27 Black-legged Kittiwake density in SEA 7 area from January to April



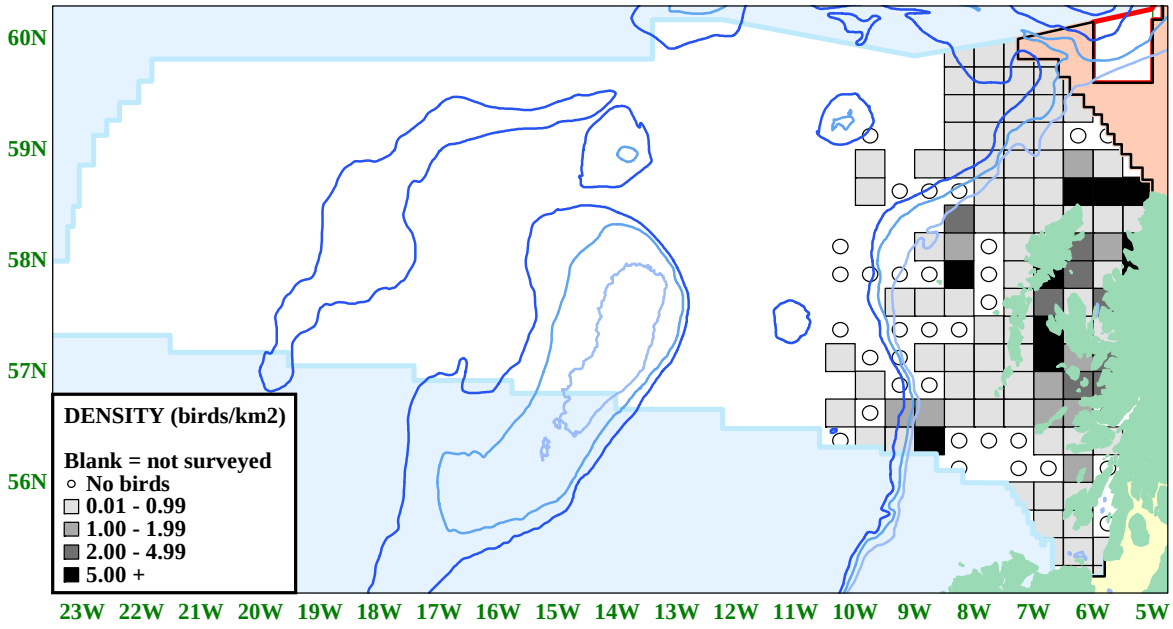
Between May and September, highest densities were recorded in inshore waters close to breeding colonies (see Barton & Pollock 2005). Birds were widespread at low densities offshore over the Rockall Trough and Bank and the Hatton Bank, becoming more scattered at greater distance from the coast (Figure 3.28).

Figure 3.28 Black-legged Kittiwake density in SEA 7 area from May to September



Survey coverage between October and December were limited to just beyond the shelf break (Figure 3.29). Black-legged Kittiwakes were widespread throughout the area surveyed, although distribution was patchy further from the coast. High densities were recorded in shelf waters north of the Western Isles, in the Minch and occasionally further offshore. Densities over the shelf break were generally low.

Figure 3.29 Black-legged Kittiwake density in SEA 7 area from October to December



3.15 Arctic Tern

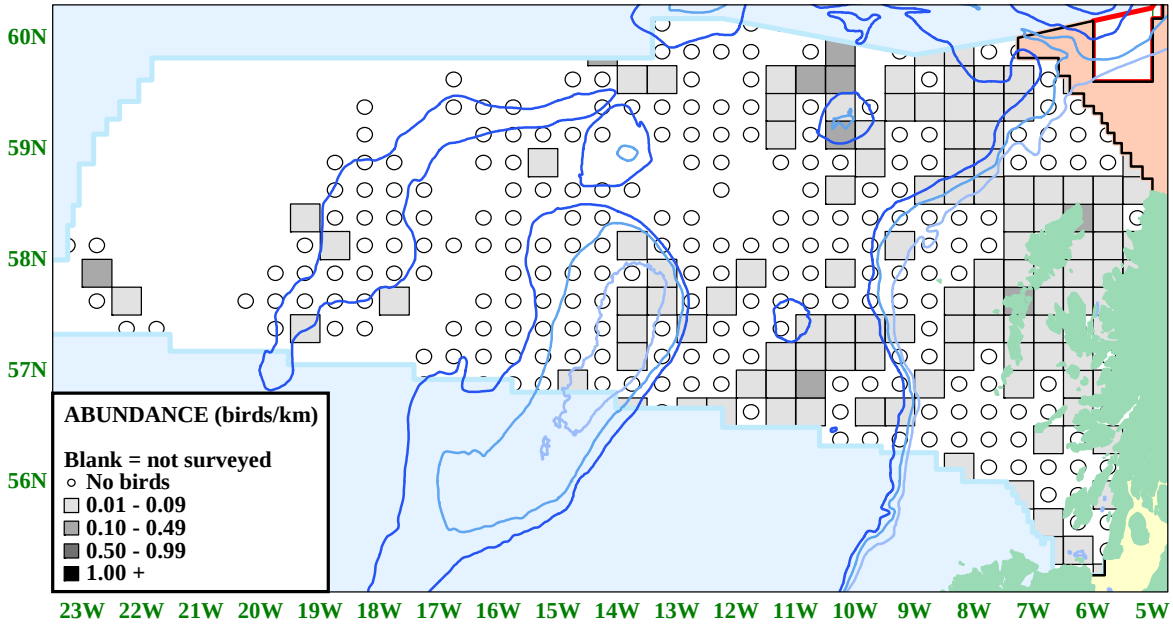
Arctic Terns are the commonest tern breeding in Britain and Ireland, and have a northerly distribution. After breeding, Arctic Terns head south to Antarctic seas, moving down the west coast of Europe and Africa to South Africa, and on south to the edge of the pack ice. Return passage begins in early March and retraces the autumn migration route northwards (Wernham *et al* 2002).

According to Seabird 2000 data, the SEA 7 area holds an estimated 10.4 % of the British breeding population of Arctic Terns, with colonies in the Hebrides and islands off the west coast of Scotland. Seabird 2000 recorded a 29 % decline in the Arctic Tern population in Britain and Ireland. Several areas bordering the SEA 7 area showed a decline e.g. Lochaber –73 %, Skye & Lochalsh –83 %, Argyll & Bute –30 % while other areas showed a considerable increase e.g. Western Isles +277 % (Mitchell *et al* 2004).

Distribution within SEA 7

Arctic Terns have been recorded on ESAS surveys between April and October, with the majority of records between May and September (Figure 3.30).

Figure 3.30 Arctic Tern abundance in SEA 7 area from May to September



Low numbers of early returning birds were recorded in April, with greater numbers seen in May, when birds were encountered as far offshore as 23° W. Distribution in June and July was concentrated around breeding colonies on the Western Isles and other west coast islands, although occasional birds were recorded in low numbers in offshore areas. Birds were more widespread in offshore areas in August, in low to moderate numbers. Numbers dropped considerably by September, with the majority of records coming from offshore areas. Low numbers remained in the Minch in October.

3.16 Little Auk

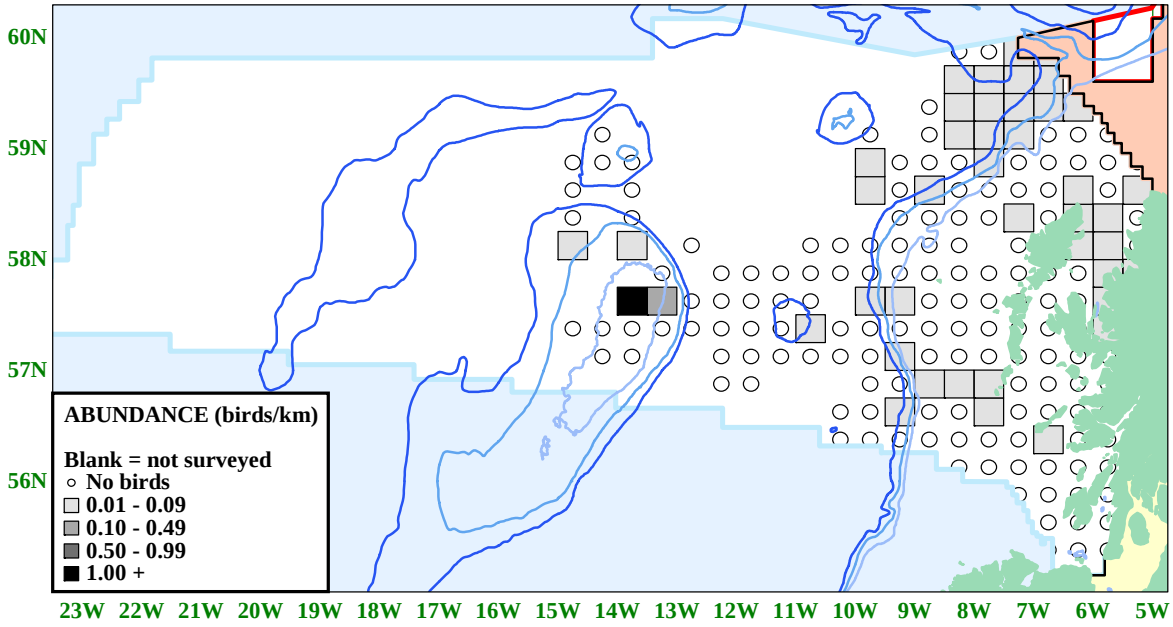
Little Auks breed in the high Arctic, with large colonies in Spitzbergen and Greenland. In winter, Little Auks are pelagic, and are generally found offshore, only visible from land following strong onshore winds (Lack 1986).

Distribution within SEA 7

The majority of Little Auks were recorded on ESAS surveys between November and March, with a few sightings between April and October.

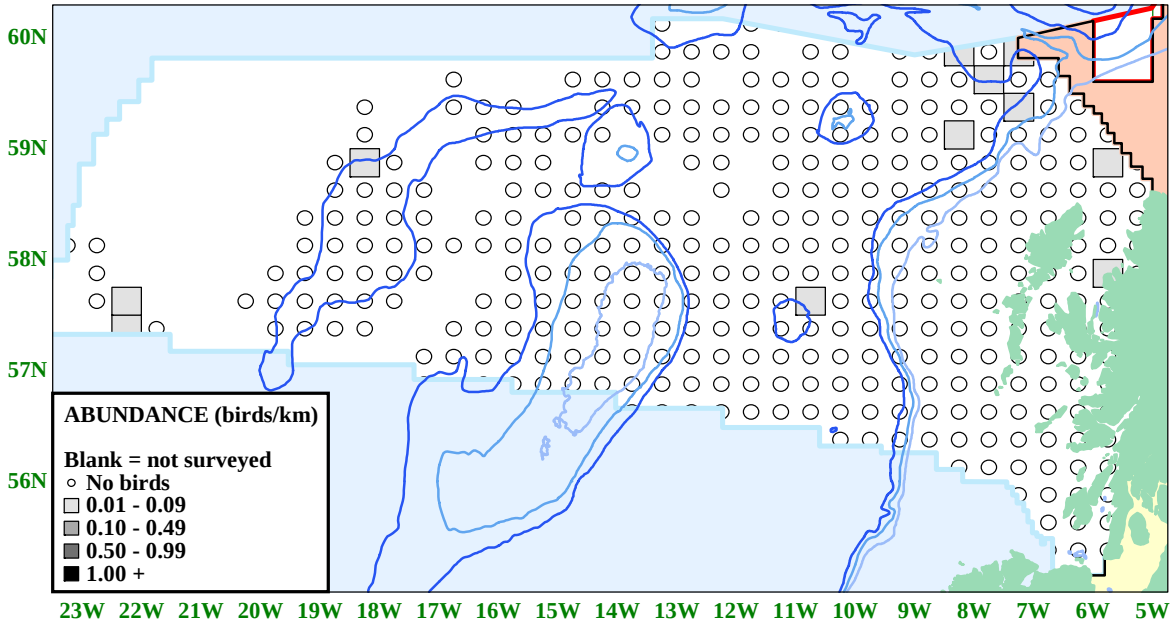
Peak numbers were recorded in November, with most birds recorded along the shelf break and in the north east of the Rockall Trough, with smaller concentrations at the northern end of the Minch. A similar pattern was recorded in December, although numbers were lower. Offshore survey coverage was greater to the west of the Western Isles in January and February when concentrations were recorded over the Rockall Bank. Birds were widely scattered in March although less offshore coverage was achieved (Figure 3.31).

Figure 3.31 Little Auk abundance in SEA 7 area from November to March



Little Auks were occasionally recorded between April and October (Figure 3.32). Only one was seen in April, north of the Western Isles, but offshore surveys in May recorded small numbers over the Hatton Bank. One was recorded over the Anton Dohrn Seamount in June, and a single bird was recorded close inshore in August. There were no sightings in July or September.

Figure 3.32 Little Auk abundance in SEA 7 area from April to October



3.17 Atlantic Puffin

Atlantic Puffins are largely pelagic, only coming ashore to breed between March and August. After breeding, birds from north-west Britain and Ireland disperse widely, with ringed birds recovered in Newfoundland and Greenland, the Canary Islands and the Mediterranean (Mitchell *et al* 2004).

An estimated 41.3 % of the British breeding population of Atlantic Puffins are found within the SEA 7 area (JNCC, Seabird 2000 database). Although Seabird 2000 recorded an increase in the Atlantic Puffin population in Scotland, several areas bordering the SEA 7 area showed a decline e.g. Lochaber –6 %, Skye & Lochalsh –82 %, Argyll & Bute –1 %, Western Isles -5 % (Mitchell *et al* 2004). The major breeding colonies for Atlantic Puffins in SEA 7 are shown in Table 3.10.

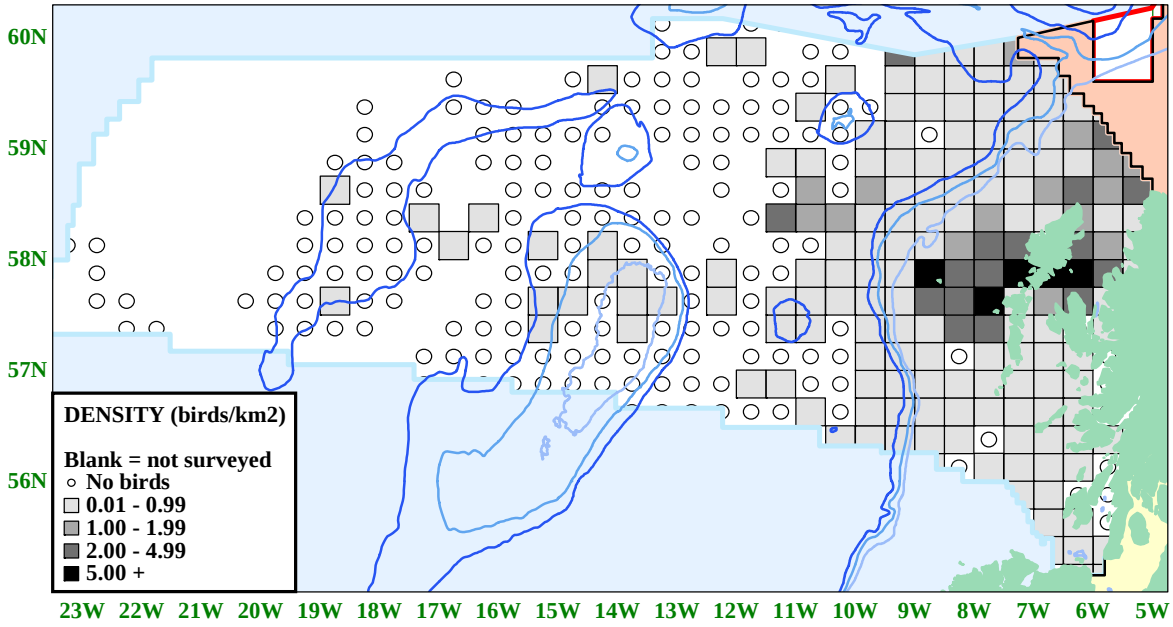
Table 3.10 Major breeding colonies for Atlantic Puffins in SEA 7 area (after Mitchell *et al* 2004)

Site	Apparently Occupied Burrows (AOB)
St Kilda	142,264
Flannan Isles	15,761
North Rona	5,265
Berneray	1,979
Canna	945
Handa	735

Distribution within SEA 7

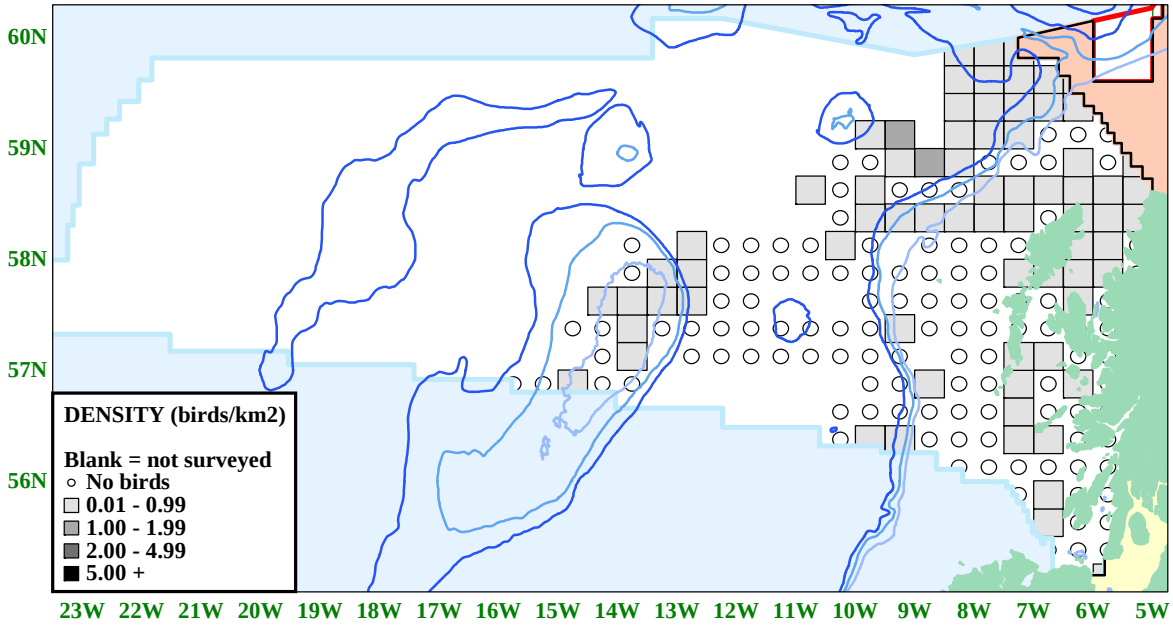
ESAS surveys recorded Atlantic Puffins in all months, although the majority of records were between April and November. Highest densities of Atlantic Puffins were recorded between April and August (Figure 3.33). Birds were widespread in inshore areas, with highest densities recorded around the Western Isles and in the Minch. Offshore, birds were widely scattered at low densities along the shelf break and eastern edge of the Rockall Trough, and as far west as the Hatton Bank. Offshore survey coverage was most extensive in May and June, with less coverage in July and August.

