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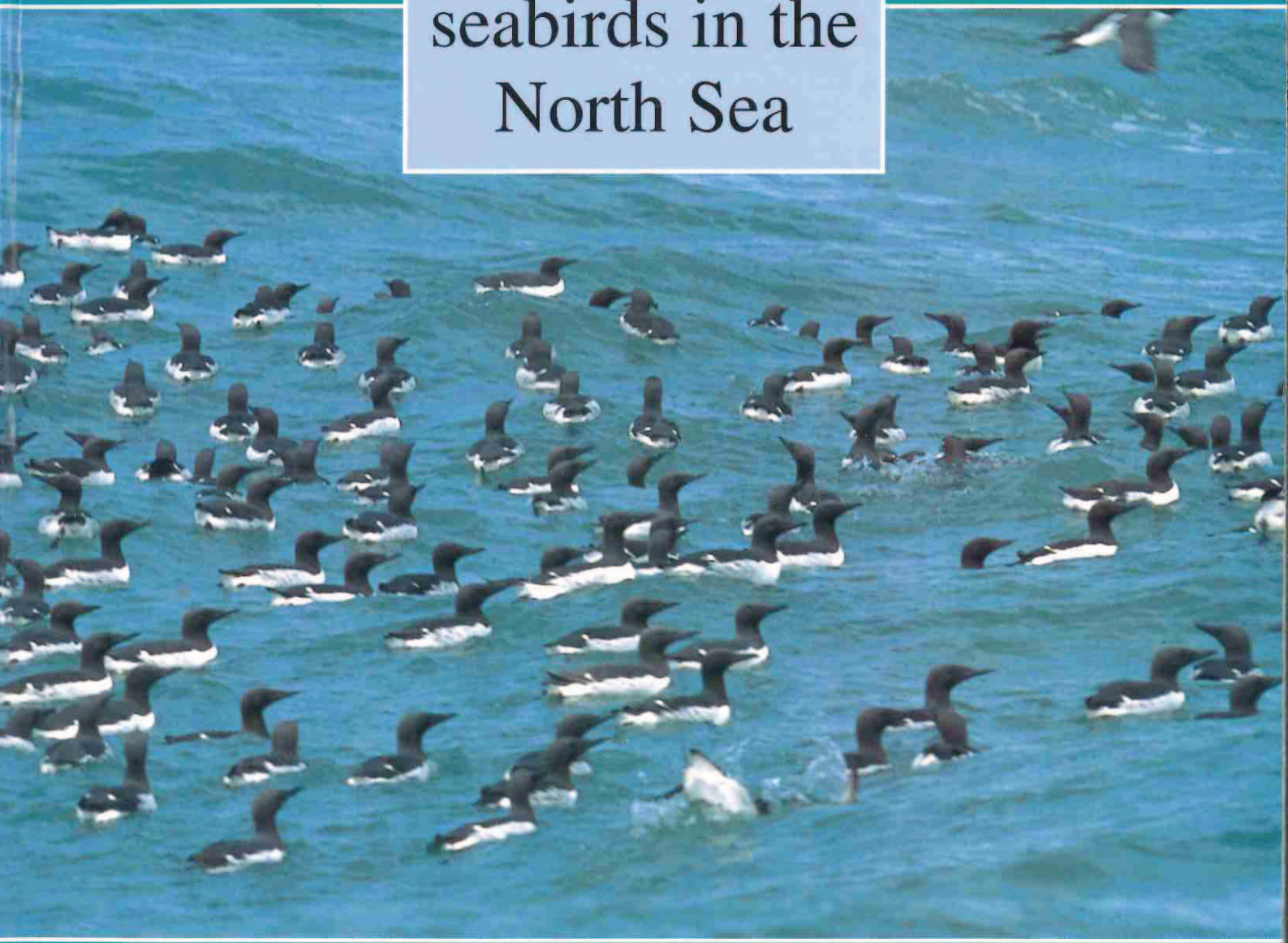
Important Bird Areas *for* seabirds in the North Sea



including the Channel and the Kattegat

BirdLife INTERNATIONAL

IMPORTANT BIRD AREAS FOR SEABIRDS IN THE NORTH SEA

including the Channel and the Kattegat

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for seabirds in the North Sea
including the Channel and the Kattegat

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Preface

The great migrations of birds, their range and their diversity have been a source of wonder and inspiration for centuries. The conservation of wild birds is an international responsibility.

The Ramsar Convention, the EC Wild Birds and the Habitats and Species Directives all require the protection of key areas through site designation. Throughout Europe the BirdLife International Important Bird Areas Programme has identified specially favoured sites on land which support vulnerable species, or particularly large concentrations of birds, or both. »Important Bird Areas in Europe« was published in 1989. Since then many European countries have produced national inventories of terrestrial and coastal sites. To date important marine sites for birds have only been systematically identified for the Baltic and southern North Sea. This differential treatment of marine sites is largely due to the relative ease of monitoring birds on land and in coastal areas and the difficulties of establishing boundaries to areas in the open sea.

Current wildlife conservation effort, which includes implementation of the EC Birds and Habitats and Species Directives, is concentrated on coastal areas within national jurisdiction. The North Sea Conference is a major opportunity to further address the international problem of managing and monitoring key areas in the open sea.

Too frequently lack of information causes action to be postponed. BirdLife International, in cooperation with the coordinators of the European Seabirds At Sea and national coastal databases, have commissioned this atlas to emphasise the international importance of marine and coastal areas in the North Sea. Important Bird Areas on land and at sea are fundamental to bird conservation. The appropriate management of these areas is an essential element in the conservation of viable bird populations in Europe, as required under international directives and conventions.

This atlas shows that requisite data are available, and that it is clearly feasible to agree and apply a methodology to select and delimit important marine areas for birds. This atlas lists 20 areas, selected on the basis of criteria which evaluate the importance of marine sites. Some areas within the North Sea remain unsurveyed and considerable information is held outside the principle databases. This list must therefore be reviewed as further survey and research work is completed.

This atlas represents the fruits of the labours of hundreds of ornithologists and the international collaboration of scientists. The atlas presents a new interpretation of the fantastic wealth of the North Sea. We urge all concerned to take the opportunities that now present themselves, to take action to maintain and enhance this wealth.

Acknowledgements

The aim of the present atlas is to provide an analysis of the conservation value of seabird areas in the North Sea, the Channel and the Kattegat. The basis for the analyses has been systematically sampled data on seabird numbers and distributions in inshore as well as offshore areas of all countries in the region through the past 15 years. The analyses and production of this atlas has been funded by BirdLife International/Royal Society for the Protection of Birds. Bird observations in offshore areas stem from the European Seabirds at Sea (ESAS) Database holding approximately 1.3 million records, while observations in coastal areas have been gathered from national databases.

We thank the survey organizers and regional coordinators for their enthusiastic support which made it possible for the first time to get an overview of important marine areas for seabirds in the entire region, among them: Peter Südbeck & Jan Blew, Niedersächsiches Landesamt für Ökologie, Germany; Georg Nehls, Germany; Groupe Ornithologique Normand, France; Groupe Ornithologique Nord, France; Picardie Nature, France; Groupe d'Etudes Ornithologique des Côtes d'Armor, France; Groupe Ornithologique Breton, France and Société d'Etudes pour la Protection de la Nature en Bretagne, France; British Trust for Ornithology, United Kingdom.

The preparation of the present report would not have been possible without the efforts of hundreds of seabird observers participating in coastal and offshore surveys. We thank them all.

It goes without saying that without the financial support and free services provided by the oil & gas industry, the European Commission as well as governmental agencies, shipping and ferry companies this document could not have been produced.

Unfortunately, the list of survey ships and aircrafts which took part in the seabird surveys is far too long to be mentioned here. Yet, we wish to express our gratitude for the help received during surveys from all crews and pilots.

We also wish to thank Patricia Bradley and Euan Dunn, Royal Society for the Protection of Birds, for their excellent back-up during the work and comments on the manuscript. Helpful comments were also given by Colin Bibby and Melanie Heath, BirdLife International as well as by BirdLife partners from all countries bordering the study region. Thanks to Inge Speierman for patient help during this process.

Limitations of the data and analysis

Due to the tight time limits for the data analyses, it has not been possible to collect all data-sets, and the report should therefore be regarded as a baseline for the future. The reader should be aware that no data have been included from the coastal areas of Norway and that coverage of coastal areas in many places is rather poor. The analyses in this report have been steered towards the identification of concentrations of seabirds at sea. The value of different areas for seabirds has been assessed using a scale which was considered suitable for distribution ranges of seabirds. This must be taken into consideration when the importance of the study region is assessed for total numbers and distribution ranges of dispersed species of seabirds. The borders between areas holding different densities of seabirds and the selection of important areas was based on contouring procedures in geographical information systems. The numeric ranges set for the contouring of bird densities may have had an important influence on the boundaries of the selected areas. The outline of the important areas may therefore be sensitive to changing the choice of numeric ranges.

Important Bird Areas

Important Bird Areas

The function of the Important Bird Area Programme is to identify and protect a network of sites, at a biographic scale, critical for the long-term viability of bird populations. Up to now, the process had identified sites of importance for four priority groups of birds:

- Species threatened with global extinction.
- Species which concentrate in large numbers or are dependent on particular sites at some period during the year.
- Species which are threatened or declining over a wide regional scale.
- Species which have relatively small world ranges.

The classification of important bird areas in coastal and terrestrial habitats is currently under revision by BirdLife International as a part of the development of the European inventory (Grimmett & Jones 1989). The IBA inventory contains internationally important sites for bird species which require effective protection at the national and international level.

It has been relatively difficult to identify and define the boundaries of important sites when dealing with large tracts of relatively homogenous habitats such as the open sea. We hope this report will contribute a further marine dimension to the IBA Programme.

However, a number of areas have not been covered by this analysis, including Ijsselmeer, the Wadden Sea and Danish and Norwegian fjords. The northern and eastern parts of the Norwegian Trench as well as parts of the Channel have not recieved sufficient coverage during previous surveys. In order to accomplish a fully updated list of important areas for birds in the region, it is therefore necessary to add information from habitats and sites not covered by this analysis. The updated list of coastal IBAs is expected to be published in 1997.

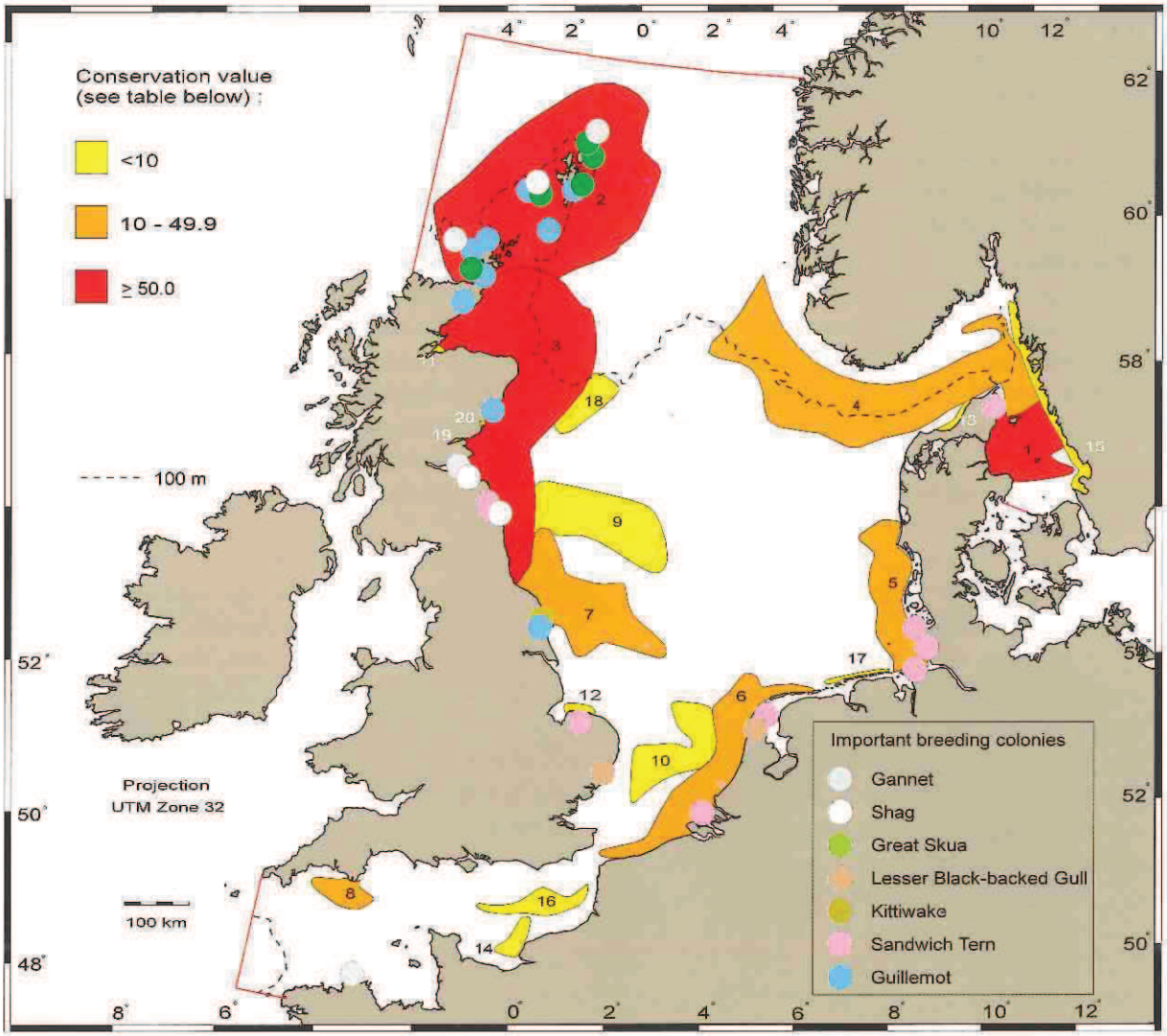
Based on the seabird surveys carried out from 1979 to 1994, general patterns in the distribution could be established across several species and genera, and many sea areas supported concentrations of international importance for several species. In this chapter we summarize the main results of the procedure for classification of marine areas described in the methods appendix.

The conclusion of the present study is that 20 areas within the North Sea, the Channel and the Kattegat have concentrations of birds which can be regarded as internationally important. The Central North Sea and the deepest parts of the region north of Orkney-Shetland, Fladen Ground, the deeper parts of the German Bight and the Danish West Coast were the poorest zones in terms of conservation value for birds. The classified areas comprise 34% of the region. The large size of the selected areas reflect the use of large areas by key species in the North Sea: Red-throated Diver, Common Scoter, Great Skua, Razorbill and Guillemot.

The six most important of these areas together account for more than 80% of the conservation value for birds of these 20 areas. Effective means to protect these top six areas would therefore protect more than 80% of the important bird concentrations occuring within this huge region. The ten most important areas support more than one species in internationally important concentrations and account for about 95% of the total conservation value for birds of these 20 areas. Nine areas have only one species in internationally important concentration and account for less than 5% of the conservation value.

Major areas

In the following, a description of the 6 most important areas for seabirds in the North Sea, the Channel and the Kattegat is given.



Location and extent of the 20 selected areas and breeding colonies of international importance for seabirds in the North Sea, the Channel and the Kattegat.

Areas of international importance for seabirds in the North Sea, the Channel and the Kattegat. The sum of proportions for each area is the cumulative percentage of each species occurring within the area in internationally important concentrations, compared to the total biogeographic population. % is percentage of grand sum of 'sum of proportions' (465.4).

Area	No of species	Sum of proportions	%
1 Northern Kattegat	10	96.7	20.5
2 Orkney – Shetland	7	93.0	19.7
3 Moray Firth – Aberdeen Bank – Tees	9	71.7	15.2
4 Skagerrak – Southwest Norwegian Trench	6	47.3	10.0
5 Eastern German Bight	6	47.3	10.0
6 Cap Gris Nez – Schiermonnikoog	7	35.4	7.5
7 Flamborough Head and the Hills	7	27.8	5.9
8 Start Point	2	10.9	2.3
9 Northeast Bank	2	8.3	1.8
10 Brown Ridge – Broad Fourteens	3	7.9	1.7
11 Inner Moray Firth	2	4.9	1.0
12 Scolt Head	1	4.1	0.9
13 Jammerbugt	1	3.8	0.8
14 Baie de la Seine – Cap D'antifer	1	2.3	0.5
15 Swedish West Coast	1	2.0	0.4
16 East Channel	1	1.9	0.4
17 East Frisian Islands	1	1.9	0.4
18 Long Forties	1	1.8	0.4
19 Tay Bay	1	1.1	0.2
20 Montrose Bay	1	1.0	0.2
Total conservation value		**471.1**	**100.0**

Area 1. Northern Kattegat

This area covers 11,000 km² with 9170 km² over the Danish continental shelf and 1,830 km² is over the Swedish continental shelf. A total of 3200 km² is less than 10 m deep.

The habitat is characterized by brackish water, large shallow sandy bays, estuaries and mosaic of sandy and rocky shoals. The hydrographic regime is dominated by surface outflows of brackish water from the Baltic via the Danish Straits. From the north there is a inflow of salt water from the Skagerrak. These waters mix and the Kattegat becomes decreasingly saline from north to south.