Figure 3.33 Atlantic Puffin density in SEA 7 area from April to August



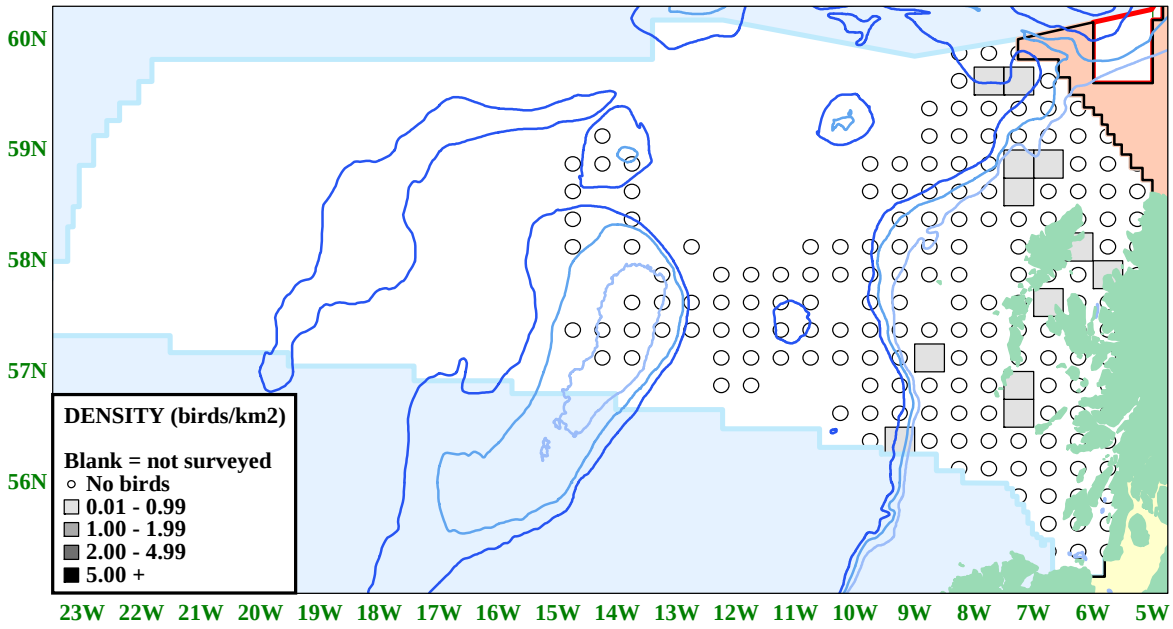
Between September and November, recorded densities of birds decreased as birds dispersed offshore away from breeding colonies. Low to moderate densities were recorded in the north-east Rockall Trough throughout this period (Figure 3.34). Offshore survey coverage was limited to waters north of the Western Isles in October and November but birds were recorded at low densities over the Rockall Bank in September.

Figure 3.34 Atlantic Puffin density in SEA 7 area from September to November



In December, few birds were detected on surveys, although offshore survey coverage was limited to waters north of the Western Isles. Birds were occasionally encountered in January and February, and numbers began to increase slightly in March north of the Western Isles and in the Minch, although densities were still low (Figure 3.35).

Figure 3.35 Atlantic Puffin density in SEA 7 area from December to March



4. Important offshore areas in SEA 7

Total seabird density for the SEA 7 area was calculated for each ¼ ICES square and mapped. These maps give a visual representation of total density in relation to bathymetry and are shown over the whole year, by season and by month.

Important areas highlighted using total seabird density were the shelf edge and Rockall Bank throughout the year (Figures 4.1 to 4.15). Northern Fulmars were the most frequently recorded species in high density areas, with Northern Gannet, and Black-legged Kittiwake also commonly recorded.

Combining all seabird density data for all months showed that the shelf edge and the Rockall Bank were the areas where highest seabird densities were likely to be encountered, with generally low densities elsewhere in offshore areas (Figure 4.1).

Figure 4.1 Total seabird density in SEA 7 area throughout the year

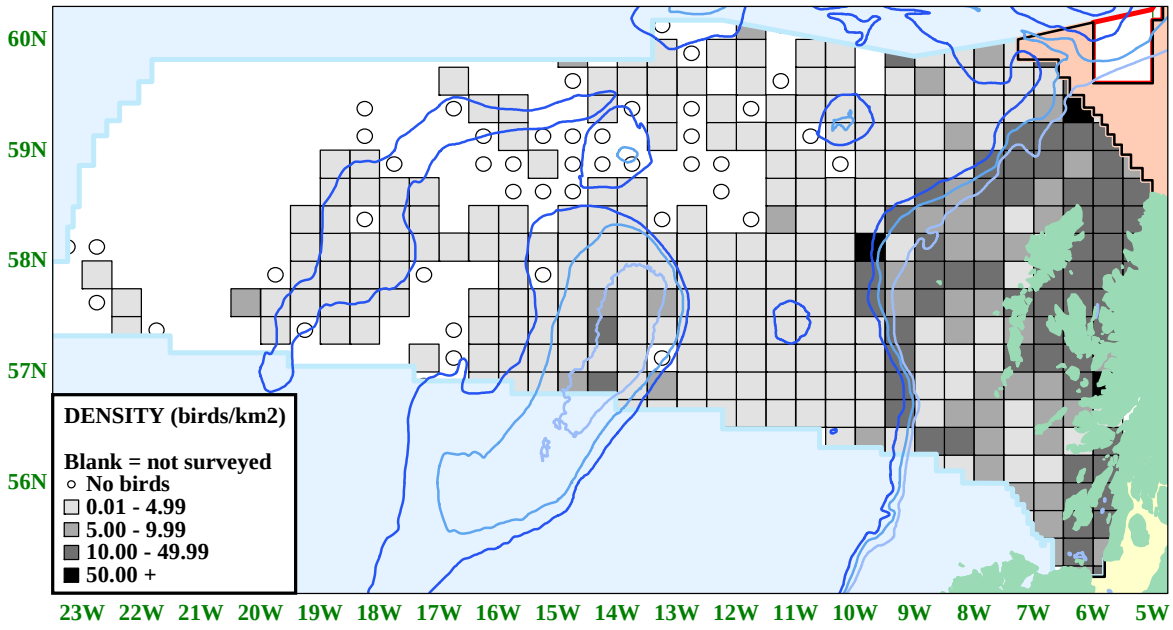
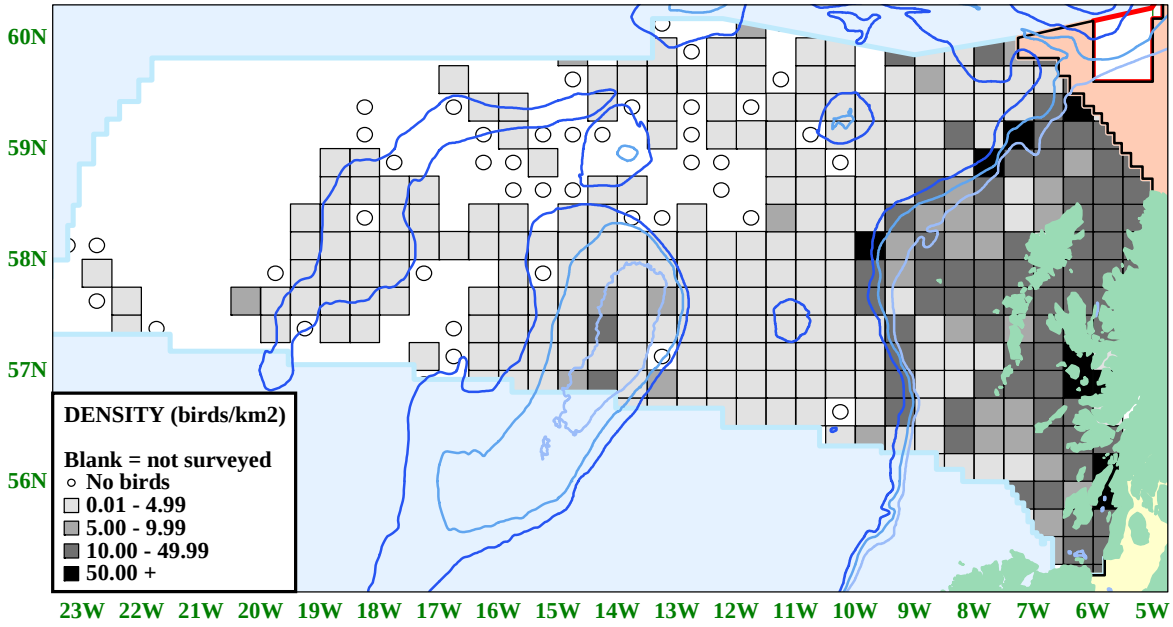


Figure 4.2 Total seabird density in SEA 7 area in summer – April to September



Seabirds generally occurred at low densities in offshore waters of the SEA 7 area in summer, with concentrations found along the shelf edge, north east Rockall Trough and over the Rockall Bank (Figure 4.2). During the winter months, lower densities of birds were found along the shelf break. Low densities were generally found in the deep waters to the west of the shelf break although coverage was limited at this time. Moderate densities were recorded close to the Anton Dohrn Seamount (Figure 4.3).

Figure 4.3 Total seabird density in SEA 7 area in winter – October to March

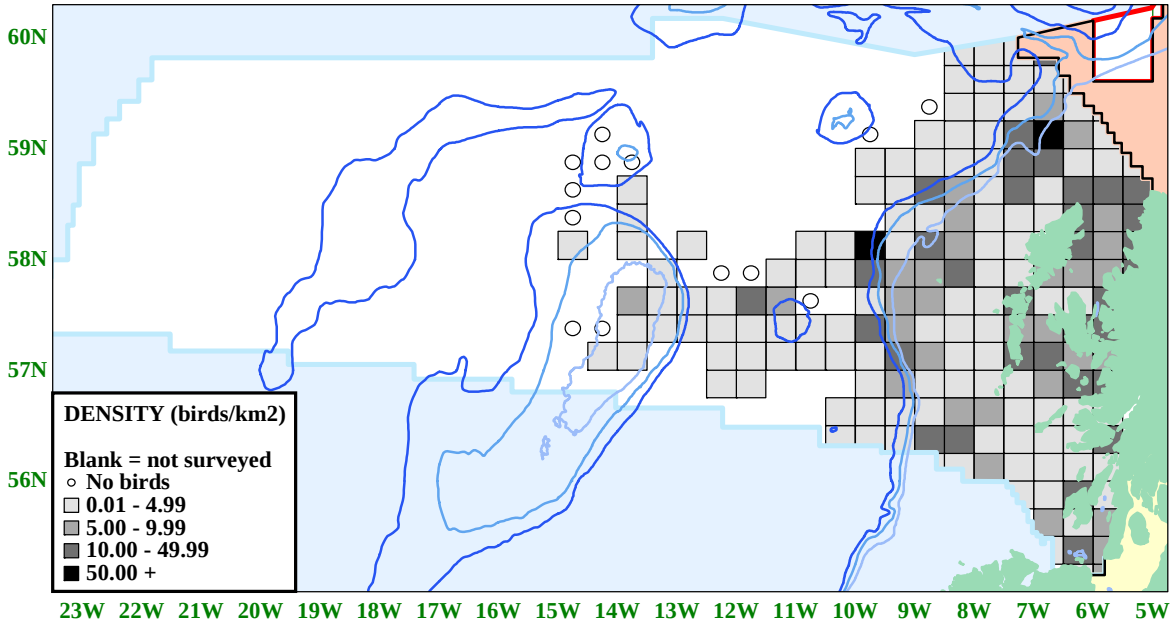
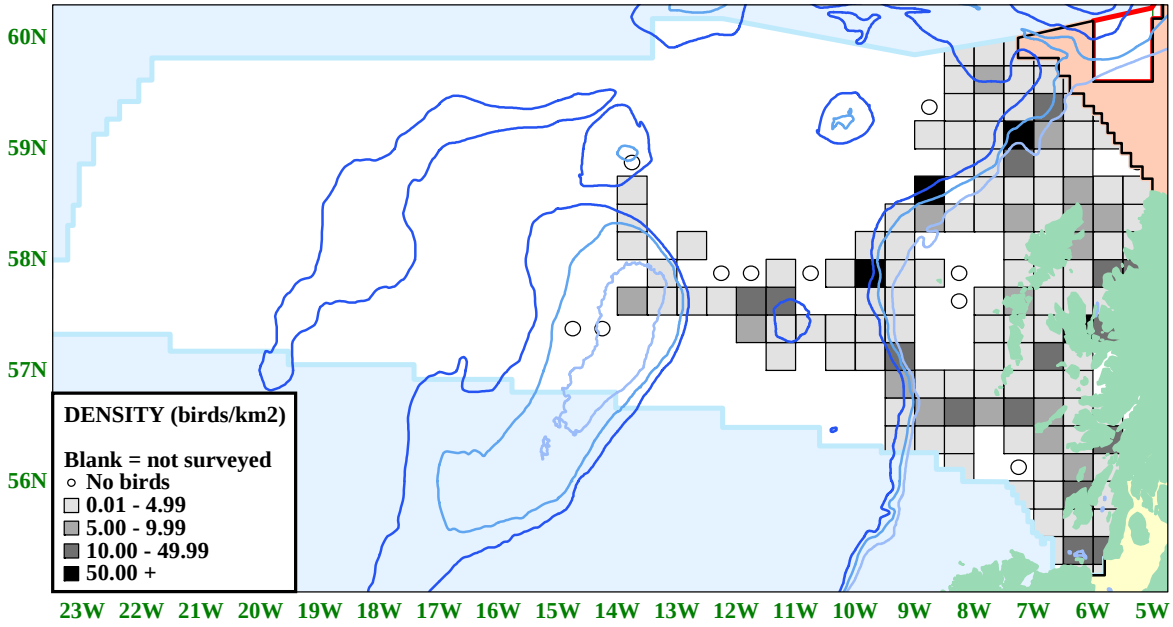


Figure 4.4 Total seabird density in SEA 7 area – January



In January, offshore high density areas were recorded along the shelf edge, around the Anton Dohrn Seamount and over the Rockall Bank (Figure 4.4). In February, offshore high density areas were found over the shelf edge (Figure 4.5).

Figure 4.5 Total seabird density in SEA 7 area – February

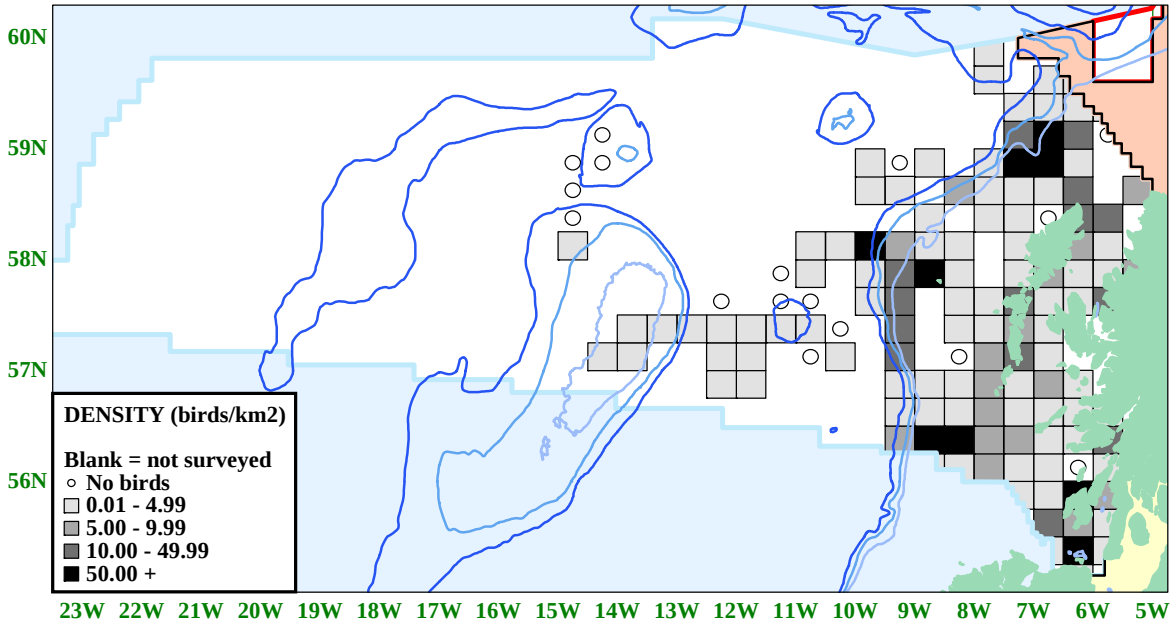
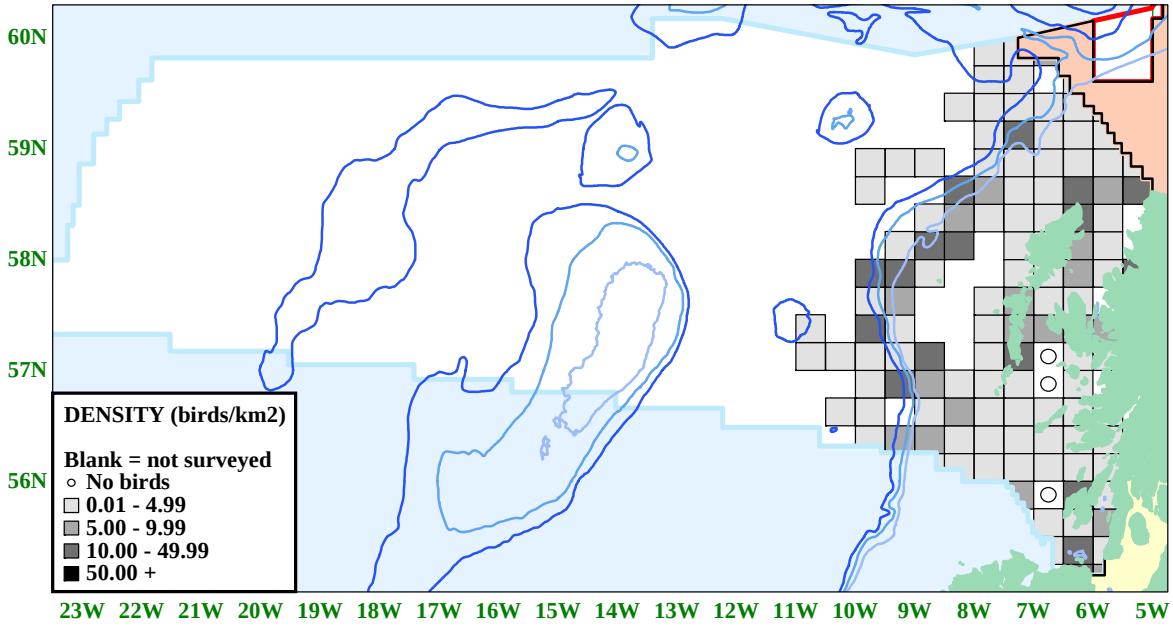


Figure 4.6 Total seabird density in SEA 7 area – March



In March, densities offshore were lower than February and were also concentrated over the shelf edge, although offshore coverage over the Rockall Trough and beyond was very limited (Figure 4.6). Densities increased again in April, and again were highest over the shelf edge (Figure 4.7).