The shallow northwestern part of the Kattegat and adjacent banks to the east is of primary importance for its wintering populations including ten species of seabirds occurring in internationally important concentrations. It also holds an internationally important Sandwich Tern colony at Hirsholmene. In Northwest Europe, the Northern Kattegat is the most important wintering area for Razorbill, Red-necked Grebe, Common Scoter and Common Eider. For Common Scoter and Razorbill it is probably the most important in the world.

The Razorbill concentration is present in the area from November to March and its location moves from west to east within the area during this period. They may appear very concentrated and a flock of 125,000 birds has been observed at Fornæs. The Common Scoter is found throughout the year but the largest numbers are found from October to March. Concentrations of up to 490,000 birds has been counted. The concentrations of Common Scoters were first discovered in the beginning of the 1970's (Joensen 1974) and have since then been observed anually during surveys after 1981 (Laursen *et al. in press.*). The concentration of Razorbill has been observed every year since 1987 (Laursen *et al. in prep.* Ornis Consult *unpubl. data*). The diving ducks, making up about 800,000 of these birds are dependent on benthic food like mussels and cockels for their survival while the other species depend on ample supplies of small fish.

Species occurring in internationally important numbers in the northern Kattegat. These figures do not represent the total number of birds within the area.

Species	Average number 1980 – 1993	Percentage of biogeographic population
Red- and Black-throated Diver	1150	1.0
Red-necked Grebe	1600	10.7
Scaup	9600	3.1
Common Eider	264000	9.7
Common Scoter	396000	30.5
Velvet Scoter	148000	14.8
Herring Gull	30000	1.1
Great Black-backed Gull	6350	1.3
Sandwich Tern	3000	2.0
Razorbill	223000	22.5
Total	**1,082,690**	**96.7**

Area 2. Orkney – Shetland

The area falls completely within the continental shelf of the United Kingdom and extends to 70,000 km². A total of 22,000 km² is less than 100 m deep , 45,000 km² is between 100 and 200 m deep and 3000 km² is deeper than 200 m.

The area is heavily influenced by North Atlantic waters flowing around the island groups. The nutrient inflow with these waters supports a productive food chain for the seabird population.

The islands have many suitable safe breeding sites, located close to these good food resources. Sandeel stocks are of particular importance to the seabirds.

The size of the area is mainly determined by the distribution of internationally important numbers of Great Skua in July and August. More than half of the world population of Great Skua is present in this area at this time, making it outstandingly important to this species. The species found in important concentration around Orkney – Shetland are all dependent on the avalability of small fish.

Species occurring in internationally important numbers in Orkney – Shetland. These figures do not represent the total number of birds within the area.

Species	Average number 1980 – 1993	Percentage of biogeographic population
Great Northern Diver	515	10.3
Gannet	37000	8.1
Shag	7600	3.0
Great Skua	15600	55.8
Herring Gull	61000	2.3
Guillemot	49000	1.2
Black Guillemot	4900	12.3
Total	**175,615**	**93.0**

The area supports the following internationally important numbers of breeding birds (individuals)

Species	Number
Fulmar	640000
Storm Petrel	20000
Gannet	53000
Cormorant	1500
Shag	18000
Arctic Skua	5900
Great Skua	16400
Common Gull	21000
Great Black-backed Gull	18000
Kittiwake	228000
Arctic Tern	59000
Guillemot	460000
Razorbill	33000
Puffin	280000
Black Guillemot	19000
Total	**1,872,800**

Area 3. Moray Firth – Aberdeen Bank – Tees

The area covers 49,000 km² and falls completely within the continental shelf of the United Kingdom. About 11,000 km² is less than 50 m deep, 26,000 km² is between 50 and 100 m deep and 12,000 km² is deeper than 100 m.

The habitat is open sea influenced by the mixing of North Atlantic and North Sea waters and underlain by a series of sand banks which hold populations of sandeels. The area is an important spawning area for herring. Parts of the area are also important for sprat and young herring in winter. Cliffs on the western edge of the area support breeding seabird populations.

The birds found in important concentrations in this area are all fisheating species. The size of the area is mainly determined by the distribution of internationally important numbers of Guillemots occurring within the area in August, equivalent to more than 30% of the biogeograhic population. Many of these birds are adults flightless due to moult of flight feathers. Both of these groups are therefore especially vulnerable to surface pollutants.

Species occurring in internationally important numbers in Moray Firth – Aberdeen Bank – Tees. These figures do not represent the total number of birds within the area.

Species	Average number 1980 – 1993	Percentage of biogeographic population
Great Northern Diver	110	2.2
Gannet	19300	4.2
Shag	2500	1.0
Great Skua	2200	7.9
Great Black-backed Gull	27500	5.7
Sandwich Tern	7000	4.7
Guillemot	1219000	30.5
Razorbill	142000	14.3
Black Guillemot	470	1.2
Total	**1,420,080**	**71.7**

The area supports the following internationally important numbers of breeding birds (individuals)

Species	Number
Gannet	44000
Cormorant	2900
Shag	18000
Lesser Black-backed Gull	9800
Kittiwake	460000
Sandwich Tern	13000
Roseate Tern	46
Guillemot	400000
Razorbill	45000
Black Guillemot	1600
Total	**994,346**

Area 4. Skagerrak – Southwest Norwegian Trench

The area covers 48,500 km², with 29,440 km² over the Norwegian continental shelf, 15,800 km² over the Danish continental shelf and 3,260 km² over the Swedish continental shelf. There is 8100 km² deeper than 50 m, 17,700 km² between 50 and 100 m water depth and 22,700 km² deeper than 100 m.

The area is situated along the southern and eastern edges of the Norwegian Trench around the 100 m contour line. The bottom slopes down from a depth of less than 20 m in the southeastern parts to about 400 m in the northern parts and is dominated by muds in the northern part and soft sandy deposits in the south.

Three currents with different salinities flow into the area from the west and the oceanographic regime is dominated by a central highly saline current of Atlantic origin. To the north of the area, the low saline Norwegian Coastal Current provides the only outlet from the North Sea. The interfaces of these waters masses enhance the availability of foods to seabirds. Upwelling events driven by several mechanisms are frequent in the area.

Six species of seabirds in internationally important numbers amounting to about 850,000 use this area at different times of year. The birds inhabiting this area prey on small fish and other animals, some species actively catch prey themselves, some species by cleptoparasitism and some birds by scavenging on fishery waste. The most numerous bird wintering in this area is the Little Auk with an average of just over 700.000 about 25% of the biogeographic population. Guillemots enter the area in late July and early August, flightless, and are therefore especially vulnerable to surface pollutants. Great Skuas move to the area at the same time. The birds using this area are mainly dependent on the availability of small fish.

Species occurring in internationally important numbers in Skagerrak – Southwest Norwegian Trench. These figures do not represent the total number of birds within the area.

Species	Average number 1980 – 1993	Percentage of biogeographic population
Gannet	14000	3.0
Great Skua	3300	11.8
Herring Gull	32000	1.2
Guillemot	46300	1.2
Razorbill	45000	4.5
Little Auk	705000	25.6
Total	**845,600**	**47.3**

Area 5. Eastern German Bight

The Eastern German Bight covers 12,800 km² with 8400 km² lying over the German continental shelf and 4400 km² in the Danish continental shelf. About 8800 km² are less than 20 m deep and just 550 km² is deeper than 30 m.

The waters are shallow lying over sediments of sand and mud and most of the area is influenced by the combined fresh water output from the rivers Elbe and Weser. The riverine waters are often bordered by a quite sharp front to the North Sea waters in the west of the area. This front may concentrate foods for seabirds and divide the area into a western medium saline and an eastern low saline part. The eastern low saline area is primarily used by the birds in important concentrations. Tidal currents keep the water mixed in most of the year.

The size and shape of the area is mainly determined by the numbers and distribution of Red- and Black-throated Divers. These species, hard to separate in the field, occur in internationally important numbers probably surpassed by only one area in the world; the Irbe Strait in the Baltic. The species occurring in important concentrations in this area are fish eaters except for Common Scoters that depend on mussels and cockels.

Species occurring in internationally important numbers in the Eastern German Bight. These figures do not represent the total number of birds within the area.

Species	Average number 1980 – 1993	Percentage of biogeographic population
Red- and Black-throated Diver	24000	21.8
Red-necked Grebe	1850	1.2
Common Scoter	190000	14.6
Little Gull	2900	3.9
Common Gull	21500	1.3
Sandwich Tern	6700	4.5
Total	**245,285**	**47.3**

Area 6. Cap Gris Nez – Schiermonnikoog

This long thin area extends to cover 16,000 km² big with 1000 km² over the French continental shelf, 1700 km² over the Belgian continental shelf and 13,300 km² over the Dutch continental shelf. A total of 6400 km² is less than 20 m deep.

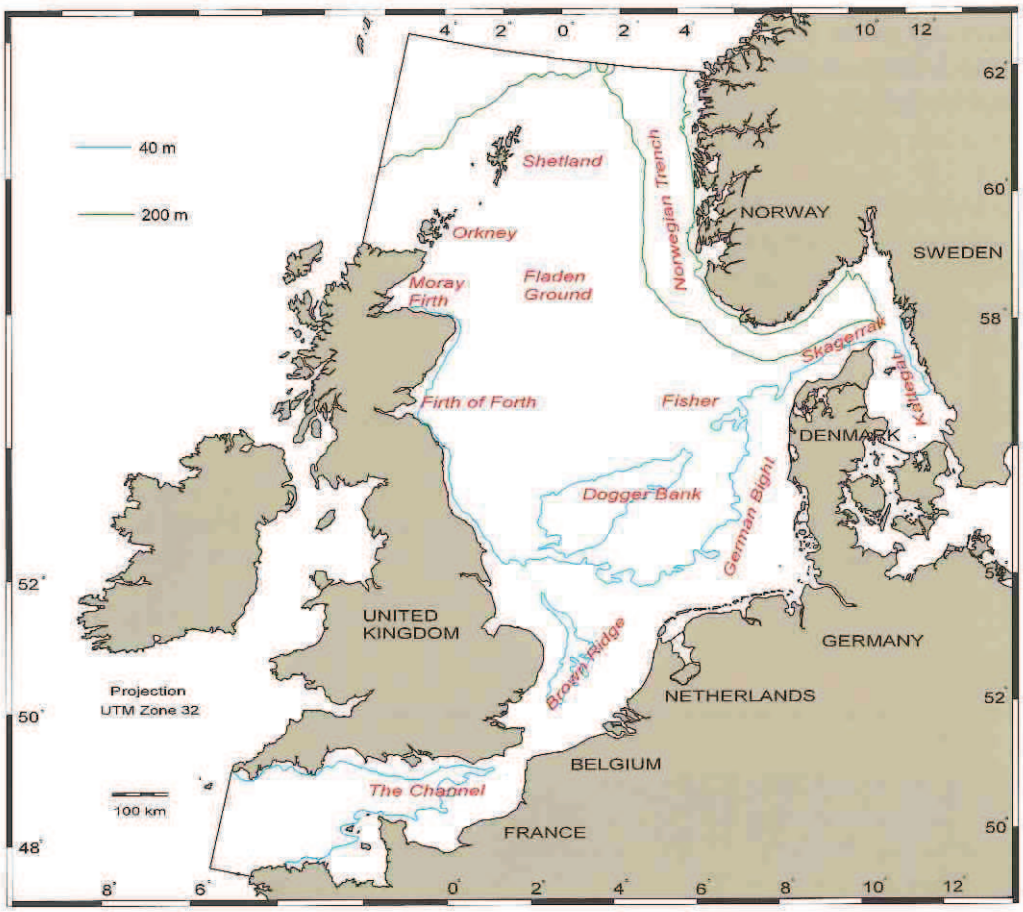
The area is predominantly shallow sea with sand bank and muddy sea beds. The northern part of the area includes water deriving from the great rivers Rhine, Maas and Schelde. More salt water from the Channel may penetrate the area. The fronts dividing these brackish waters from the waters of the North Sea and Channel may concentrate foods for seabirds. Tidal currents keep the water mixed in most of the year.

The Wadden Sea and Voordelta are immediately adjacent, with Wadden Sea islands forming important nesting grounds for a number of seabird species.

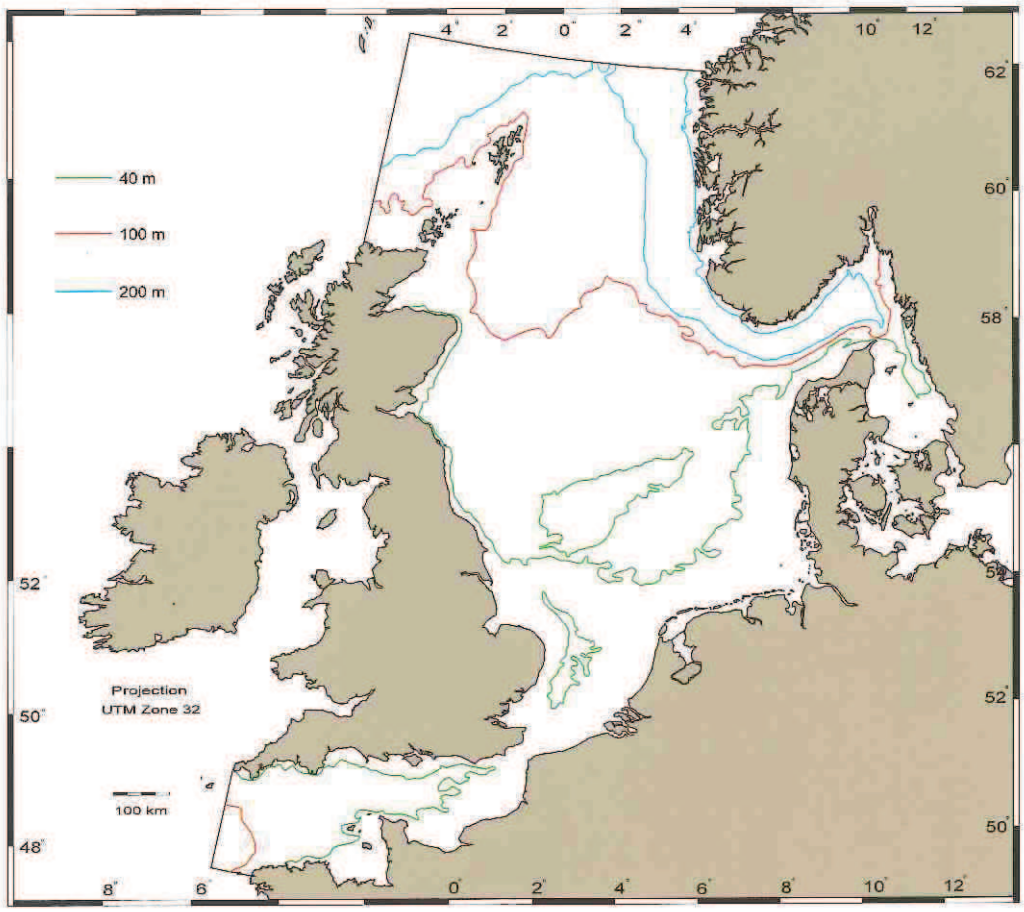
The birds species occurring in internationally important numbers in this area are mainly fish eaters although the gulls may utilize a wide range of foods.

Species occurring in internationally important numbers in Cap Gris Nez – Schiermonnikoog. These figures do not represent the total number of birds within the area.

Species	Average number 1980 – 1993	Percentage of biogeographic population
Red- and Black-throated Diver	3100	2.8
Great Crested Grebe	10500	10.5
Common Scoter	75000	5.8
Little Gull	6700	8.9
Herring Gull	53000	1.9
Lesser Black-backed Gull	17000	2.4
Sandwich Tern	5100	3.4
Total	**170,400**	**35.4**



Study region in the North Sea, the Channel and the Kattegat.



Bathymetry of the study region.

The North Sea Environment

The distribution of seabirds is primarily affected by their food supply and by the location of safe nesting areas. Food supply is in turn affected by the physical and biological environment. This section describes briefly the foods taken by seabirds and the various factors that affect food supply. A brief description of the factors underlying choice of nest site is also made. In a North Sea context, the relative importance of these factors is poorly understood and requires further research.

Topography and hydrography of the North Sea

The North Sea is essentially a relatively shallow rectangular basin, sloping from the south (30m depth) to the north (200m depth). A trench, 700m deep, lies off the Norwegian coast on its north-east side, and the continental shelf edge and a deep (>1500m) oceanic trench forms the north-west part of the sea. The Channel is a wedge of sea about 30m deep in the east sloping to 100m deep in the west. The Kattegat is a shallow basin between 10m and 50m deep. Including the Channel and the Kattegat, the North Sea has a surface area of about 750,000 km².

Water comes into the North Sea from the Atlantic Ocean and from the land in rivers. To the north-west of Shetland, currents are dominated by the North Atlantic Drift, flowing north-eastwards. Water from this current enters the North Sea, particularly along the west side of the Norwegian Trench. Atlantic water also enters through the gap between Orkney and Shetland, as the Fair Isle Current, and through southward currents off the east coast of Shetland. There is a net flow of water eastwards in the Channel. Fresh water arrives into the North Sea through the rivers, which have a particularly great influence in the shallow areas of sea off the continent. The Kattegat is less saline than much of the North Sea owing to the brackish outflow of the Baltic. Water leaves the North Sea as the north-flowing Norwegian coastal current (Turrell *et al.*, 1992).