Figure 4.7 Total seabird density in SEA 7 area – April

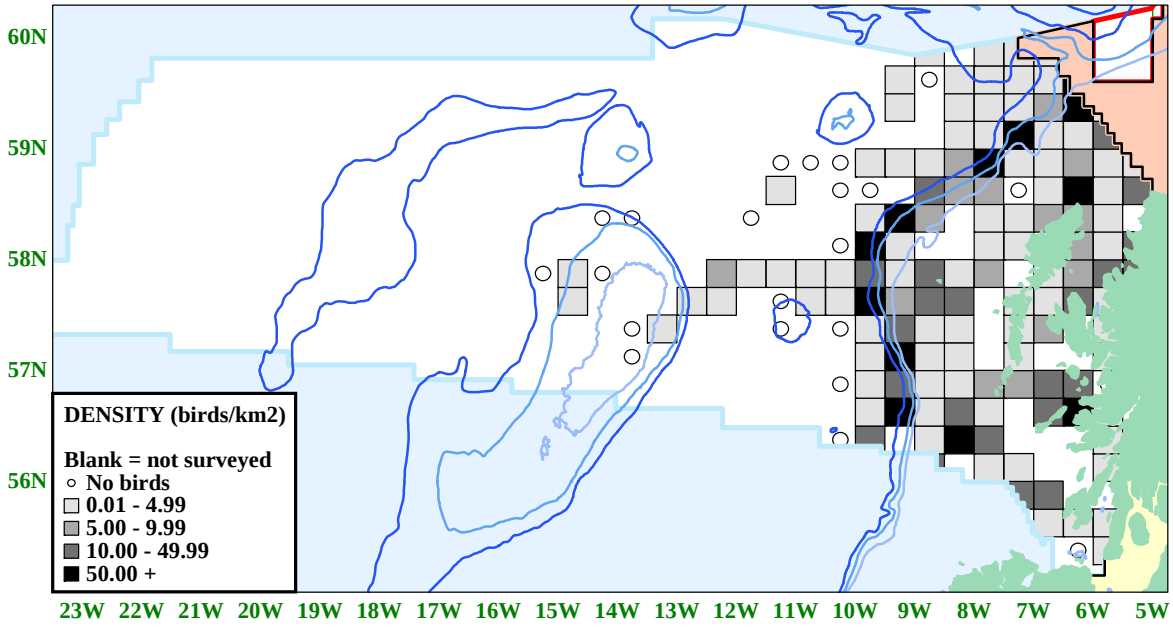
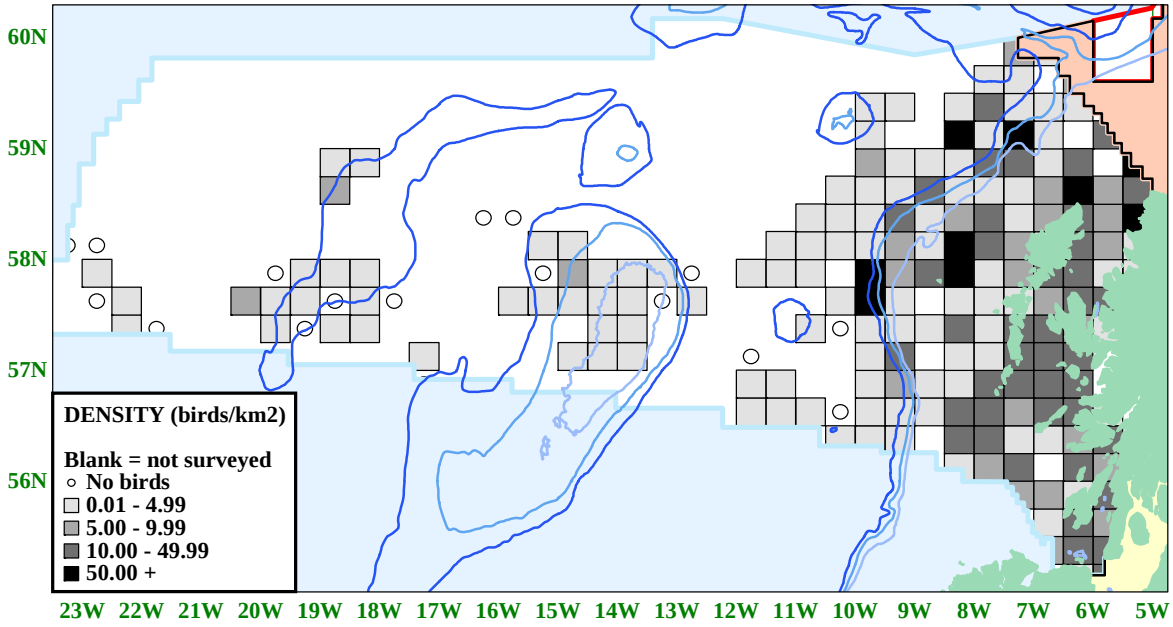


Figure 4.8 Total seabird density in SEA 7 area – May



Offshore coverage was greater in May and June, with highest densities of seabirds recorded over the shelf edge and to a lesser extent over the Rockall and Hatton Banks (Figures 4.8 and 4.9).

Figure 4.9 Total seabird density in SEA 7 area – June

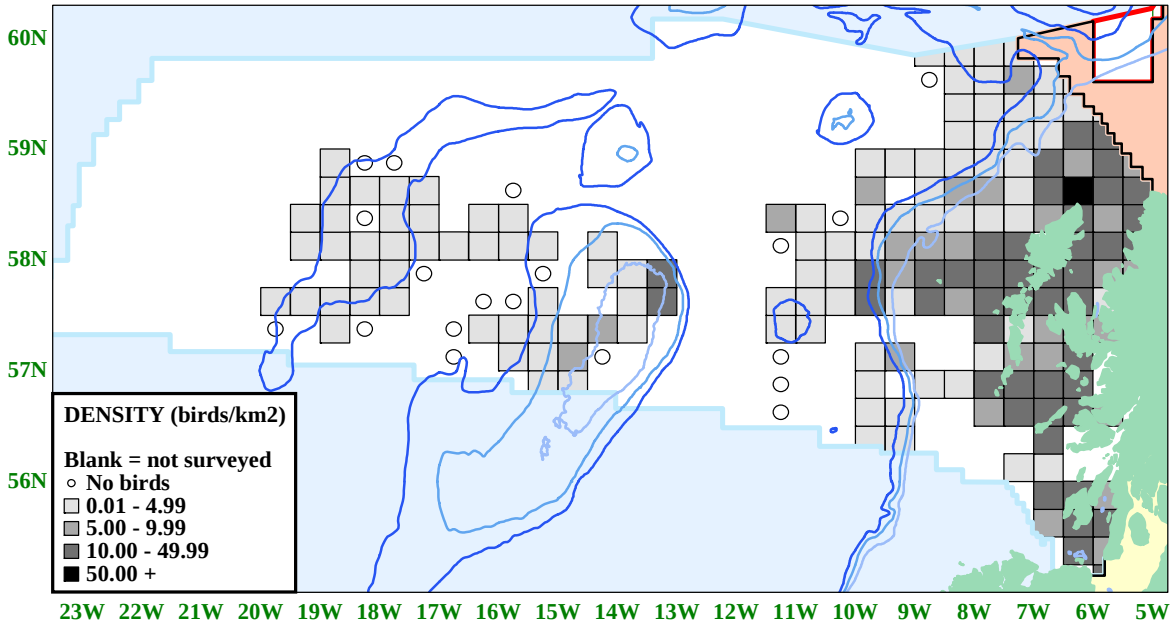
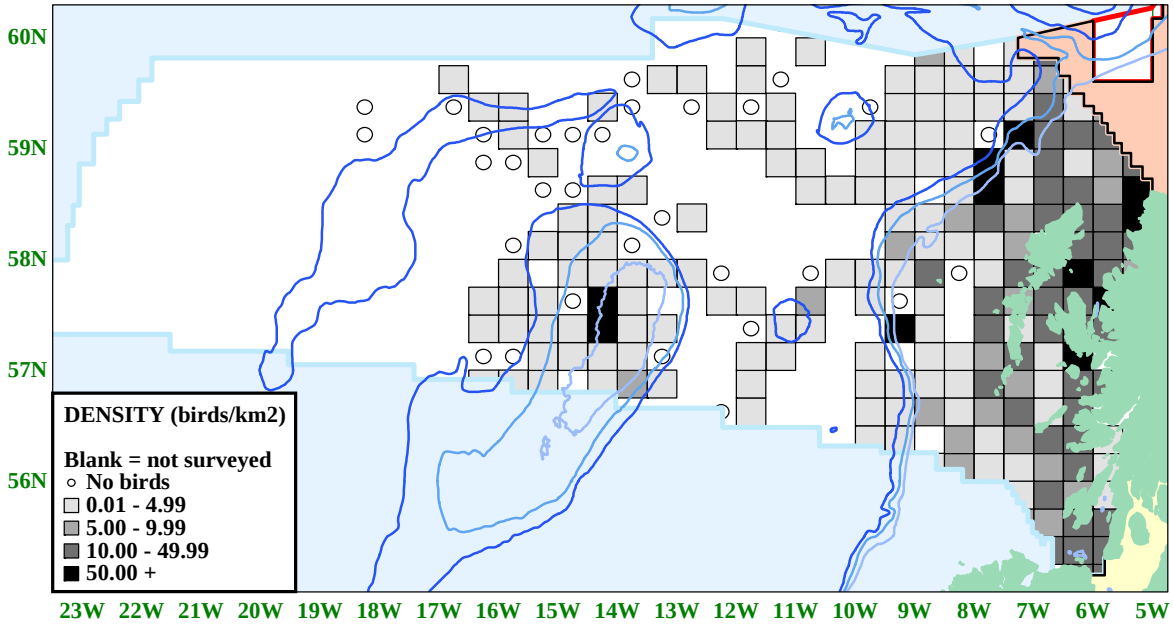


Figure 4.10 Total seabird density in SEA 7 area – July



In July, highest densities were recorded on the shelf edge to the north west of the Western Isles and over the Rockall Bank (Figure 4.10). A similar pattern was recorded in August, although lower densities were recorded (Figure 4.11).

Figure 4.11 Total seabird density in SEA 7 area – August

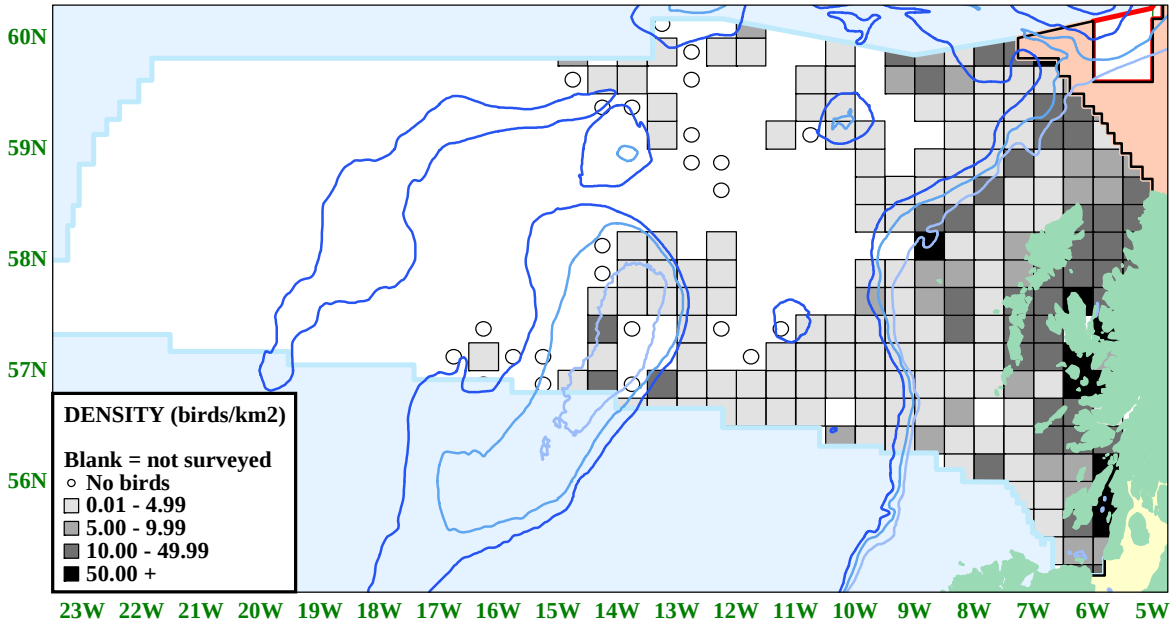
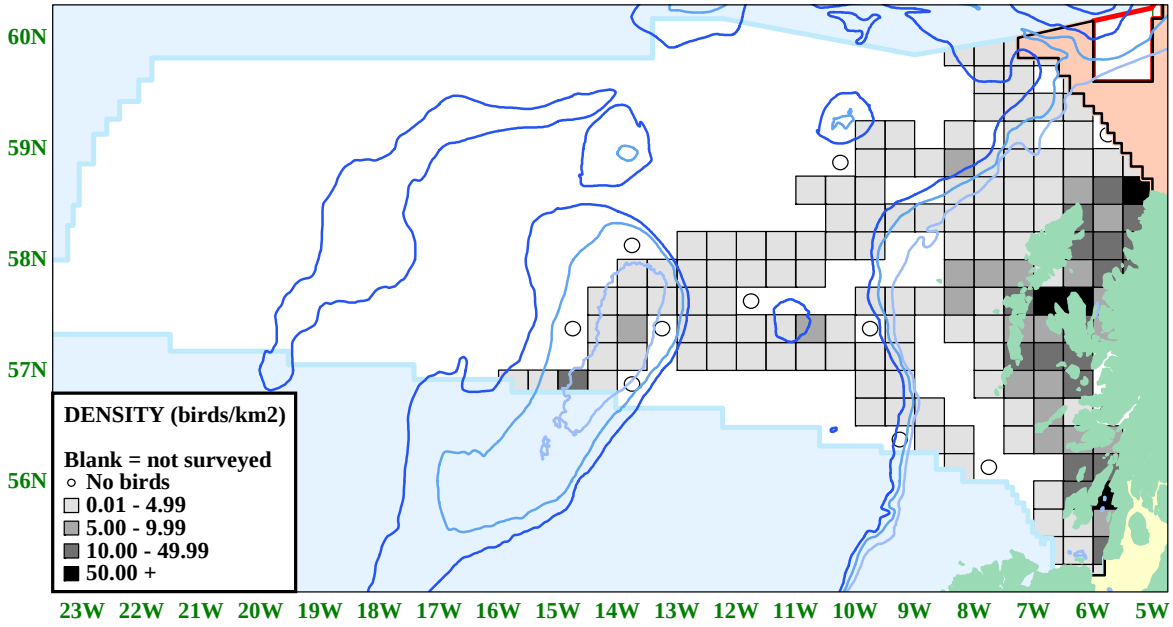


Figure 4.12 Total seabird density in SEA 7 area – September



In September, offshore densities were generally low, with moderate densities recorded occasionally on the shelf edge, around the Anton Dohrn Seamount and over the Rockall Bank (Figure 4.12). Offshore coverage in October was very limited, but again low densities were recorded along the shelf break (Figure 4.13).

Figure 4.13 Total seabird density in SEA 7 area – October

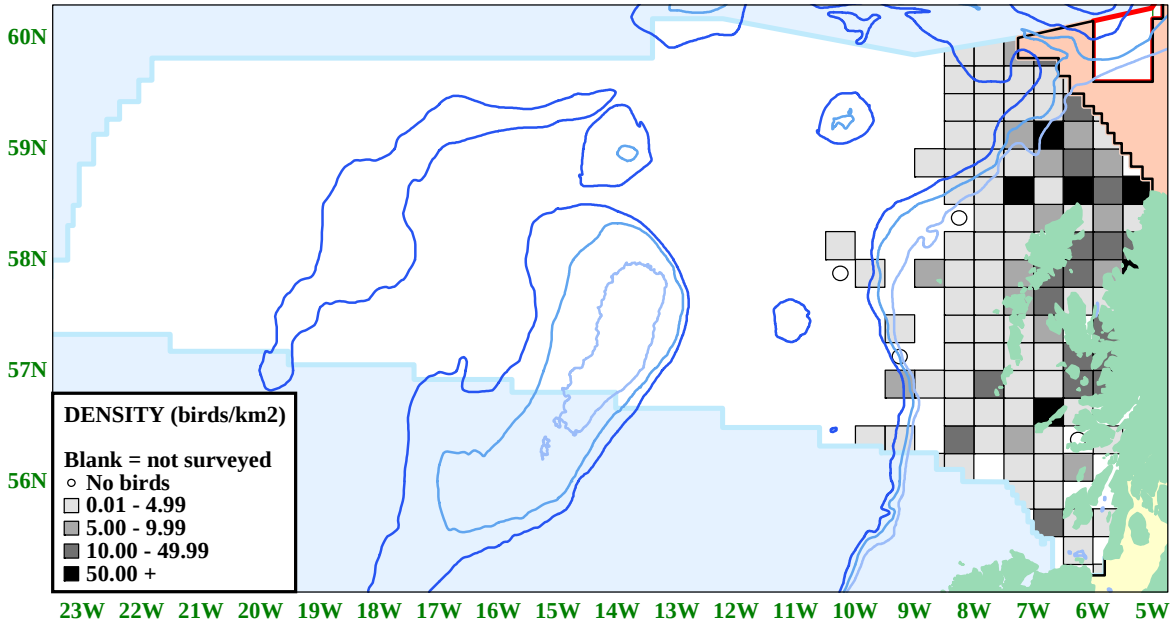
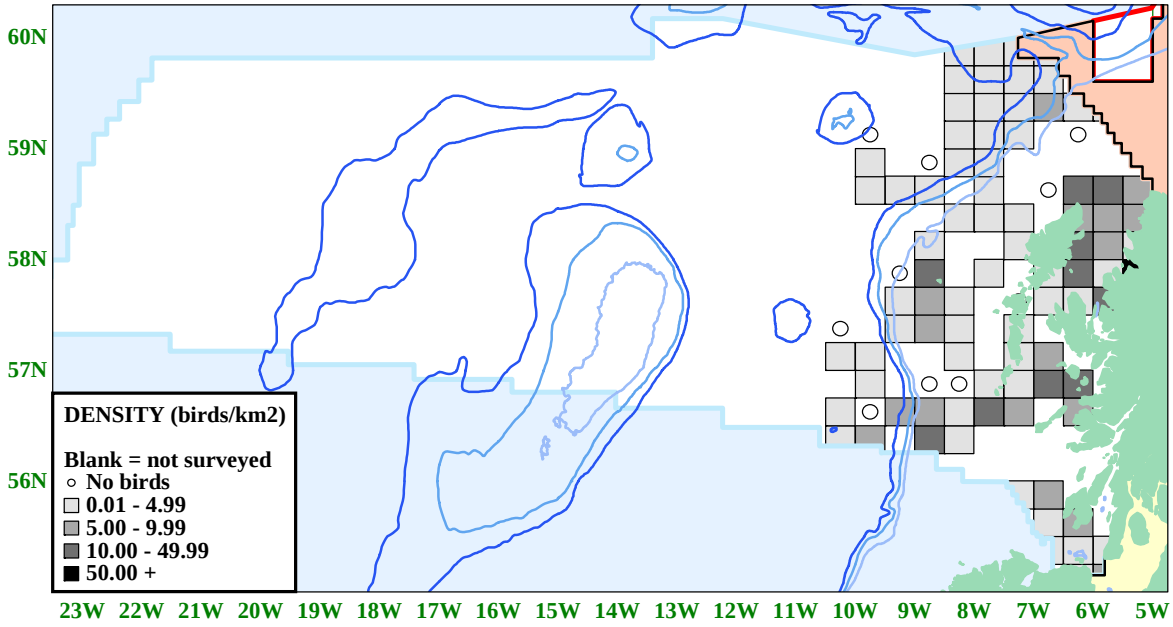
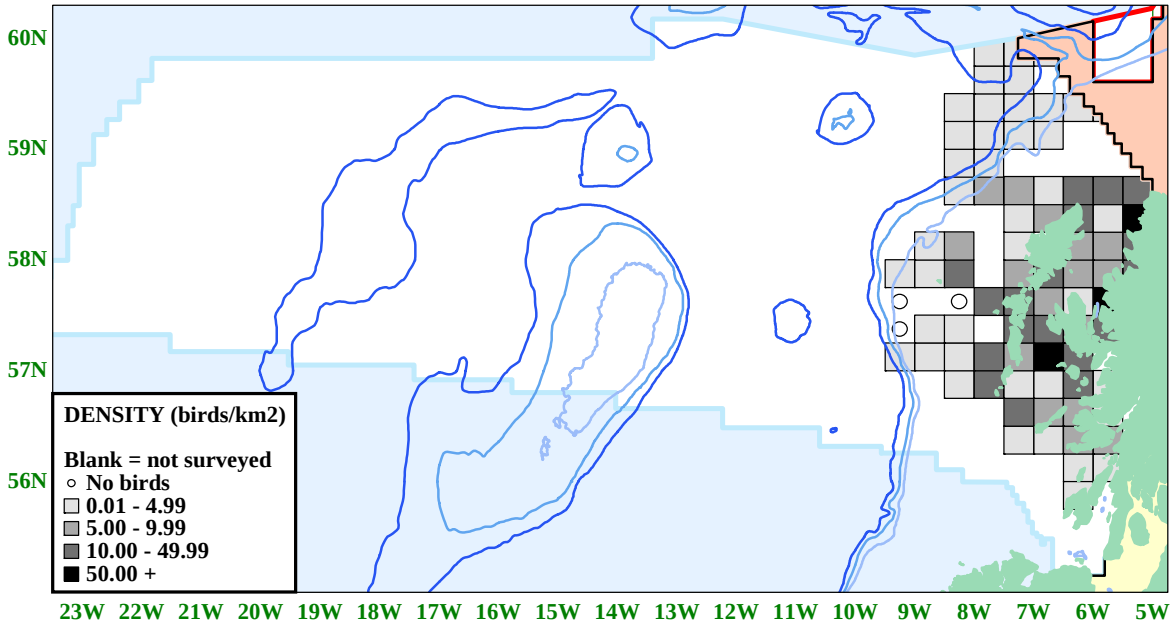


Figure 4.14 Total seabird density in SEA 7 area – November



Offshore coverage was very limited in November and December, however low densities were again recorded over the shelf edge (Figures 4.14 and 4.15).