In summer, warmed surface water becomes less dense than cooler deep water, and in deeper areas the water column becomes thermally stratified. This happens over much of the northern and central North Sea. To the south, tidal currents mix the water column. The boundary between stratified and mixed water is frequently narrow. These areas, called fronts, restrict dispersion of nutrients and can change the local plankton flora and fauna community. In the North Sea, such fronts often form in the summer over the western Dogger Bank and Silver Pit areas, in waters off the Wadden Sea, off the eastern coast of Scotland, and to the north-west and north-east of Orkney (Becker 1990). Upwelling of colder water, caused by tidal or oceanic currents can also cause thermal fronts and enhance productivity of areas. In the North Sea, such upwelling occurs in the German Bight and the Skagerrak. Water masses with different salinity leads to the presence of permanently stratified waters in the Skagerrak and the fronts between these may also enhance food availability for seabirds.

Marine habitats for seabirds

The currents described above, with their different water masses, varying both in temperature and salinity, and flowing over a shallow varied topography, generate a wide range of conditions for seabirds and their food. Many seabirds specialise in exploiting particular foods in particular habitats. These habitats may vary greatly in size, from water masses covering the northern North Sea, to small scale frontal features lying close to the coast or to estuaries. Studies within the North Sea demonstrate that some bird distributions are significantly influenced by depth (Stone *et al.*, 1995), salinity and temperature (Joiris 1983, Durinck *et al.* 1993b), and bottom sediments.

On a smaller scale, seabirds congregate near features that concentrate food locally. Off Norway, increased concentrations of Little Auks have been found over saline fronts (Follestad 1990) and elsewhere upwellings can concentrate seabird distribution (Schneider 1990). Briggs *et al.* 1984 found that transitory gyres in currents were important for some species off California. Offshore sand banks

appear to be favoured feeding areas for seabirds in the Northwestern North Sea, probably owing to the habitat preferences of sandeels.

Seabird foods and their spatial variability

Seabirds do not feed directly on phytoplankton, the organisms at the base of the marine ecosystem, but do feed on most other parts of the food web, both pelagic and benthic. The distribution of these components of the food chain depends greatly on the oceanography of the North Sea. The productivity of the seas in an area relies on a number of features; perhaps the two key features for phytoplankton to grow are sunlight and a supply of nutrients. Lack of sediment in the water column is thus of importance in allowing light penetration.

Plankton

Phytoplankton are fed on in turn by zooplankton, or are remineralised to inorganic components, by bacterioplankton. In summer, northern waters generally hold a greater zooplankton biomass than southern waters in the North Sea (Krause and Martens, 1990), while bacteria are more important in the south. Some seabirds, such as Storm Petrels feed directly on large zooplankton, such as the euphuasiid *Meganyctiphanes norvegica* and may prefer areas where these are concentrated. Small-scale hydrographic features may further concentrate plankton on the surface.

Fish

Fish, the main prey of many birds, feed on a wide range of marine organisms and their distribution may not be directly linked to primary productivity. Some species live on or near the seabed (demersal), others live in the water column (pelagic), and some live near the bottom, but feed predominantly in the water column. Frequently the distribution of individual species changes between young and mature stages of life. Many, however, feed on zooplankton and tend to be present in higher quantities in the Northern North Sea. In turn, the Northern North Sea has a higher biomass of piscivorous fish compared to the south. Among fish important for seabirds are sandeel *Ammodytidae*, Sprat *Sprattus sprattus*, Herring *Clupea harengus*, gobies *gobiidae*, Whiting *Merlangius merlangus*, Poor Cod *Trisopterus minutus*, Norway Pout *Trisopterus esmarchii* and Cod Gadus morhua, Mackereel *Scomber scombrus* and Pilchards *Sardina pilchardus*.

There have been no comprehensive surveys of sandeel abundance in the North Sea and there is some evidence of inter-year variations in abundance in parts of the North Sea. The species that dominates the northern and central North Sea fauna, Ammodytes marinus, prefers well-oxygenated offshore sandbanks. These are widespread, but those off the eastern coast of Scotland and north-eastern coast of England seem to be particularly important, judging by fishery catches (Jensen *et al.* 1994). Little detail is known of the distribution of the commonest sandeel in the southern North Sea and Channel, *Ammodytes tobianus*.

Herring spawn on well-oxygenated gravel beds in many parts of the North Sea, but primarily in the west. During their larval phase, they are swept eastwards by currents. Consequently, young Herring and Sprat are more abundant in the eastern North Sea, in the Kattegat and in parts of the Channel, with some localised concentrations in the western North Sea (Knijn *et al.* 1993).

Other features may concentrate seabirds over areas important for fish. An area of increased deposition of organic matter occurs at the Friesen Front between 53³0'N, 4°E and 54°N, 5°E (De Gee *et al.* 1992). This area has high concentrations of Sprat and Herring shoals in summer (Sprong *et al.* 1990). These shoals become more widespread in the southern Bight in winter. In summer, this Bight is used predominantly by Larus gulls (the commonest being the Lesser Black-backed Gull), and to a lesser extent, terns. In winter, more gulls move into the area, along with Guillemots.

The Eastern Channel's fish fauna is dominated by flatfish, and the shallow water gadoids such as Pout, Whiting and Poor Cod. These species are not fed upon particularly by any seabird, and thus this area does not attract many piscivorous birds. However, Sprat occur locally, and are fished in the winter off the south-east coast of England. The deeper waters of the Western Channel has a wide variety of bottom

sediments, and a wider range of fish. These include pelagic fish such as Mackerel *Scomber scombrus* and Herring. Pilchards *Sardina pilchardus* occur in some years, particularly in the southern part of the western Channel. The eastern Channel is used in winter by Guillemots and other auks as are areas relatively close to the shore, such as Lyme Bay, in the western Channel. The shoals of pelagic fish may attract Gannets and Great Skuas.

Benthic invertebrates

Diving ducks feed on benthic organisms, primarily shellfish such as Blue Mussels *Mytilus edulis*, cockles *Cardium spp.*, clams e.g. *Spisula* and other bivalves, also crustaceans such as crabs e.g. *Carcinus maenas* and shrimps. Such benthic organisms live in most shallower areas of the North Sea, with particular species preferring different seabed conditions.

The highest proportion of shallow areas of the North Sea are in the south and east, offshore from the Wadden Sea. Significant areas of such shallow waters are present also in the northwest Kattegat, off Norfolk, in the Thames estuary and in several other firths and estuaries. The benthic communities of these areas are rich in molluscs and crustaceans. Bottom-feeding birds such as seaduck and divers are concentrated in these seas. In a North Sea scale, mean biomass of benthic animals per unit of seabed is at its highest in the shallower southern waters (Künitzer *et al.* 1992). In the northwest Kattegat, the benthic community is dominated by a Venus community, again with a higher biomass per unit area than communities nearby in deeper water (Thorson 1979). Inshore areas of the Channel have a higher biomass per unit area than offshore, but lower than equivalent areas in the North Sea. Although no formal analysis of the relationship between benthic biomass and bird concentrations has been carried out, it seems likely that diving ducks respond to biomass of benthos, as well as to other factors such as water clarity and shelter.

Fishery wastes

Discarded fish and offal from fisheries may be important for some seabirds at some times of year. Recent studies by Camphuysen *et al.* (1993, 1995) show that eight species of seabird, including Fulmars, Gannets, Great Skuas and gulls are common near fishing vessels, but each has a specific pattern of occurrence, both within the North Sea, and between different seasons. Competition for these foods is intense, leading to specialisation both in type and size of food taken.

Breeding areas

Seabirds breed usually in areas out of reach of most mammalian predators. Many islands are suitable; in the Southern North Sea these are often little more than vegetated offshore sand and mud banks. In the Northern North Sea and the Channel, cliffs and rocky islands form the majority of safe nesting areas. The distribution of seabirds at sea during summer is concentrated in areas relatively near breeding colonies owing to the need to return frequently to the colony. A suitable area of breeding habitat will not however be occupied if there is not suitable nearby feeding habitat.

Other factors which concentrate seabird distribution

Cormorants and Shags need to go on land frequently to dry their feathers and this restict their ranges to coastal areas. Many gulls return to land or fixed structures in the sea to roost at night. Some seabirds move through the North Sea while migrating from northern breeding grounds to wintering areas to the south and west. Seabirds such as Common Scoters move through the Southern North Sea in considerable numbers. Pauses during this migration may generate concentrations of birds. Weather conditions may also concentrate birds. Notably, in cold winters when coastal waters in the Baltic become frozen, there is often a large scale movement of birds westwards to the North Sea; similarly, if inland waters such as the IJselmeer become frozen, large numbers of ducks and grebes can be displaced to nearby parts of the North Sea. Some areas used by seabirds in cold winters are known, but further study is required.

Methods Summary

Study region

The present atlas includes the entire North Sea, the Channel and the Kattegat as defined by the 1993 North Sea Ministerial Conference (North Sea Task Force 1993). The study region is shown on page 16 and is bound by the coastlines of England, Scotland, Norway, Sweden, Denmark, Germany, the Netherlands, Belgium and France. It includes all coastal, territorial as well as international waters between the western Channel (6°W), the Northern Atlantic (62°N, 6°W), and the Kattegat (between Grenå and Sjællands Odde).