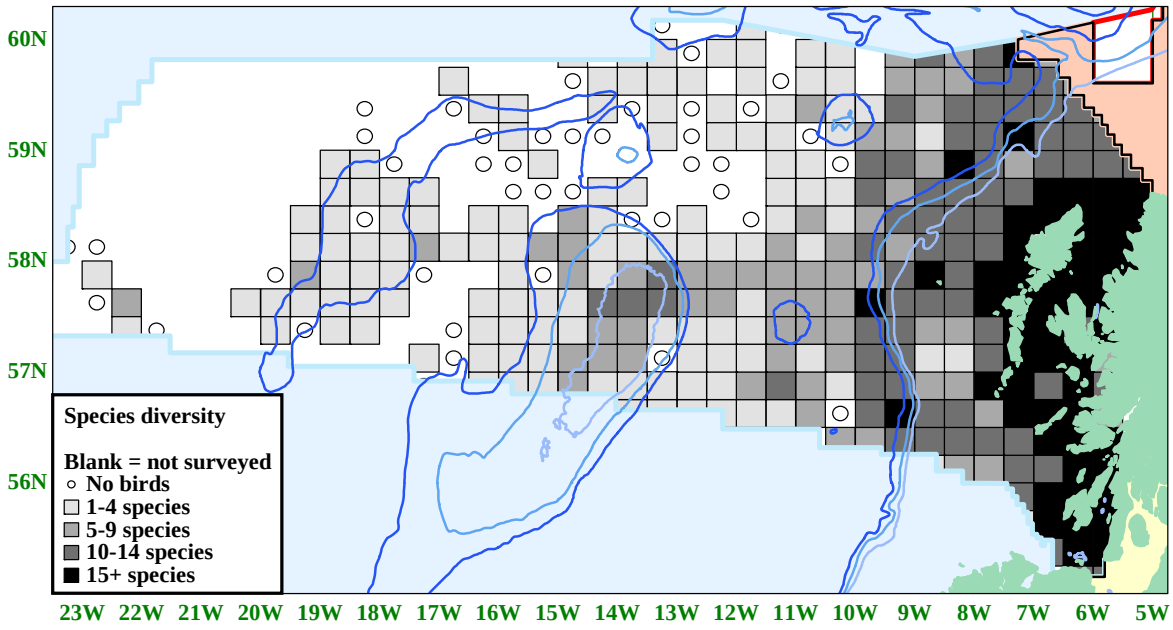
Figure 4.15 Total seabird density in SEA 7 area – December



4.1 Species diversity

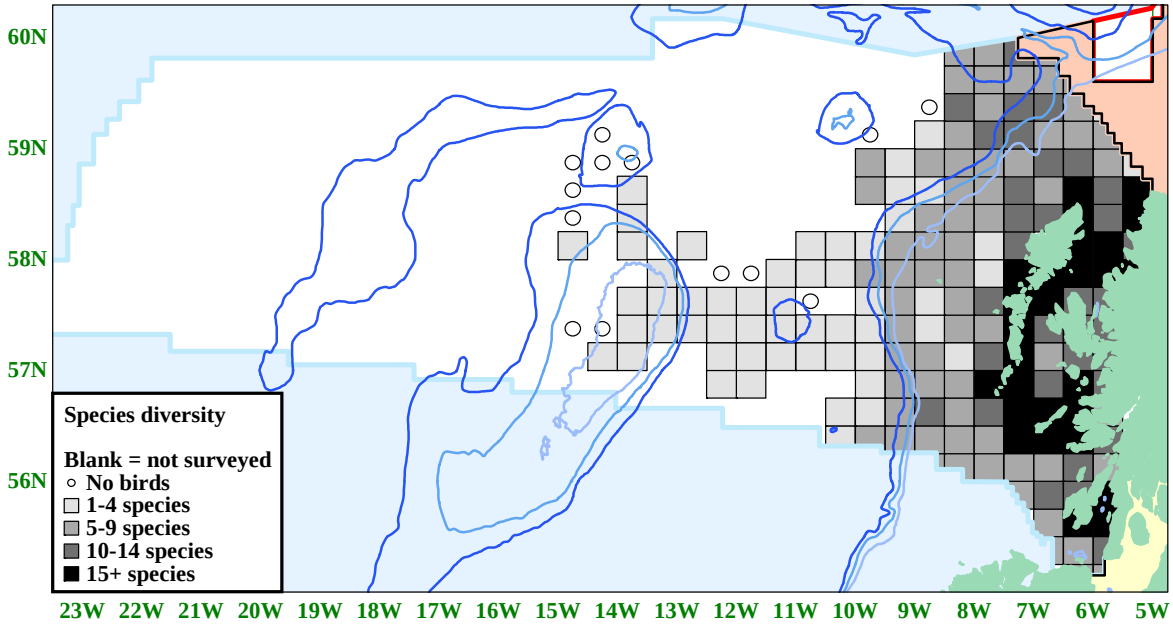
Overall species diversity in the summer months (April to September) and winter months (October to March) is shown in Figures 4.16 & 4.17. Generally, species diversity was highest in inshore shelf waters where over 15 species were recorded, with fewer species in offshore areas. In summer, more than 15 species were recorded in some areas of the shelf break, while the Rockall Bank and Rockall Trough held between 5 and 14 species. Less than 5 species were recorded in most other offshore areas. Species diversity was highest over the Rockall Bank in July and September, with Northern Fulmar, Northern Gannet and Black-legged Kittiwake being the most common species. Other species regularly recorded in these areas in summer included Great Shearwater, Manx Shearwater, Sooty Shearwater, Great Skua and Lesser Black-backed Gull.

Figure 4.16 Species diversity in SEA 7 area in summer (April to September)



Although survey coverage was not as extensive in the winter period, lowest species diversity was again recorded in offshore waters. Between 5 and 14 species were recorded in the north east Rockall Trough and along the shelf break between October and December (Figure 4.17). Less than 5 species were recorded in most other parts of the Rockall Trough and Rockall Bank, with Northern Fulmar, Northern Gannet and Black-legged Kittiwake being the most common species.

Figure 4.17 Species diversity in SEA 7 area in winter (October to March)



5. Vulnerability to surface pollution

5.1 Vulnerability maps

The following maps show vulnerability to surface pollution for all species, and have been compiled using data from ship-based and aerial survey data from the ESAS database (Figures 5.1 to 5.15). Although the primary focus of this report is on the offshore waters of the SEA 7 area, data from inshore areas was included in the analysis for comparison.

Seabird vulnerability in offshore areas of SEA 7 was generally low throughout the year (Figure 5.1). However there are important offshore seabird colonies e.g. St. Kilda, North Rona and Sula Sgeir in SEA 7, and waters around these colonies are very vulnerable to surface pollution and disturbance.

Figure 5.1 Average seabird vulnerability in SEA 7 area – all year

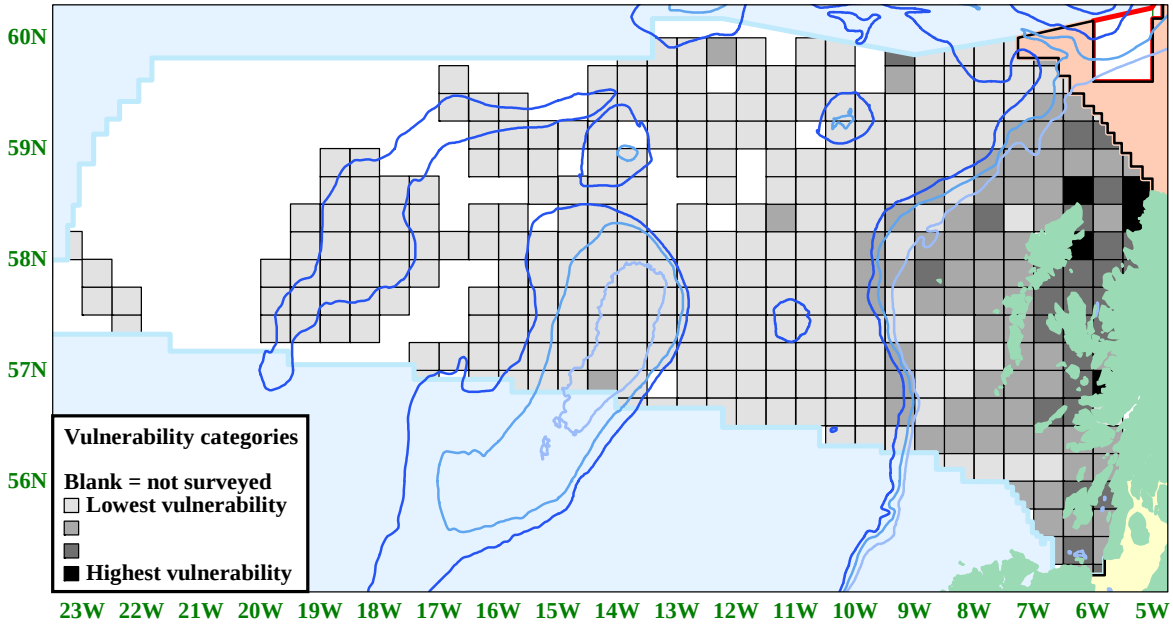
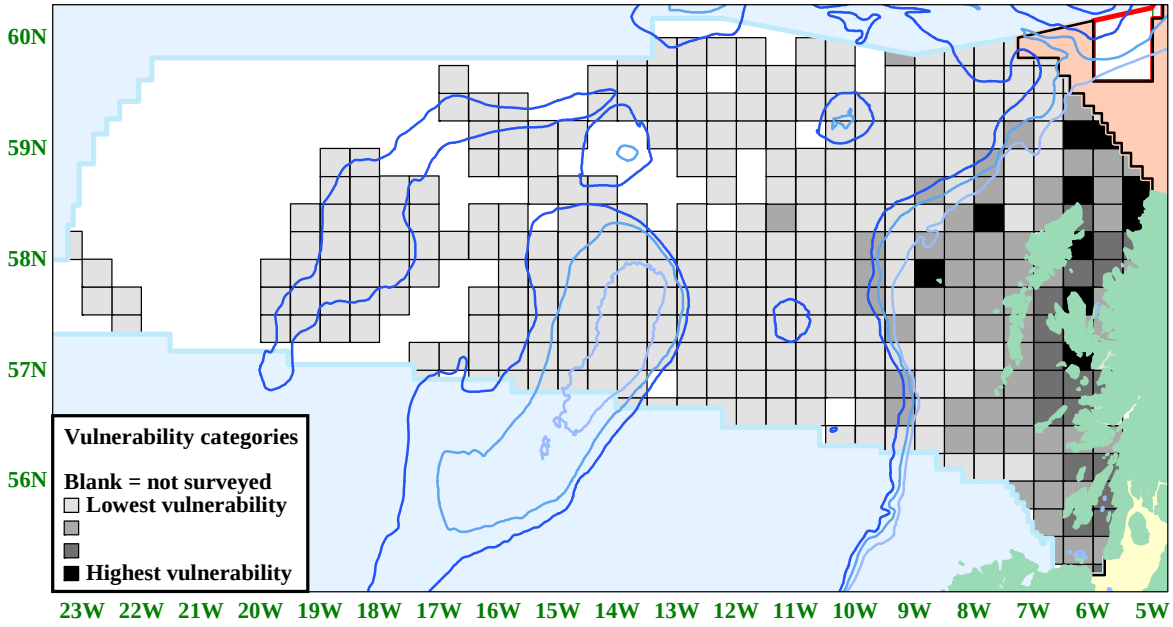
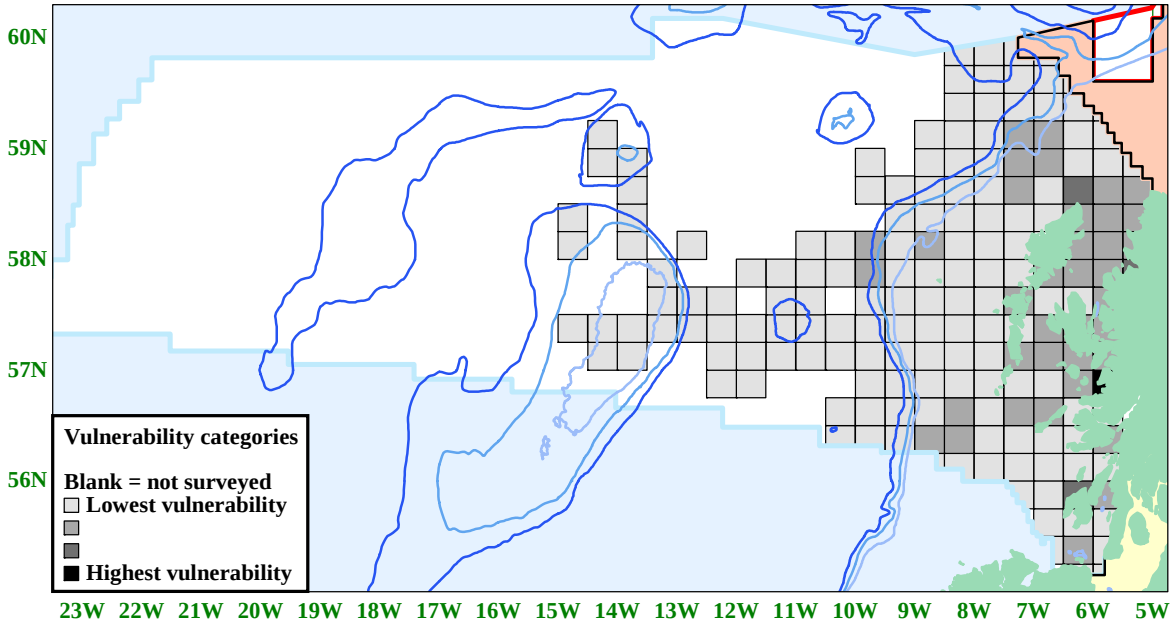


Figure 5.2 Average seabird vulnerability in SEA 7 area in summer – April to September



During the summer months, vulnerability was low in offshore waters, with some moderate areas of vulnerability along the shelf edge (Figure 5.2). Waters around the offshore colonies of St Kilda, North Rona and Sula Sgeir and in some inshore areas were highly vulnerable at this time. Survey coverage was limited in the winter months, particularly between October and December, but seabird vulnerability remained low in the offshore areas that were covered (Figure 5.3).

Figure 5.3 Average seabird vulnerability in SEA 7 area in winter – October to March



Seabird vulnerability to surface pollutants in the SEA 7 area by month are shown in Figures 5.4 to 5.15. Most offshore waters showed low monthly vulnerability, with moderate areas along the shelf break in April and around the offshore colonies of St Kilda, North Rona and Sula Sgeir during the summer months.