Estuaries, sea lochs, fjords and other semi-closed brackish water areas have been included for United Kingdom, France and the southern Netherlands, while they have been excluded for the other countries due to already existing and comparable classifications of the ornithological importance of these areas. The ornithological importance of the offshore area of the southeastern North Sea in winter and spring and the Kattegat in winter has already been described by Skov *et al.* (1994) and Durinck *et al.* (1994). The classification of these areas is refined with respect to seasons and years of coverage in this report.

Selection of bird species and seasons

The distribution of 30 bird species provides the basis for the analysis and identification of important bird areas in the atlas (Appendix). Each of the 30 species selected has a population in the study region of at least 1% of the species' biogeographic (breeding or non-breeding) population during parts of the year. In the selection of data from specific survey platforms we have generally followed the recommendations from Pihl *et al.* (1992) and used only the best observation platform as the major source of data for each species. Information gained by other methods were used to supplement that from the best platform. Seasonal selection was carried out after examining monthly maps, following Stone *et al.* (1995).

Survey methods

Five sampling methods have been employed to collect the data analysed in this report; counts from land, aerial total counts, aerial transect counts, ship total counts and ship transect counts.

Land-based counts

Within predefined stretches of coastline, birds were recorded from the shore to an undefined distance. It is assumed that accurate identification and counts of birds were only possible within 1 km of the shore.

Aerial counts

Total counts

Birds in inshore waters as well as over offshore grounds in the Kattegat were recorded from aircraft flying at a speed of 100 – 140 kilometers per hour and at a height of 60 to 100 meters. Only data from aircraft, collected with methods comparable to those of Pihl & Frikke (1992), have been used. When conducting a total survey, the plane flew along survey lines which enabled a full count of all birds present in the survey area.

Transect counts

Transect counts from aeroplanes have been used to a limited extent in offshore areas. When carrying out these surveys, the plane followed lines much further apart than during total counts and only the birds within a narrow band of less than 200 meters on both sides of the plane were recorded.

Ship counts

Total counts

A limited number of total counts of selected species were carried out from ships in inshore waters. Seaducks in the German Bight were counted using the methods of Offringa & Leopold (1991).

Transect counts

Only ship-based data collected by methods comparable to the standard description of Tasker *et al.* (1984) have been included. Most surveys were made from ships of opportunity. However, a substantial part of the effort east of the British coast (particularly in the Moray Firth), in the German Bight and in the Skagerrak-Kattegat was made from chartered ships following transect lines 10 – 30 km apart. The observations were made from platforms 5-20 meters above sea-level. More than 90% of the observations from ships were made using 300 m wide transects. The birds were usually recorded in 10-minute intervals and grouped into transect 'bands' according to their distance from the trackline. These bands were usually: a) 0 – 50 meters, b) 50 – 100 m, c) 100 – 200 m and d) 200 – 300 m. Alternative distance groups of 150 m were operated by Danish and Norwegian teams for some surveys.

Database

The analysis included observations held in the ESAS database version 2.0 in inshore and offshore areas and observations in coastal areas coordinated by individual countries during the period 1980-1993 inclusive. Some additional data from 1994 were added, among those the results of the coordinated seabird surveys onboard fishery research vessels on the International Bottom Trawl Survey (Camphuysen *et al.* 1995). More details on the database are provided in the Appendix.

Coastal areas

The location of coastal counts is shown in Appendix together with information on survey platforms and seasons. No coastal data were received from Norway.

Offshore areas

Only data sets which were suitable for linking with geographical information systems (GIS) were used. Data gathered during adverse weather conditions (> sea state 4) have been removed prior to analysis. The line transects used are shown in Appendix.

Colonies

Information on numbers of birds which would be expected to be associated with the breeding colonies of seabirds in the study region have been derived from the United Kingdom Seabird Colony Register, Lloyd *et al.* (1991), Grimmett & Jones (1989) and Hälterlein & Steinhardt (1993).

Data handling

On a seasonal basis all unsurveyed areas were omitted from analysis. In coastal areas these were coastal stretches with no total counts or transect counts, while unsurveyed offshore areas were at least 5 nautical miles off the coast and which had not been intersected by survey lines. The area between two neighbouring lines was determined as unsurveyed if the distance between them exceeded 15 nautical miles. A more detailed account of the data treatment is provided in the Appendix.

Transect counts

An ideal count of a transect would include all birds on the water. However, in reality the probability of missing a bird increases with distance to the observer. We therefore determined a correction factor to allow for birds missed while making counts of birds on the water using the software package DISTANCE (Laake *et al.* 1991, Buckland *et al.* 1993,). Numbers of counted birds on the water were corrected using these factors (see Appendix). Numbers of birds counted flying in the transect could not be corrected in this way. The average density of birds in 300 m transects from ships for a particular season was calculated by dividing the sum of the corrected numbers of sitting birds and (uncorrected) numbers of flying birds per count unit by the area covered during each count. The density from ship-

based transects of 200 m was calculated using the correction factors of Stone *et al.* (1995), while densities from transects narrower than 200 m were calculated without correction.

Total counts

The land-based, aerial and ship-based total counts have been averaged over a number of counts of stretches of coast and shallow grounds. To be able to compare the results from coastal surveys with the results of the offshore transects, the average total numbers were converted to densities per square km of sea surface. Thus, the resulting densities describe average values for comparable stretches of coast.

In the United Kingdom and Belgium, where several surveys were performed per season, average values for a particular season were obtained by averaging the maximum counts for that season, for each year that data were available.

Colonies

For seabird species known to exploit narrow feeding areas around the colony during the breeding season, numbers of breeding birds associated with colonies of international importance were used to derive expected densities of feeding birds in the near-colony area. This information was used only to map presumed important feeding areas in regions with poor survey effort.

Data interpolation

A Geographical Information System mapping routine, developed by Ornis Consult Ltd., was used to perform a detailed stratification of species distributions within predefined numeric ranges (see Appendix for details). The numeric ranges chosen were identical to those used for the analysis of seabird distribution in the Baltic (Durinck *et al.* 1994b). Density and population estimation as well as subsequent calculations of area importance were carried out separately for each density level.

Map interpretation

All maps have been prepared by using Universal Transverse Mercator projection (UTM, zone 32). Each map occupies one page. The borders between concentrations and hence between selected important bird areas should therefore be regarded as guidelines. Determination of exact boundaries at national and regional levels may require further analysis.

Offshore distributions are presented using the smoothed contour polygons of exact scale derived from the GIS. The numeric ranges set for contouring of bird densities of seabirds may be changed, thus affecting the outline of the boundaries of the selected areas.

Inshore distributions are shown using long-shore polygons with a width large enough to enable proper visualisation of differences in mean densities between the different stretches of coast. Therefore, the scale of the coastal polygons is often exaggerated by at least a factor two (two km or more) in comparison with the real distribution. Due to the lack of information on gull distribution in coastal areas, the maps showing the distribution of gull species contain only data from offshore areas. The distribution of divers, grebes and Shag in coastal areas in France is biased due to the lack of available coastal data on these species. In general, maps showing distributions of birds in coastal areas outside the winter season lacks information from coastal counts in France, Belgium and Sweden. The most comprehensive picture of coastal distributions of seabirds are given for areas in Netherlands, Denmark and Sweden.

Species like the Black Guillemot which occur strictly inshore have been severely undersampled during all surveys.

As single birds may occur throughout the study region, a lower limit of 20 birds and 0.1 birds per km² has been set in order to remove 'noise' from the maps.

Classification of marine areas

The importance of an area for a bird species is determined in relation to the total biogeographic popula-

tion following recent estimates by Lloyd *et al.* (1991), Durinck *et al.* (1994b) and Rose & Scott (1994). The geographic boundaries of the biogeographic populations vary between species. Areas holding at least 1% of a total biogeographic population of at least one bird species have been selected. This classification criterion has been adopted in accordance with the Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) and the BirdLife International/International Waterfowl and Wetlands Research Bureau inventory of important bird areas in Europe (Grimmett & Jones 1989, Rose & Scott 1994).

Definitions of threshold levels are needed to classify the relative importance of marine sites and due to the generally large size of marine areas a combination of population and area proportions is needed in order to ensure comparability between areas. In order to avoid the selection of large areas mainly as a function of their size further criterion was developed (Marine Classification Criterion (MCC) (Skov *et al.* 1994)). More details on this criterion and other aspects of the classification system applied are found in the Appendix.

The classification procedure follows the specific seasonal patterns of each species. If an area is important to a species in more than one season or in both mild and cold winters, the maximum seasonal value is used in subsequent analyses of the total importance of the areas.