Figure 5.4 Seabird vulnerability in SEA 7 area - January

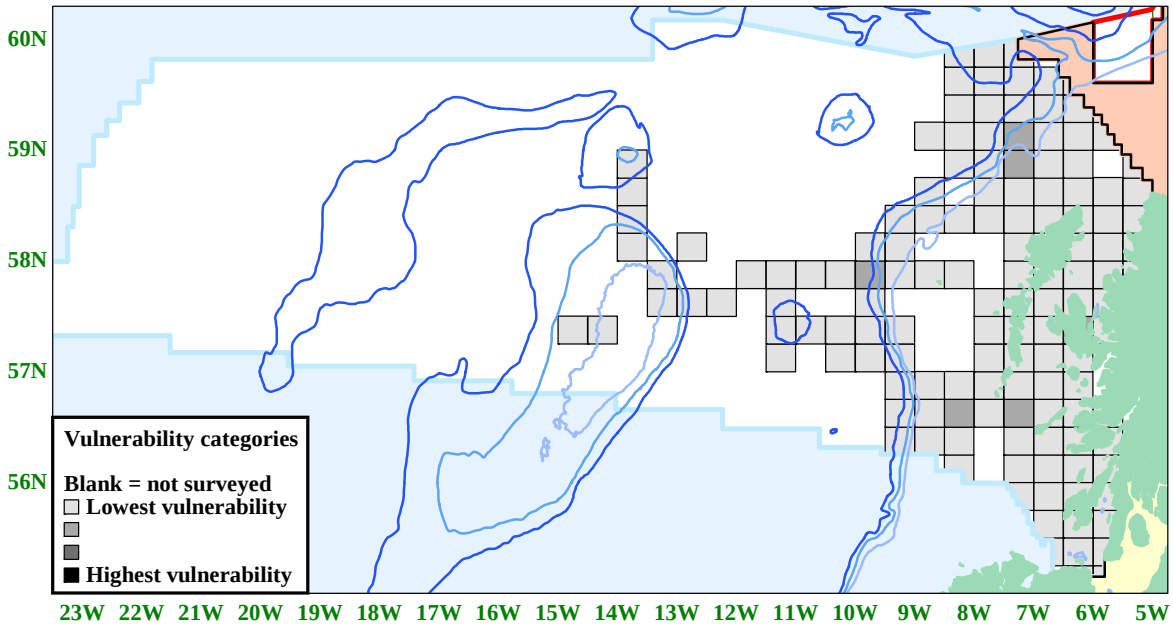


Figure 5.5 Seabird vulnerability in SEA 7 area - February

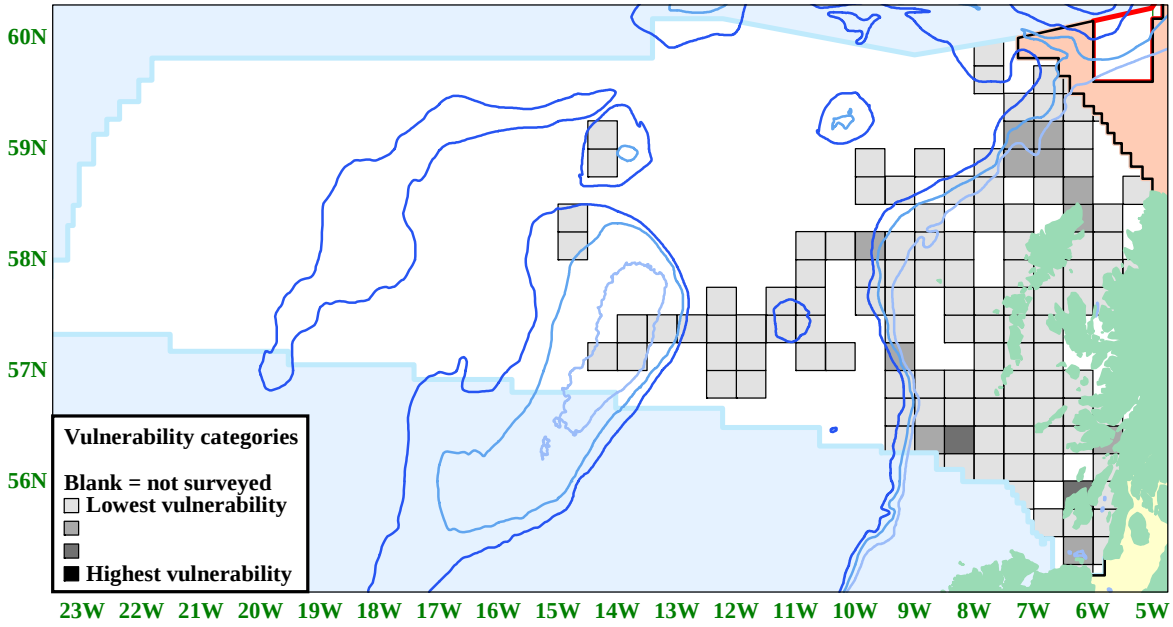


Figure 5.6 Seabird vulnerability in SEA 7 area - March

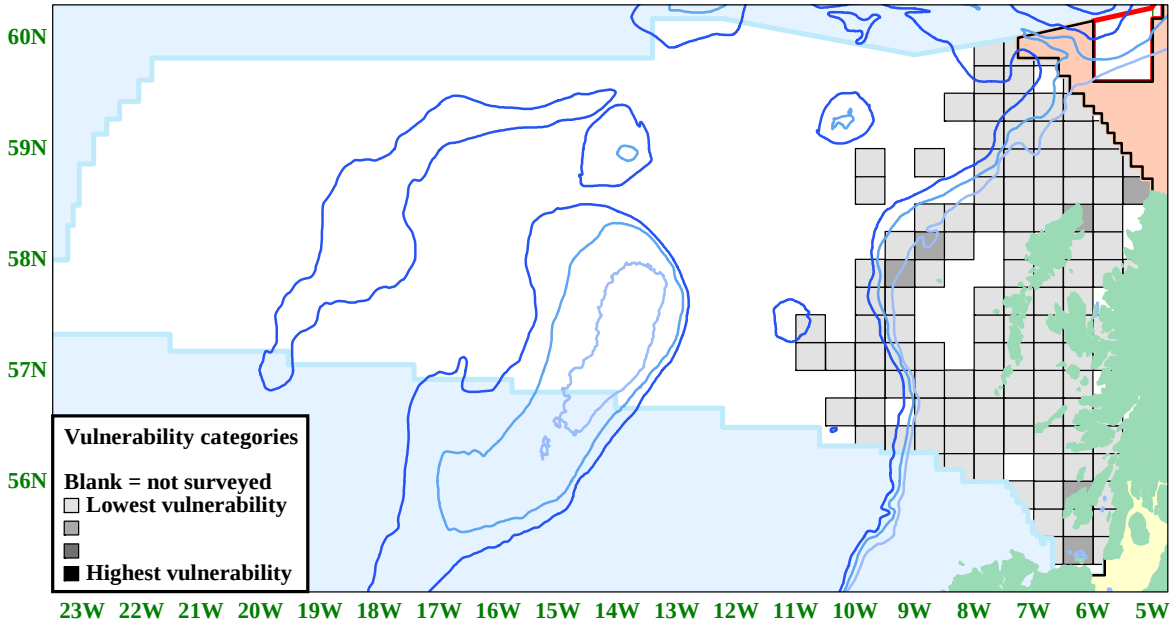


Figure 5.7 Seabird vulnerability in SEA 7 area - April

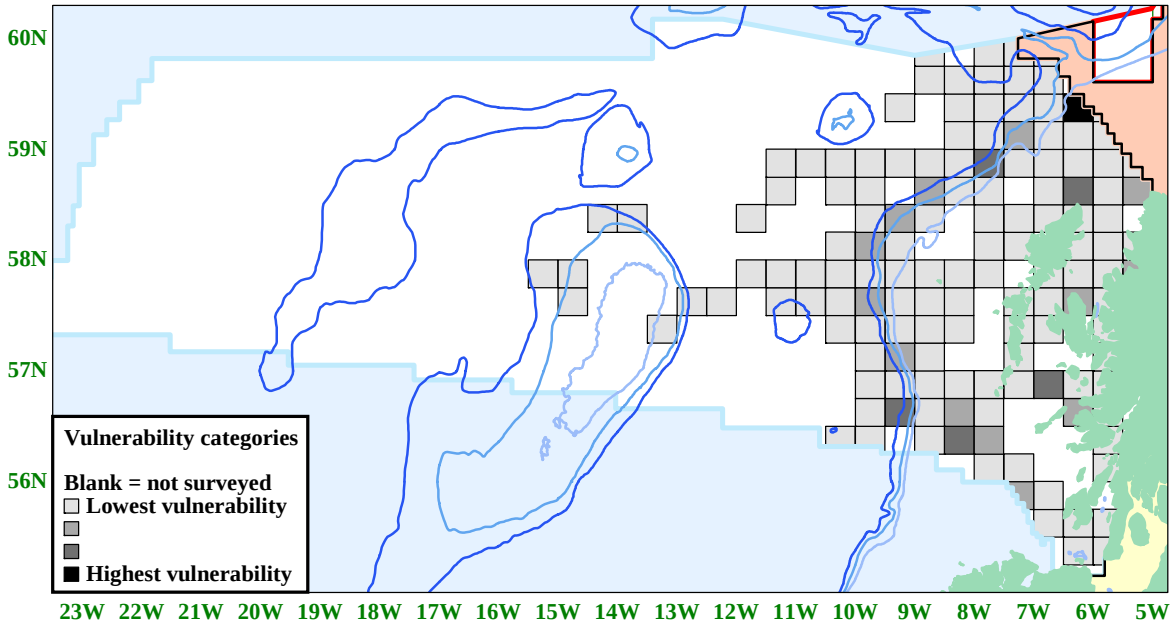


Figure 5.8 Seabird vulnerability in SEA 7 area - May

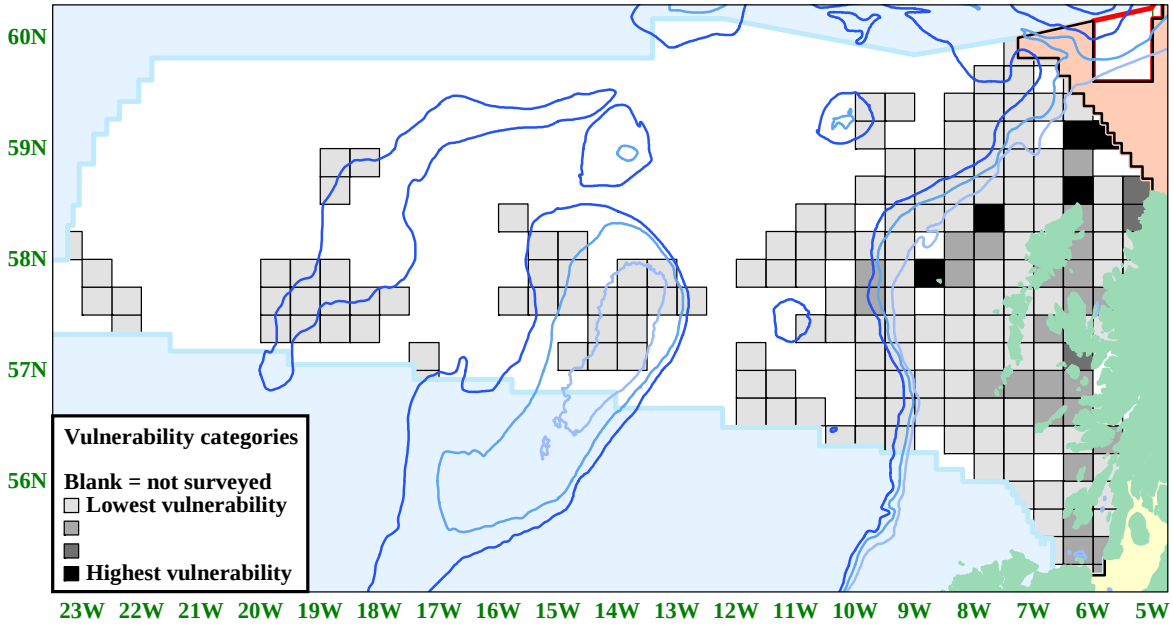


Figure 5.9 Seabird vulnerability in SEA 7 area - June

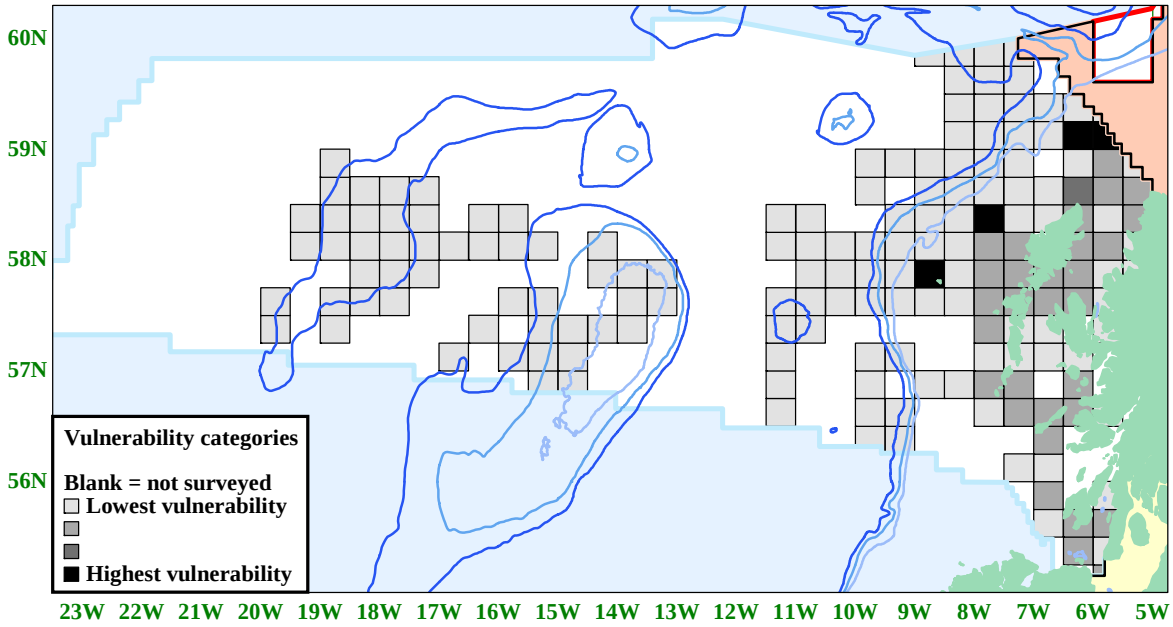


Figure 5.10 Seabird vulnerability in SEA 7 area - July

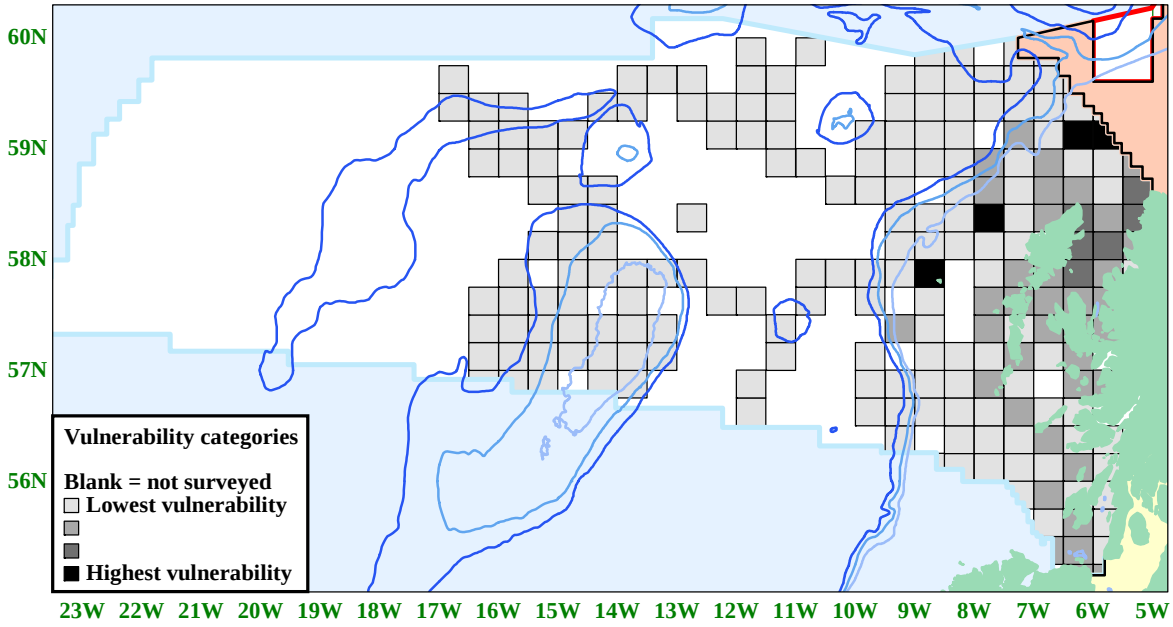


Figure 5.11 Seabird vulnerability in SEA 7 area - August

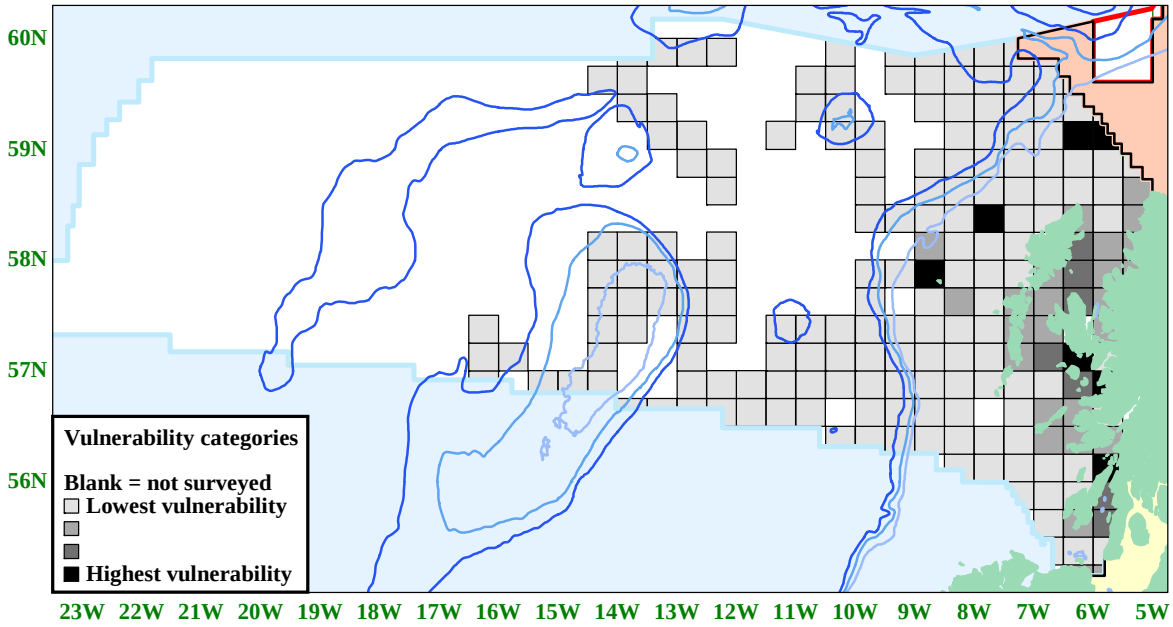


Figure 5.12 Seabird vulnerability in SEA 7 area - September

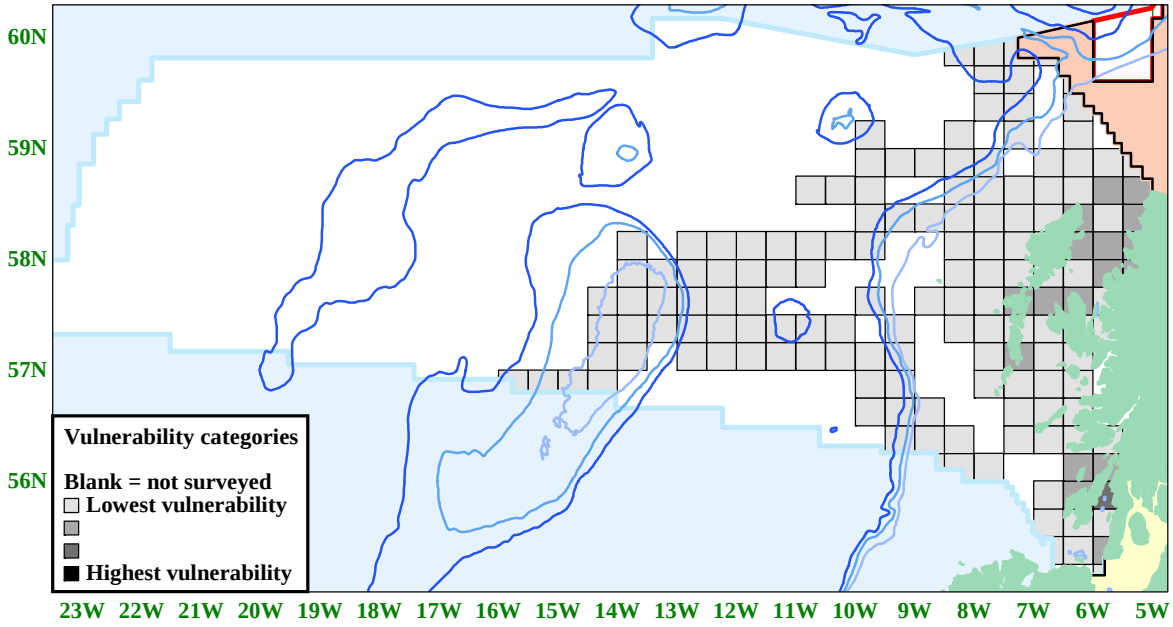


Figure 5.13 Seabird vulnerability in SEA 7 area - October

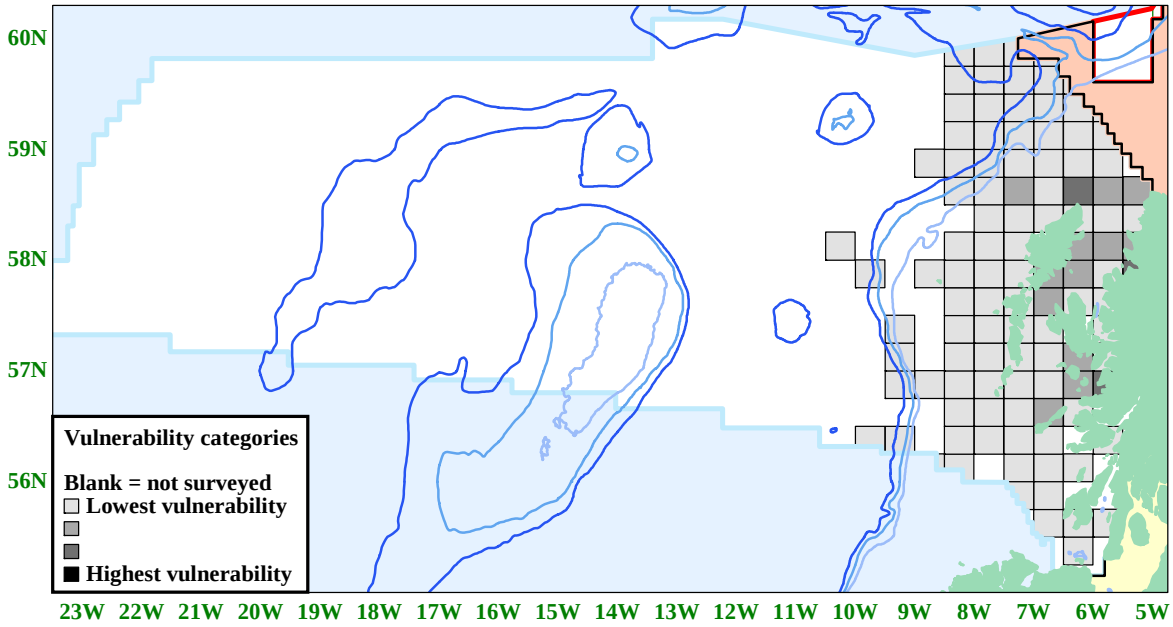


Figure 5.14 Seabird vulnerability in SEA 7 area - November

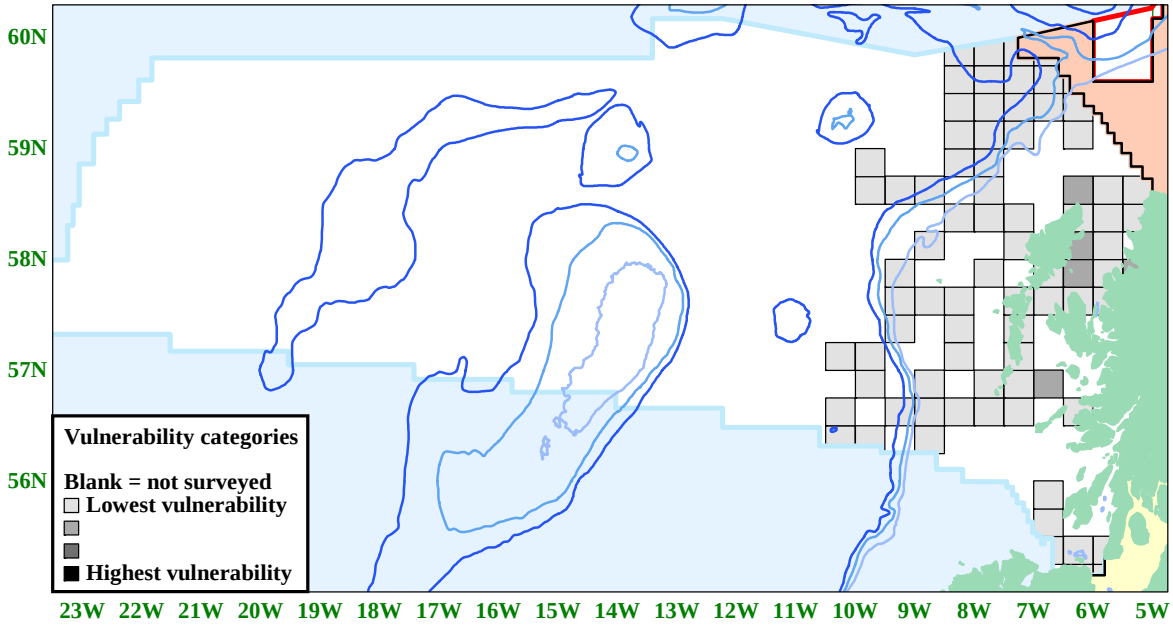
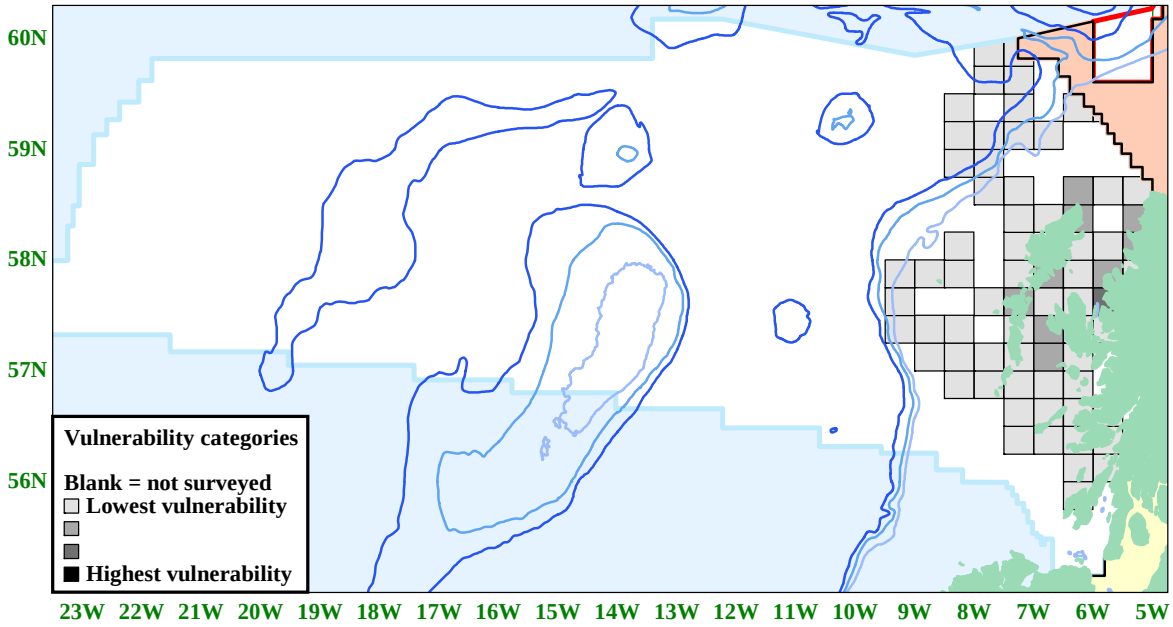


Figure 5.15 Seabird vulnerability in SEA 7 area - December



5.2 Offshore seabird colonies in the SEA 7 area

St Kilda

St Kilda is a group of remote Scottish islands lying in the North Atlantic about 70 km west of North Uist in the Outer Hebrides. The St Kilda group consists of the largest island of Hirta, nearby Dun and Soay, and Boreray with its flanking pinnacles of Stac Lee and Stac an Armin together with some smaller rocky islets. The islands are steep, with precipitous cliffs reaching 430 m on Hirta and 380 m on Soay and Boreray.

The total seabird breeding population on St Kilda is one of the largest concentrations in the North Atlantic and the largest in the UK, with 16 species of breeding seabirds (Table 5.1). St Kilda is designated as an SPA because of the nationally and internationally important numbers of Leach's Storm-petrel, European Storm-petrel, Northern Gannet, Great Skua and Atlantic Puffin that breed there. St Kilda also qualifies as an SPA as it is an internationally important assemblage of breeding seabirds (JNCC 2001).

In addition, St Kilsa was designated as a marine Special Area of Conservation (SAC) in March 2005, for the reefs and submerged or partially submerged sea caves habitats, which are listed on Annex I of the EU Habitats Directive. The vegetated sea cliffs are a qualifying terrestrial interest of the SAC. The islands are also designated as a Biosphere Reserve, a National Nature Reserve, a SSSI, and a World Heritage Site (SNH 2006).

Table 5.1 Numbers of breeding seabirds on St Kilda as a percentage of the Britain & Ireland population

Species	St Kilda population	Percentage of Britain & Ireland total population
Northern Fulmar	68,448 AOS [1]	12.7 %
Manx Shearwater	4,803+ AOS [1]	1.4 %
European Storm-petrel	1,121+ AOS [1]	1.4 %
Leach's Storm-petrel	45,433 AOS [1]	94.0 %
Northern Gannet	59,622 AOS [2]	22.9 %
European Shag	19 AON [3]	< 0.1 %
Arctic Skua	1 AOT [3]	< 0.1 %
Great Skua	240 AOT [1]	2.5 %
Common Gull	1 AON [3]	< 0.1 %
Lesser black-backed Gull	16 AON [3]	< 0.1 %
Herring Gull	29 AOT [3]	0.1 %
Great black-backed Gull	25 AOT [3]	0.1 %
Black-legged Kittiwake	3,886 AON [3]	0.9 %
Common Guillemot	23,393 Individuals [3]	1.5 %
Razorbill	2,521 Individuals [3]	1.2 %
Atlantic Puffin	142,264 AOB [1]	23.7 %

1 Mitchell *et al* 2004 2 Wanless *et al* 2005 3 JNCC, Seabird 2000 database

Flannan Isles

The Flannan Isles are a group of six rocky islands, with outlying skerries, which lie about 30 km west of Lewis, off the north-west coast of Scotland. The vegetation of the islands is predominantly maritime grassland. The Flannan Isles have been designated as an SPA because of the internationally important assemblage of breeding seabirds there, including Northern Fulmar, Leach's Storm-petrel, Black-legged Kittiwake, Common Guillemot, Razorbill and Atlantic Puffin (Table 5.2). Breeding numbers of Leach's Storm-petrel are internationally important (JNCC 2001).

The islands are also designated as an Important Bird Area (IBA), and a Site of Special Scientific Iinterest (SSSI) (Birdlife International 2005).

Table 5.2 Numbers of breeding seabirds on the Flannan Isles as a percentage of the Britain & Ireland population

Species	Flannan Isles population	Percentage of Britain & Ireland total population
Northern Fulmar	7,735 AOS [3]	1.4 %
European Storm-petrel	7 AOS [3]	< 0.1 %
Leach's Storm-petrel	1,425 AOS [1]	2.9 %
Northern Gannet	2,760 AOS [2]	1.1 %
European Shag	77 AON [3]	0.2 %
Great Skua	1 AON [3]	< 0.1 %
Lesser black-backed Gull	9 AOT [3]	< 0.1 %
Herring Gull	20 AOT [3]	< 0.1 %
Great black-backed Gull	55 AOT [3]	0.3 %
Black-legged Kittiwake	1,392 [3]	0.3 %
Common Guillemot	14,638 Individuals [1]	0.9 %
Razorbill	1,569 Individuals [1]	0.7 %
Atlantic Puffin	15,761 AOB [1]	2.6 %

1 Mitchell *et al* 2004 2 Wanless *et al* 2005 3 JNCC, Seabird 2000 database

Sula Sgeir and North Rona

North Rona and Sula Sgeir lie off the north-west coast of Scotland, about 65 km north east of Lewis in the Outer Hebrides. Sula Sgeir is about 15 km west of the far larger North Rona, and both islands have been designated as a single SPA because of the nationally and internationally important numbers of Leach's Storm-petrel, European Storm-petrel, Northern Gannet and Common Guillemot that breed there. North Rona and Sula Sgeir also qualify as an SPA as they hold an internationally important assemblage of breeding seabirds, with 15 species of breeding seabirds (Table 5.3) (JNCC 2001).

The islands are also designated as a National Nature Reserve (NNR), and a Site of Special Scientific Iinterest (SSSI) (Birdlife International 2005).

Table 5.3 Numbers of breeding seabirds on North Rona and Sula Sgeir as a percentage of the Britain & Ireland population

Species	North Rona population	Sula Sgeir population	Combined population	Percentage of Britain & Ireland total population
Northern Fulmar	3,520 AOS [1]	3,916 AOS [2]	3,520+ AOS [1]	0.7 %
European Storm-petrel	368 AOS [1]	9 AOS [1]	377 AOS [1]	0.4 %
Leach's Storm-petrel	1,132 AOS [1]	5 AOS [1]	1,137 AOS [1]	2.4 %
Northern Gannet	-	9,225 AOS [3]	9,225 AOS [3]	3.5 %
European Shag	156 AON [4]	54 AON [4]	210 AON [4]	0.7 %
Great Skua	19 AOT [4]	-	19 AOT [4]	0.2 %
Lesser black-backed Gull	3 AON [4]	-	3 AON [4]	< 0.1 %
Herring Gull	40 AON [4]	8 AON [4]	48 AON [4]	0.2 %
Great black-backed Gull	983 AOT [1]	-	983 AOT [1]	5.0 %
Black-legged Kittiwake	3,398 AON [4]	1,206 AON [4]	4,604 AON [4]	1.1 %
Arctic Tern	9 AON [4]	-	9 AON [4]	< 0.1 %
Common Guillemot	10,497 Individuals [1]	20,877 Individuals [4]	31,374 Individuals [4]	2.0 %
Razorbill	824 Individuals [4]	801 Individuals [4]	1,625 Individuals [4]	0.8 %
Black Guillemot	13 Individuals [4]	-	13 Individuals [4]	< 0.1 %
Atlantic Puffin	5,265 AOB [1]	177 AOB [4]	5,442 AOB [4]	0.9 %

1 Mitchell *et al* 2004 2 Not counted for Seabird 2000 - Figure from SCR census (1985-88) 3 Wanless *et al* 2005
4 JNCC, Seabird 2000 database

6. Potential for offshore SPAs in SEA 7

The EU Birds Directive (79/409/EEC) provides for protection, management and control of naturally occurring wild birds within the European Union through a range of mechanisms. One of the key provisions is the establishment of an internationally co-ordinated network of protected areas. Member States are required to identify and classify the most suitable areas in size and number for rare and vulnerable species listed on Annex I of the Directive. In addition, provision must also be made for regularly occurring migratory species, regarding their breeding, moulting and wintering areas as well as staging posts along their migration routes. Designated sites are known as special protection areas (SPAs).

Table 6.1 shows the status of offshore species considered in this report, in relation to the EU Birds Directive.

Table 6.1 EU Birds Directive status of offshore species in the SEA 7 area considered in this report

Species	Birds Directive status
Northern Fulmar	Migrant
Great Shearwater	Migrant
Manx Shearwater	Migrant
Sooty Shearwater	Migrant
European Storm-petrel	Annex I
Leach's Storm-petrel	Annex I
Northern Gannet	Migrant
Pomarine Skua	Migrant
Arctic Skua	Migrant
Long-tailed Skua	Migrant
Great Skua	Migrant
Lesser black-backed Gull	Migrant
Great black-backed Gull	Migrant
Black-legged Kittiwake	Migrant
Arctic Tern	Annex I
Little Auk	Migrant
Atlantic Puffin	Migrant

Note: Migrant = regularly occurring migratory species (Article 4.2, Birds Directive)

Annex I = listed on Annex I of Birds Directive

Three Annex I species, European Storm-petrel, Leach's Storm-petrel and Arctic Tern are found in the offshore waters of SEA7. Almost all the Britain and Ireland breeding population of Leach's Storm-petrels and up to half of the Britain and Ireland breeding population of European Storm-petrels breed in SEA 7 waters. Important feeding areas for these two species need to be considered for SPA status.

Studies examining seaward extensions of existing breeding seabird colony SPAs recommended that the marine SPA boundary around colonies be increased by two km for Northern Gannet, and 1 km for Common Guillemot, Razorbill and Atlantic Puffin. This extension should apply to all colonies where 1 or more of these species is included in the breeding seabird assemblage (McSorley *et al* 2003). This would include offshore seabird colonies in the SEA 7 area, such as St Kilda, Flannan Isles, North Rona and Sula Sgeir (see Section 5.2). Such seaward extensions would not include feeding areas for European Storm-petrel and Leach's Storm-petrel, which feed further offshore. Both these species require protection based on their breeding numbers in the SEA 7 area, and their Annex I status.

Some preliminary analyses to assess the suitability of using ESAS data to determine marine feeding areas by spatial analysis have been conducted (Johnston *et al* 2002). The analyses used different criteria to define inshore and offshore species than were used for this review, resulting in a slightly different suite of species being considered. This review considered species regularly occurring in waters greater than 200 m deep, whereas Johnston *et al* (2002) considered offshore species those where "50 % of ESAS database records occurred at greater than 15 km from the coast".

Species considered to be offshore by Johnston *et al* (2002) and not covered here were Herring Gull, Common Tern, Common Guillemot and Razorbill. These species were covered in the Inshore Review of SEA 6, 7 and 8 (Barton & Pollock 2005, Barton & Pollock 2006).

Three offshore species considered in this report (Great Shearwater, Pomarine Skua and Long-tailed Skua) were not considered for spatial analysis by Johnston *et al* (2002) as there were less than 400 records of each in the ESAS database.

Species with more than 400 records in the ESAS database were considered suitable for spatial analysis, although no further work has been conducted yet. It is anticipated that the marine SPA work addressing offshore SPAs for feeding and other aggregations of birds will commence very soon, and is scheduled to take two years (Jim Reid, *pers comm.*).

The major difficulty with selecting potential offshore Special Protection Areas in the SEA 7 area is that offshore waters generally support low densities of seabirds, and that the existing ESAS data does not show any obvious hotspots. Seabirds are very mobile, moving from one food source to another, often a considerable distance away, and therefore are not tied to one area.

Combining all ESAS seabird density data for all months showed that the shelf edge and the Rockall Bank were the areas where highest seabird densities were likely to be encountered, with generally low densities elsewhere in offshore areas. Other studies also highlighted the importance of the shelf edge for seabird species (e.g. Pollock *et al* 1997, Pollock *et al* 2000). These areas could be used as the start point of the upcoming JNCC marine SPA work.

Terrestrial SPA selection primarily focussed on designating multi-species SPAs and it may be that offshore areas that hold higher densities of seabirds such as the Rockall Bank could be suitable areas to consider for designation. It must also be kept in mind that survey effort has been limited in offshore waters of the SEA 7 area, and several years of data would be needed to confirm the importance of particular areas for feeding or moulting seabirds.