Identification of important areas

The final maps of the main areas of importance to each species were combined on the G.I.S.. Those species which use the region in numbers of global significanse use relatively large areas. The boundaries of areas of importance to these species tend to contain most areas of importance to other species.

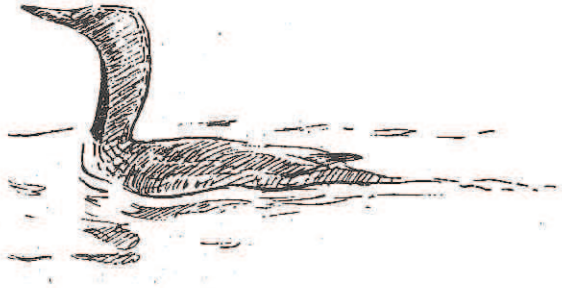
Adjacent areas were only merged, if their total value for seabirds was at the same level.

The total value of each geographical area for all species of seabirds was then calculated as the sum of proportions of the total populations of the species occurring in internationally important concentrations within the area. Each of the selected areas has been ranked by summarising the proportions of species concentrations estimated within them. No attempts were made to segregate areas characterized by marine habitat types or different bird communities.

We had the fortune to be able to build on the experiences of previous works presenting maps of seabird distribution in this area (Joensen 1974, Blake *et al.* 1984, Tasker *et al.* 1987, Lorentsen *et al.* 1993, Skov & Durinck 1993, Baptist & Wolf 1993, Camphuysen & Leopold 1994, Durinck *et al.* 1994b, Skov *et al.* 1994b) as well as Stone *et al.* (1995), Laursen *et al. (in press.)* and Offringa *et al. (in prep)*.

Important Bird Species

Red- and Black-throated Diver *Gavia stellata* and *Gavia arctica*



The Red-throated Diver and the Black-throated Diver have circumpolar distributions. They breed on lakes in the forest zone of the tundra, the Red-throated Diver having a more northerly distribution than the Black-throated Diver. Within the study region the Red-throated Diver breeds on Orkney and Shetland. These two diver species winter and moult at sea. In Europe, the most important wintering regions occur in the Baltic (Durinck *et al.* 1994b), the Black Sea and the North Sea (Skov *et al.* 1994b). Most divers wintering in Northwest Europe breed in Fennoscandia and Russia. In winter, Red-throated and Black-throated Divers feed on small fish such as cod, herring, sprat, gobies and sticklebacks caught in waters shallower than 30 m (Madsen 1957, Bauer & Glutz 1966, Cramp & Simmons 1977, Durinck *et al.* 1994a).

Importance of the North Sea

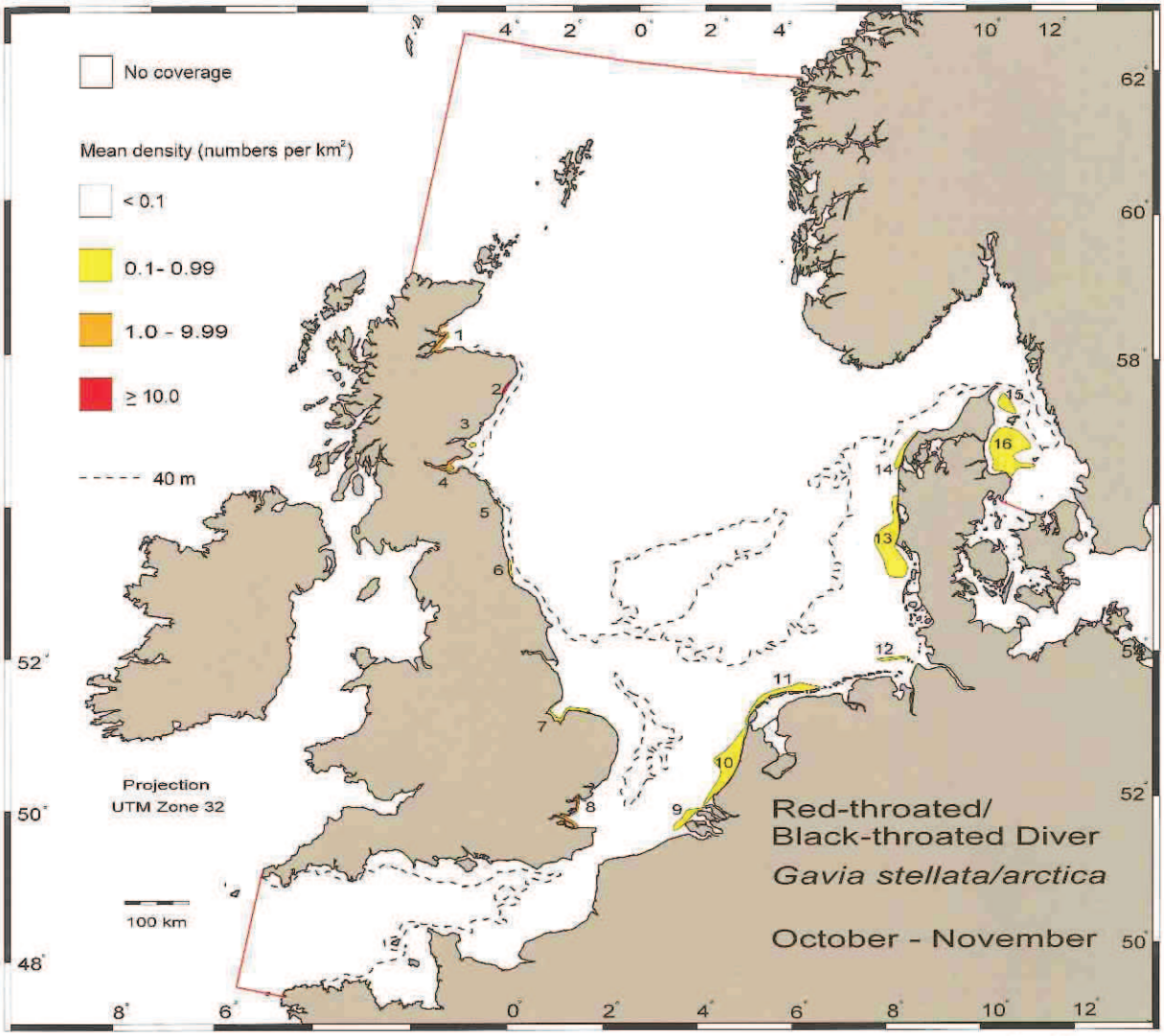
Based on recent surveys, Durinck *et al.* (1994b) estimated the total wintering population of the two species in Northwest Europe at 110,000. Of these, 48,000 winter in the North Sea, the Kattegat and the Channel (44% of the Northwest European wintering population), 43,000 winter in the Baltic (Durinck *et al.* 1994b) and less than 5,000 along the west coast of Britain and the central and southern coasts of Norway (Danielsen *et al.* 1993). The numbers observed on spring migration in the Northern Baltic are within the same order of magnitude (Leivo *et al.* 1994).

Main areas

During the non-breeding season, the most important concentrations of both of these divers seem to occur in the same areas year after year. At least half of the British birds are found in one inshore concentration north of Aberdeen which is of international importance from October to May. Most of the two divers were found in the southeastern part of the North Sea. In winter, internationally important concentrations are found here off the West and East Frisian Islands and in an extensive area north of the Elbe Estuary. More than 24,000 birds were estimated in the latter (areas 15-18), thereby making this concentration the largest known for the two species in Europe and of global importance. A large area with low densities in the southeastern North Sea also supports large numbers. In spring, a second area off the northwestern coast of Denmark is of international importance. In the Kattegat area, the shallow northwestern part is of international importance in winter. There were no data from France or Norway, and information is lacking from some of the lower density areas off United Kingdom.