7. Survey coverage in the SEA 7 area

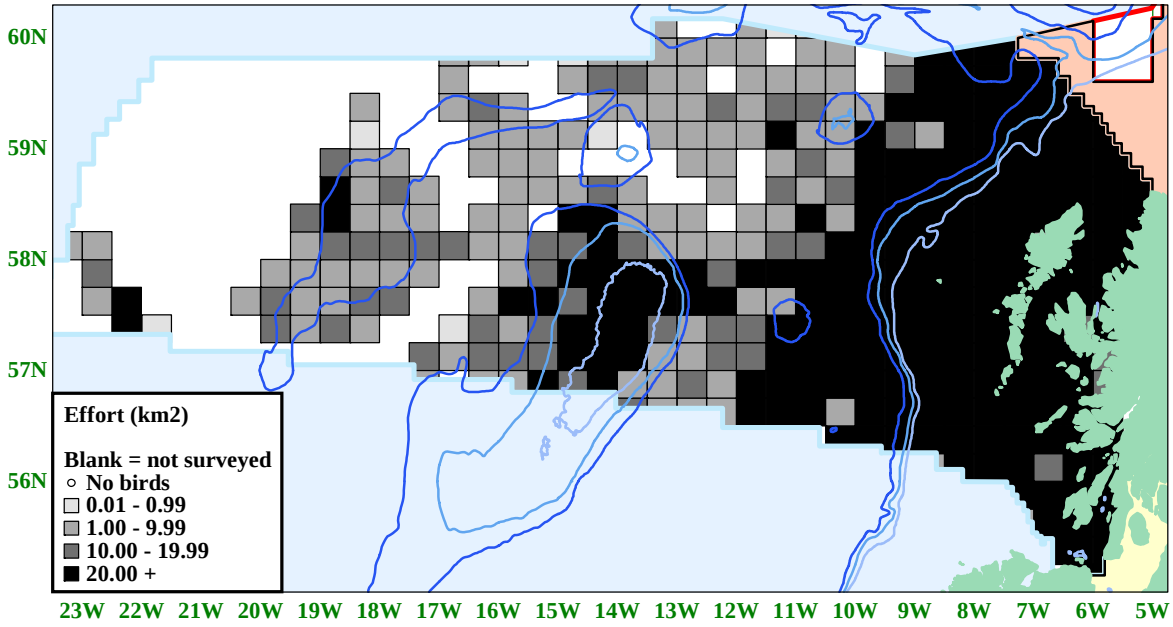
7.1 Survey effort

ESAS data analysed in this report were collected over 25 years between August 1980 and September 2005, covering an area of 31,659.74 km^2. Three quarters of the surveys were ship-based. Note that inshore aerial survey data collected by the JNCC between 2003 and 2005 have been included in this review although they do not currently feature in the ESAS database.

Figures 7.1 & 7.2 show the seasonal survey effort. Monthly effort maps in the SEA 7 area are shown in Appendix C.

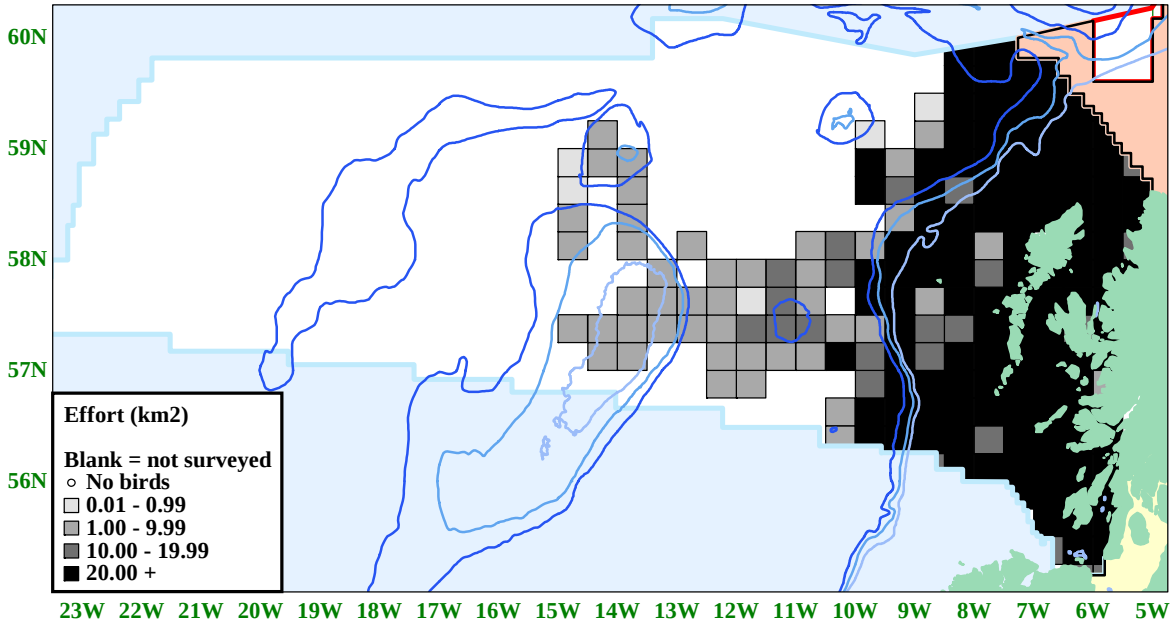
Greatest survey coverage was achieved during the summer months, between May and August. Least offshore coverage was recorded between October and December, and in March.

Figure 7.1 Survey effort within SEA 7 area in summer (April to September)



Coverage over the shelf break and north east Rockall Trough was good for most of the year. Other offshore areas such as the Rockall Trough, Rockall Bank and Hatton Bank had good coverage in summer, but poor coverage during the winter months.

Figure 7.2 Survey effort within SEA 7 area in winter (October to March)



7.2 Gaps in coverage

A recent analysis of gaps in survey coverage for all SEA areas found that in SEA 7, 7 % of the total area was surveyed which was 25 % of the overall suggested target amount (Pollock & Barton 2006). This was the lowest overall coverage in all SEA areas. During the summer months, just under 33 % of the target coverage was achieved, while in winter just under 20 % of the recommended survey coverage was achieved (Pollock & Barton 2006).

8. Conclusions

Overall, there are large gaps in coverage in the offshore waters of SEA 7, particularly during the winter months. However, based on survey work conducted to date, seabird density and species diversity is generally low beyond the shelf edge. ESAS surveys found that the most commonly recorded species in offshore waters was Northern Fulmar, which is very abundant and not threatened. Northern Gannet and Black-legged Kittiwake were also commonly recorded in the offshore waters of SEA 7. The SEA 7 area was also important for European Storm-petrel and Leach's Storm-petrel.

Species vulnerability in offshore areas was generally low. However there are important offshore seabird colonies e.g. St. Kilda, Flannan Isles, North Rona and Sula Sgeir in SEA 7, and waters around these colonies are very important feeding and resting areas for breeding seabirds. These waters are therefore very vulnerable to surface pollution during the breeding season.

The major difficulty with selecting potential offshore Special Protection Areas in the SEA 7 area is that offshore waters generally support low densities of seabirds, and that the existing ESAS data does not show any obvious hotspots.

Combining all ESAS seabird density data for all months showed that the shelf edge and the Rockall Bank were the areas where highest seabird densities were likely to be encountered, with generally low densities elsewhere in offshore areas. These areas could be used as the start point of the upcoming JNCC marine SPA work addressing offshore SPAs for feeding and other aggregations of birds. Feeding areas for European Storm-petrel and Leach's Storm-petrel should be identified as part of this study.

Terrestrial SPA selection primarily focussed on designating multi-species SPAs and it may be that offshore areas that hold higher densities of seabirds such as the Rockall Bank could be suitable areas to consider for designation. Several years of data would be needed to confirm the importance of particular areas for feeding or moulting seabirds.

Although the inshore and shelf waters of SEA 7 are of more importance for seabirds and are most vulnerable to surface pollution, seabird surveys in the offshore waters of SEA 7 should be continued to improve existing data and to determine long term trends and short term fluctuations in the offshore distribution of seabirds.

9. Recommendations

Based on this review, it is recommended that:

- Further studies should be conducted to identify important areas for seabirds in offshore waters in SEA 7, including feeding areas for European Storm-petrel and Leach's Storm-petrel
- Offshore survey coverage in SEA 7 should be increased throughout the year.

10. Acknowledgements

Thanks to Andy Webb of the JNCC Seabirds at Sea Team for providing ESAS survey data and to the ESAS partners (UK SAST, NIOZ, Ornis Consult, NINA, Vogelwarte Helgoland, INB (Belgium) & CMRC) for allowing the data to be used. Thanks also to Dr Ian Mitchell and Tim Dunn (JNCC) for supplying Seabird 2000 data for St Kilda.

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APPENDIX A

Scientific names of species mentioned in the text

Table A.1 Scientific names of species mentioned in the text

Species	Latin Name
Red-throated Diver	*Gavia stellata*
Black-throated Diver	*Gavia arctica*
Great Northern Diver	*Gavia immer*
Northern Fulmar	*Fulmarus glacialis*
Cory's Shearwater	*Calonectris diomedea*
Great Shearwater	*Puffinus gravis*
Manx Shearwater	*Puffinus puffinus*
Sooty Shearwater	*Puffinus griseus*
European Storm-petrel	*Hydrobates pelagicus*
Leach's Storm-petrel	*Oceanodroma leucorhoa*
Northern Gannet	*Morus bassanus*
Great Cormorant	*Phalacrocorax carbo*
European Shag	*Phalacrocorax aristotelis*
Common Eider	*Somateria mollissima*
Long-Tailed Duck	*Clangula hyemalis*
Common Scoter	*Melanitta nigra*
Red-Breasted Merganser	*Mergus serrator*
Pomarine Skua	*Stercorarius pomarinus*
Arctic Skua	*Stercorarius parasiticus*
Long-tailed Skua	*Stercorarius longicaudus*
Great Skua	*Stercorarius skua*
Little Gull	*Larus minutes*
Sabine's Gull	*Larus sabini*
Black-headed Gull	*Larus ridibundus*
Common Gull	*Larus canus*
Lesser Black-backed Gull	*Larus fuscus*
Herring Gull	*Larus argentatus*
Glaucous Gull	*Larus hyperboreus*
Great Black-backed Gull	*Larus marinus*
Black-legged Kittiwake	*Rissa tridactyla*
Common Tern	*Sterna hirundo*
Arctic Tern	*Sterna paradisaea*
Little Tern	*Sterna albifrons*
Common Guillemot	*Uria aalge*
Razorbill	*Alca torda*
Black Guillemot	*Cepphus grylle*
Little Auk	*Alle alle*
Atlantic Puffin	*Fratercula arctica*

APPENDIX B

Oil Vulnerability Index (OVI) scores

Table B.1 Offshore Vulnerability Index (OVI) score for all seabird species (after Webb *et al* 1995)

Species	OVI	Species	OVI
Red-throated Diver	29	Black-headed Gull	11
Black-throated Diver	29	Common Gull	13
Great Northern Diver	29	Lesser black-backed Gull	20
Diver Sp	29 [1]	Herring Gull	15
Northern Fulmar	18	Glaucous Gull	17
Great Shearwater	12	Great black-backed Gull	21
Sooty Shearwater	19	Large Gull Sp.	19 [1]
Manx Shearwater	23	Black-backed Gull Sp.	21 [1]
European Storm-petrel	18	Kittiwake	17
Leach's Storm-petrel	18	Gull Sp.	18 [1]
Petrel Sp.	18	Common Tern	18 [2]
Gannet	22	Arctic Tern	16
Great Cormorant	20	Commic Tern	17 [1]
European Shag	24	Little Tern	19
Common Eider	16	Tern Sp.	18 [1]
Long-Tailed Duck	17	Common Guillemot	22
Common Scoter	19	Guillemot / Razorbill	23 [1]
Red-Breasted Merganser	21	Razorbill	24
Pomarine Skua	19	Black Guillemot	29
Arctic Skua	24	Little Auk	22
Great Skua	25	Atlantic Puffin	21
Little Gull	24	Auk Sp.	24 [1]

1 Mean of constituent species 2 Revised based on updated biogeographic population

APPENDIX C

Monthly effort maps

Figure C.1 Survey effort within SEA 7 area in January

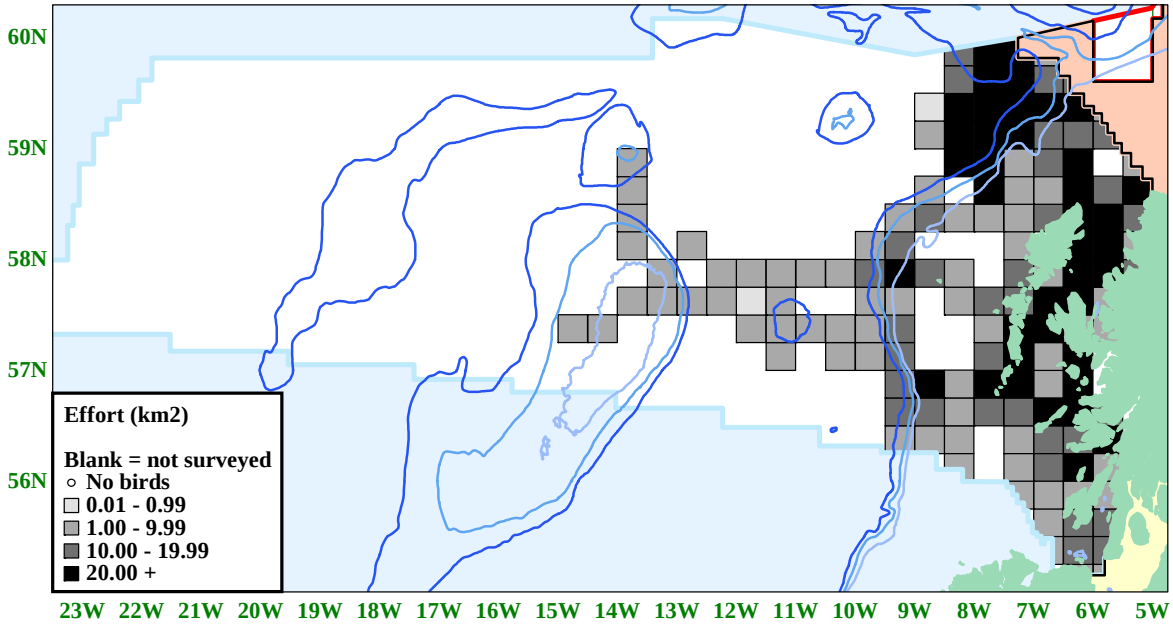

Figure C.2 Survey effort within SEA 7 area in February

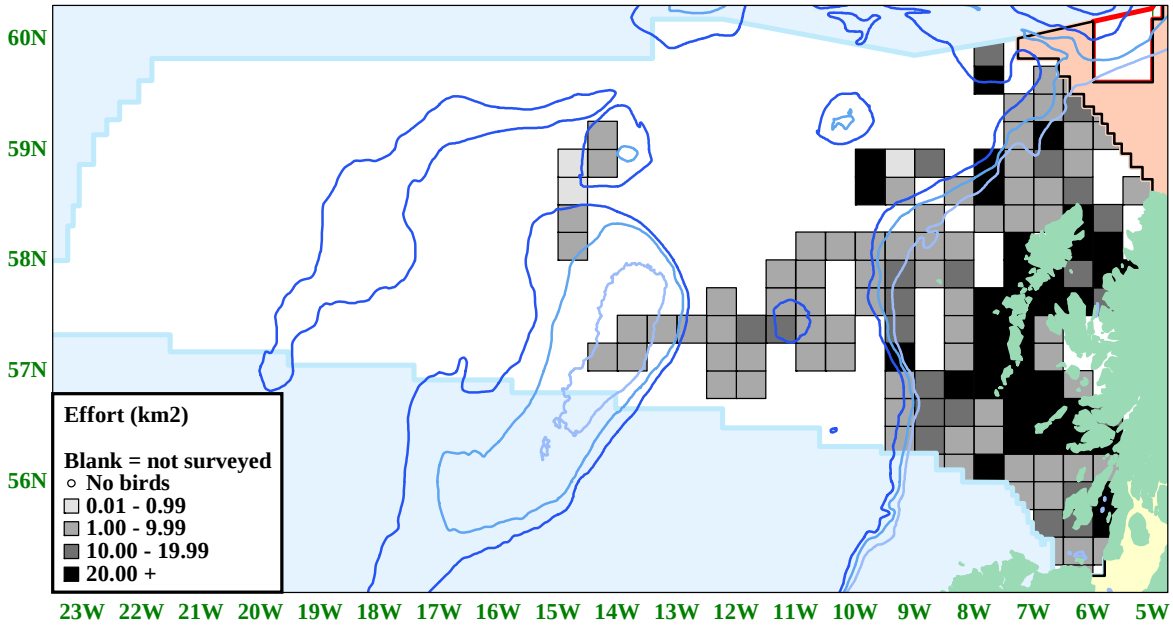

Figure C.3 Survey effort within SEA 7 area in March

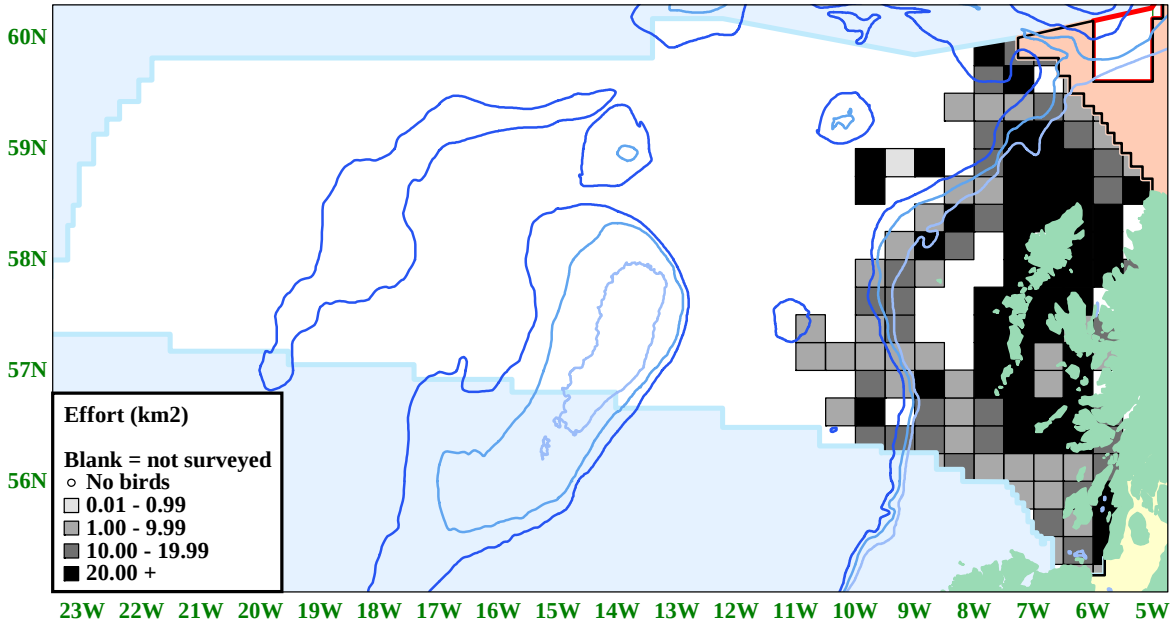

Figure C.4 Survey effort within SEA 7 area in April

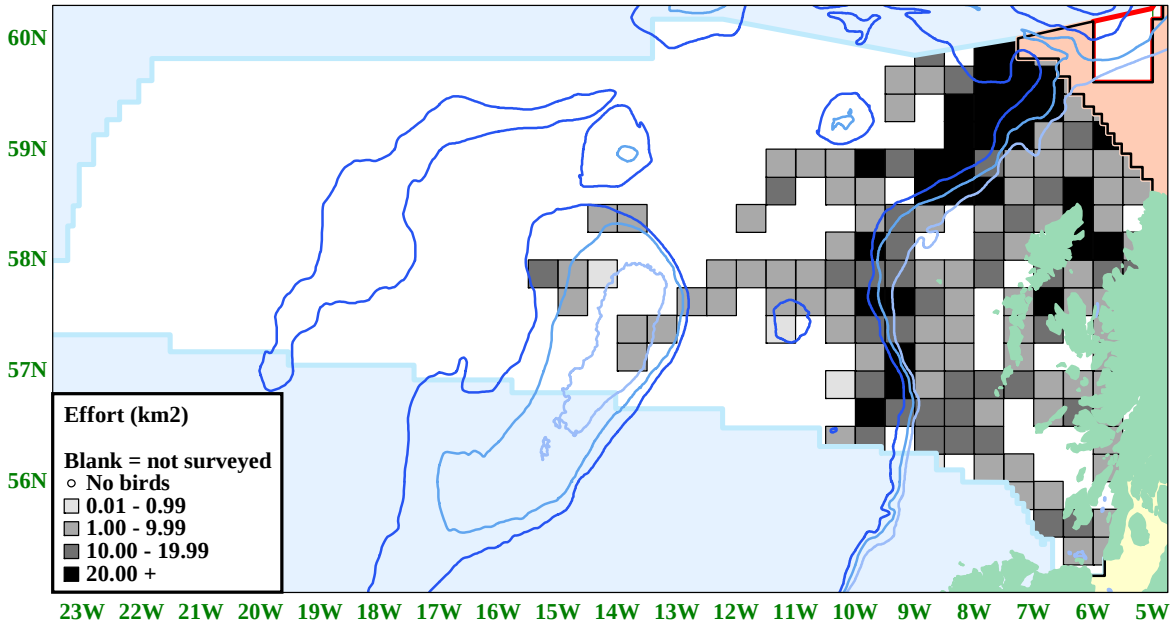

Figure C.5 Survey effort within SEA 7 area in May

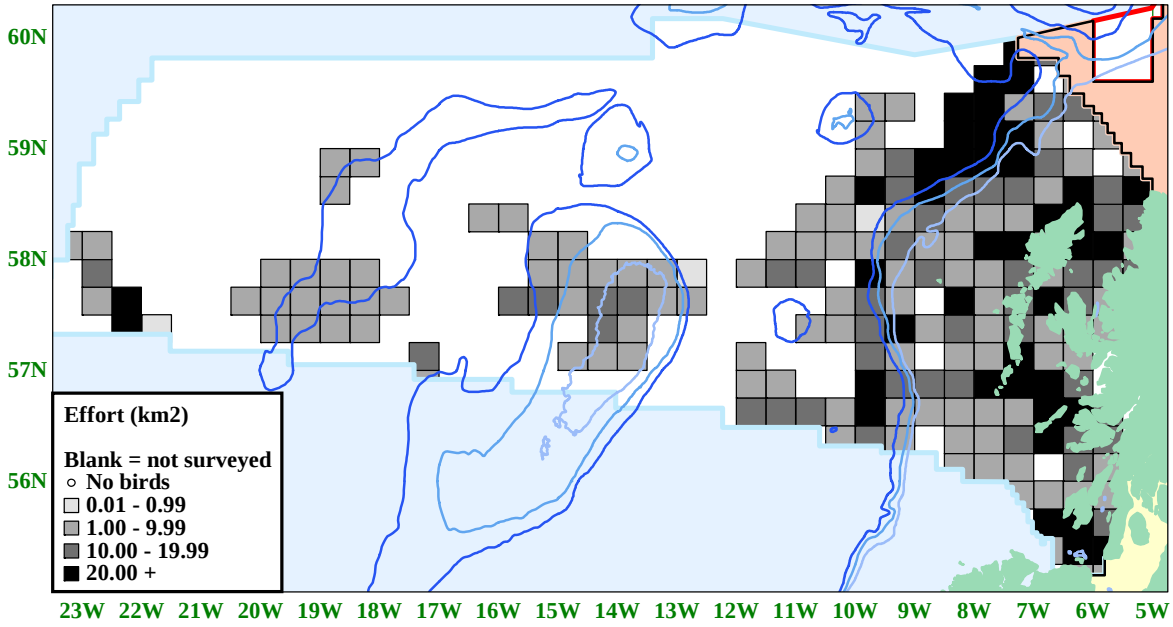

Figure C.6 Survey effort within SEA 7 area in June

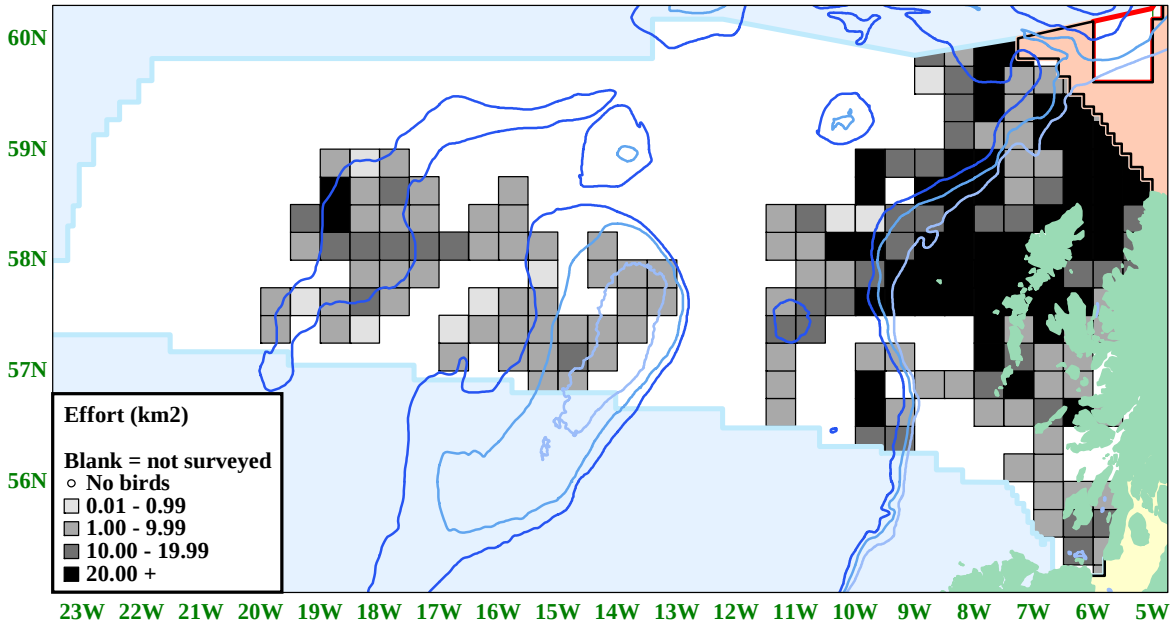

Figure C.7 Survey effort within SEA 7 area in July

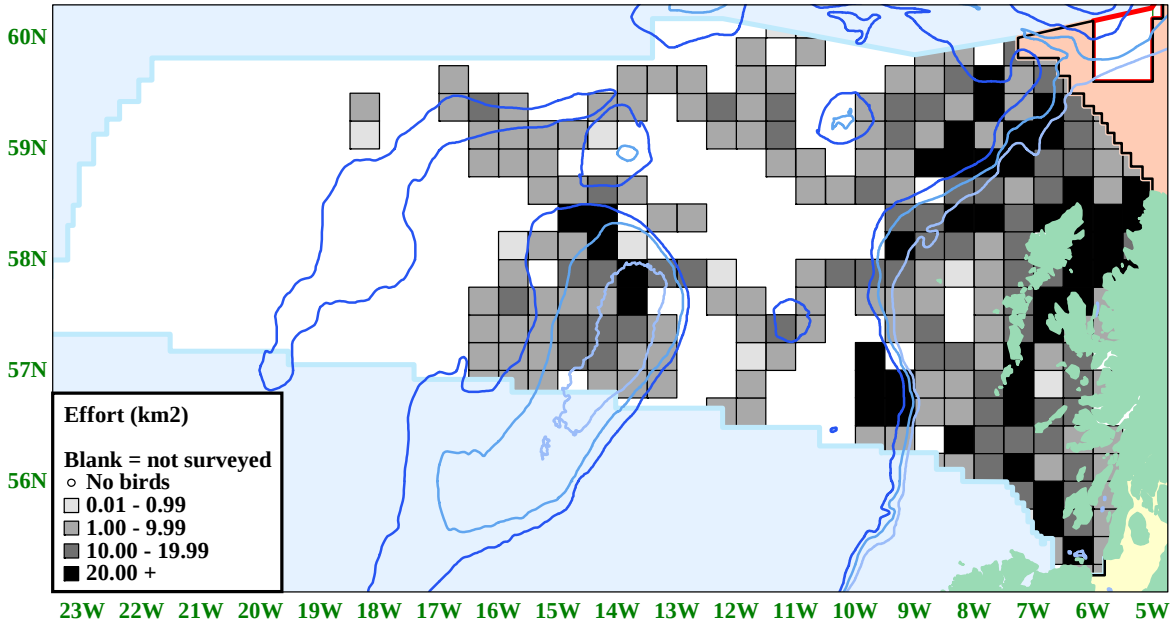

Figure C.8 Survey effort within SEA 7 area in August

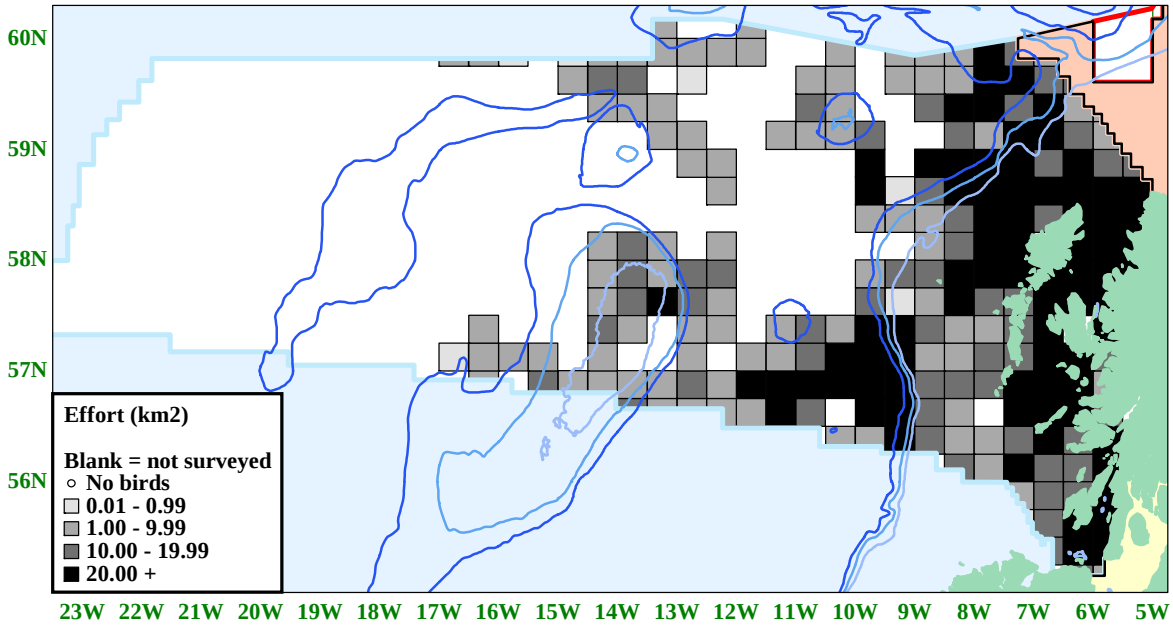

Figure C.9 Survey effort within SEA 7 area in September

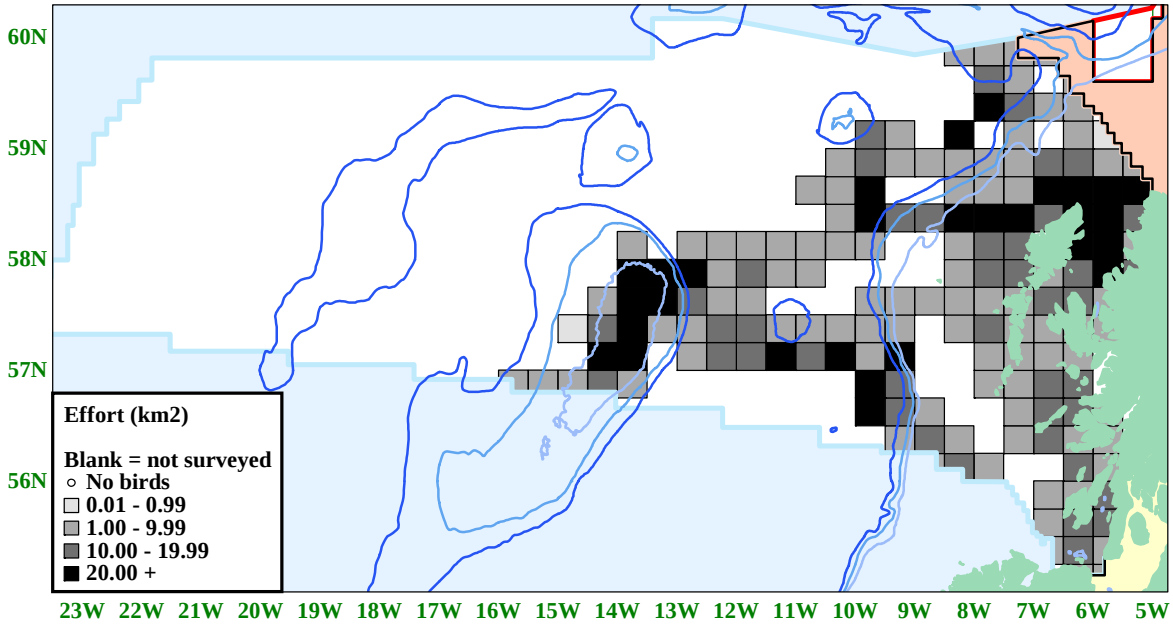

Figure C.10 Survey effort within SEA 7 area in October

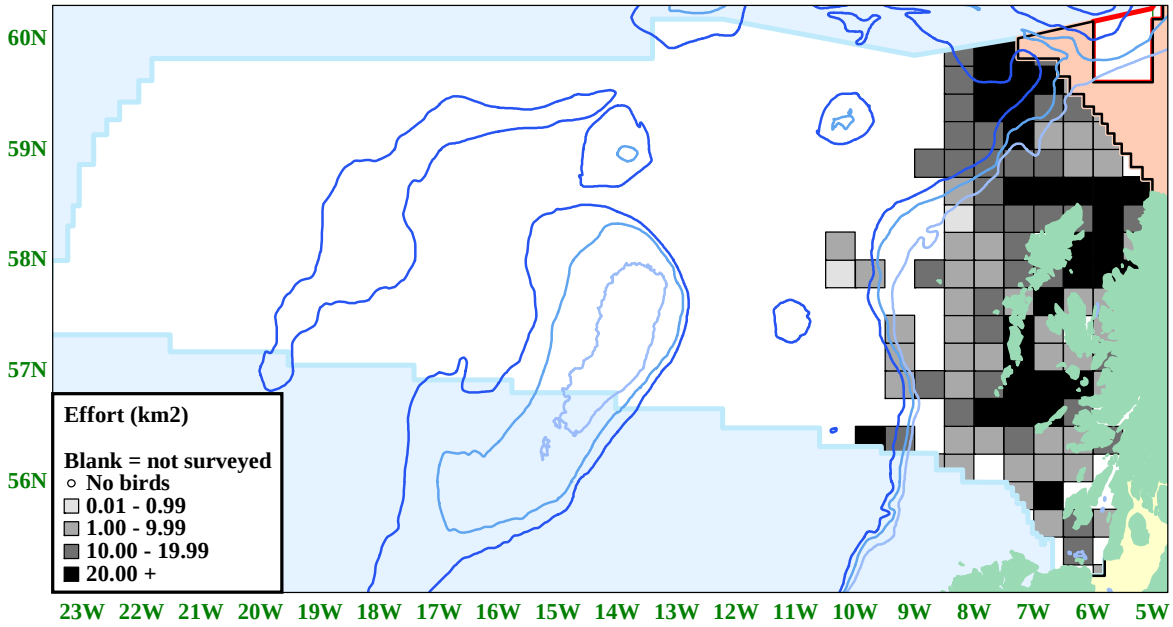

Figure C.11 Survey effort within SEA 7 area in November

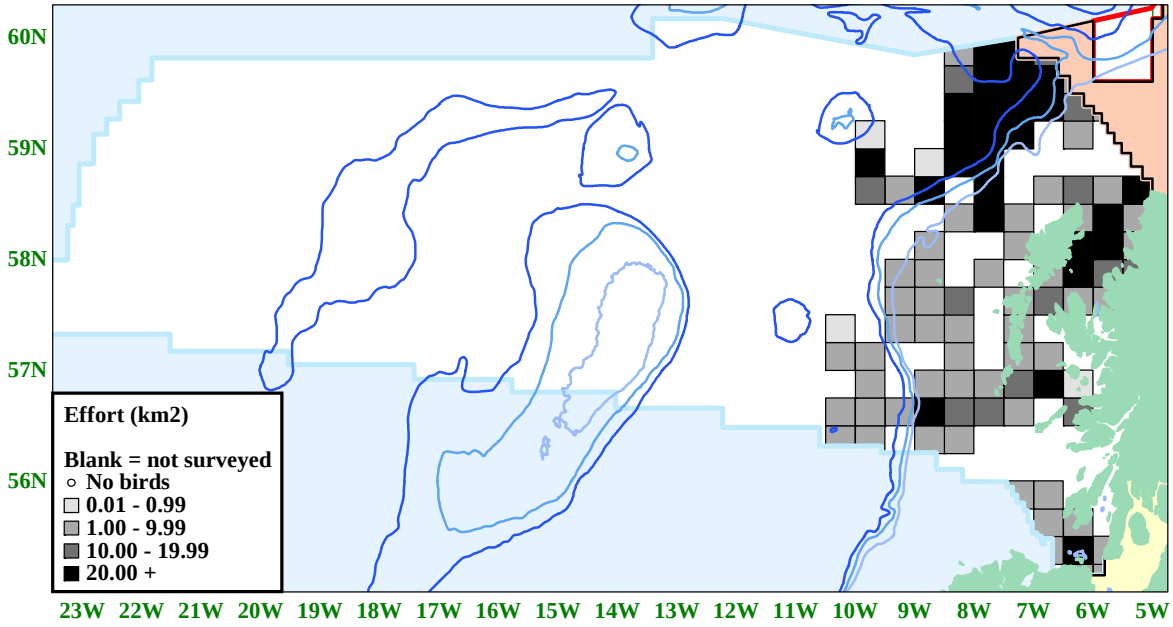

Figure C.12 Survey effort within SEA 7 area in December