Distribution patterns

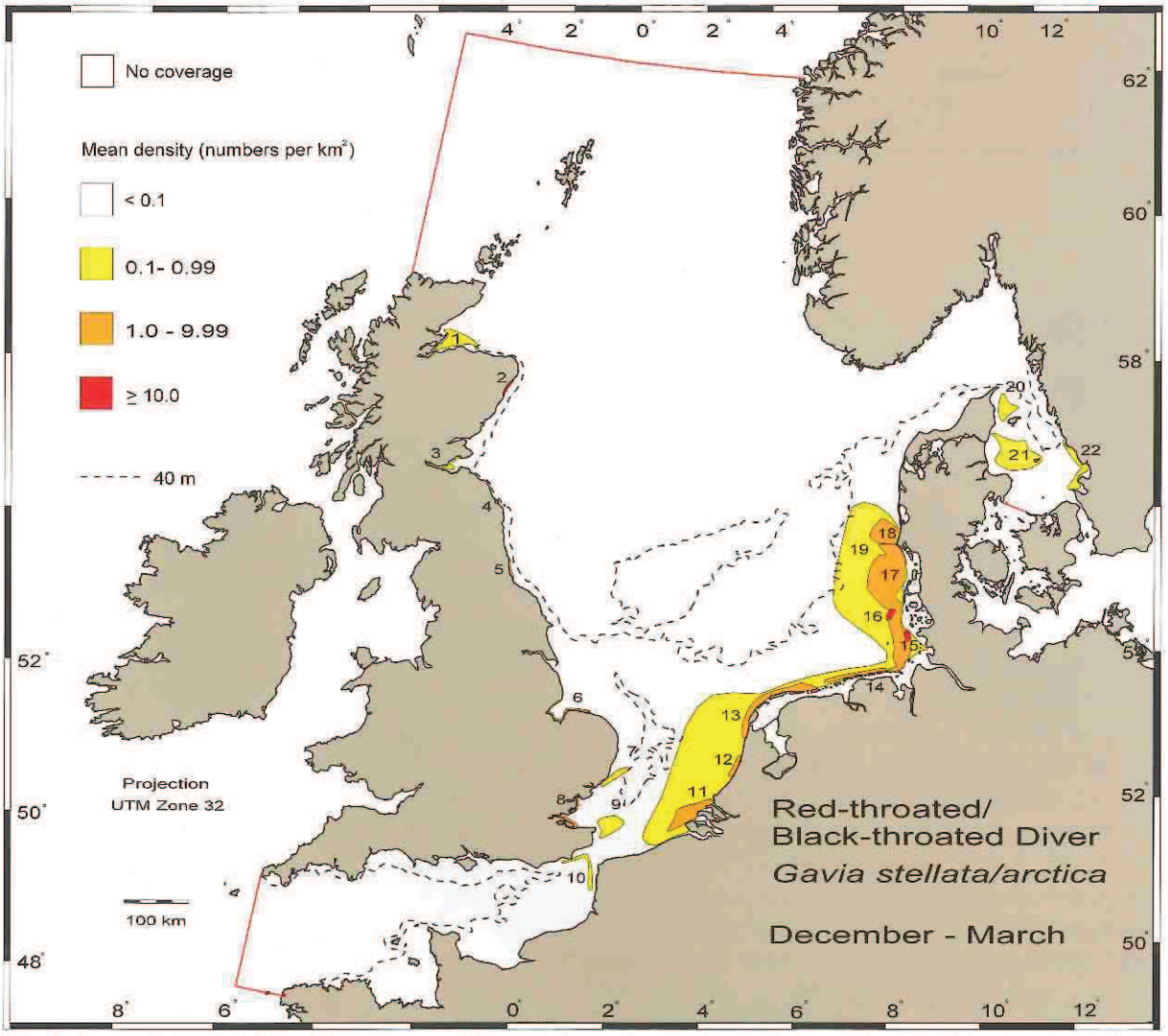
Although both species are commonly seen in inshore areas, the bulk of birds are found in offshore waters shallower than 30 m, especially off estuaries influenced by large river outfalls like the Elbe, Weser, Thames and Schelde. Both species begin to arrive in the study regions in September and in the following months the numbers gradually increase (Bauer & Glutz 1966). The distribution of the two diver species is only partly known since it has only been possible to specifically identify a minority of the birds at sea. In autumn and winter all areas in the western North Sea, the Channel and the Eastern North Sea south of 55° N are dominated by Red-throated Diver (> 90%). In spring an influx of Black-throated Diver is noted in the eastern part of the North Sea and in the Kattegat, the proportion of Black-throated varying between 25% and 50%.



Distribution and density of Red-& Black-throated Diver Gavia stellata/arctica *in the North Sea, the Channel and the Kattegat from October to November 1980-1994.*

The average numbers of Red-& Black-throated Diver *Gavia stellata/arctica* in key areas from October to November 1980-1994. Areas marked with bold are of international importance (MCC criteria).

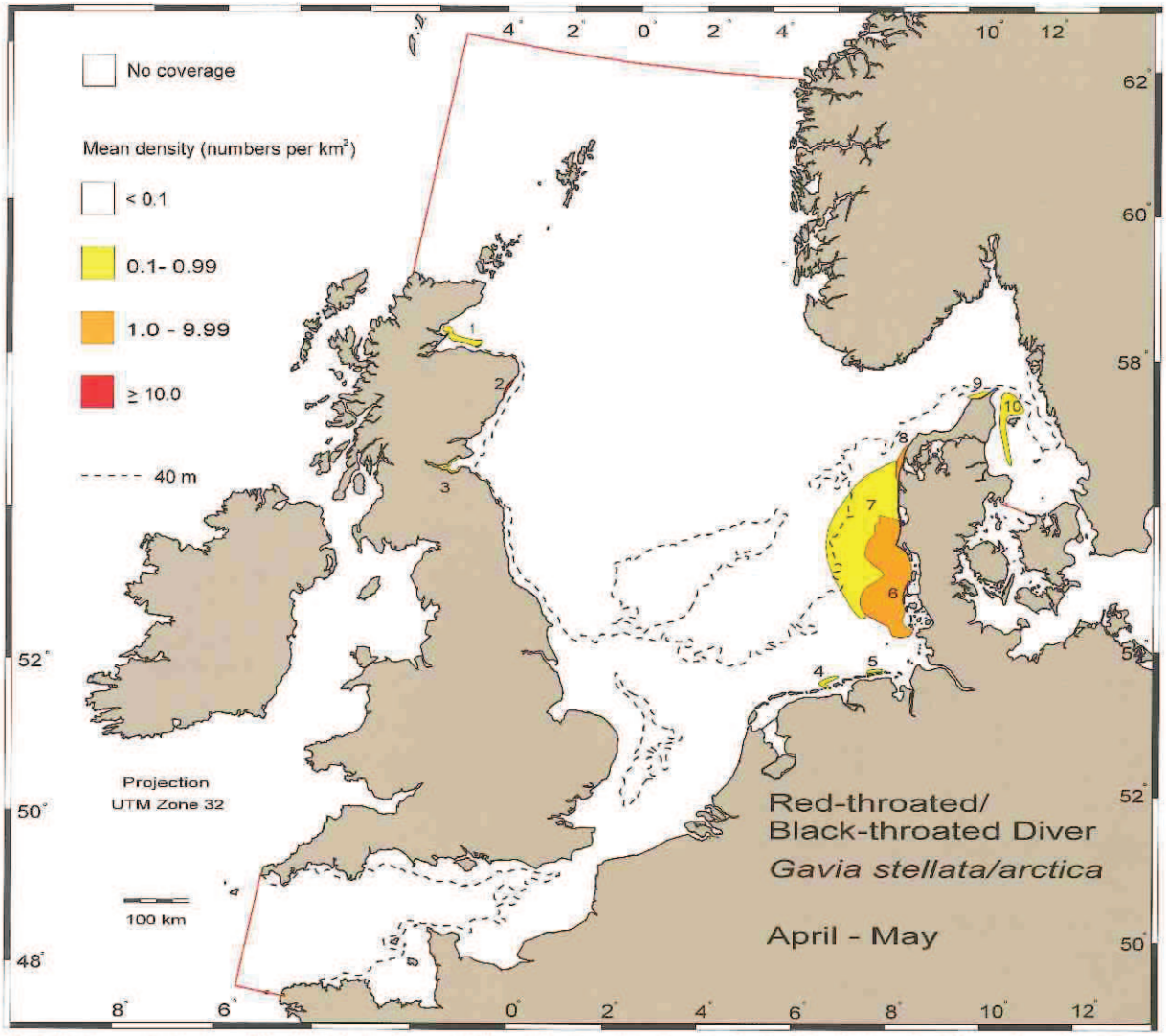
Locality	Density	Km²	Estimate	%
1 Moray Firth	1.29	400	500	7.37
2 Aberdeen-Cruden Bay	**18.57**	**70**	**1300**	**19.17**
3 St. Andrews Bay	0.98	55	55	0.81
4 Firth of Forth	1.22	40	50	0.74
5 Lindisfarne	0.57	35	20	0.29
6 Durham coast	0.9	30	25	0.37
7 Wash	0.64	125	80	1.18
8 Thames Estuary coast	1.10	210	230	3.39
9 Voordelta	0.86	490	400	5.90
10 Dutch Mainland coast	0.10	2490	250	3.69
11 West Frisian Islands	0.63	1300	800	11.80
12 Helgoland Bight	0.10	500	50	0.74
13 Eastern German Bight	**0.43**	**3240**	**1400**	**20.65**
14 Northwest Danish coast	0.23	425	100	1.47
15 North Læsø	0.15	460	70	1.03
16 Northwestern Kattegat	0.25	3265	800	11.80
Residual			650	9.59
Total			**6780**	**100.00**



Distribution and density of Red-& Black-throated Diver Gavia stellata/arctica *in the North Sea, the Channel and the Kattegat from December to March 1980-1994.*

The average numbers of Red-& Black-throated Diver *Gavia stellata/arctica* in key areas from December to March 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Moray Firth	0.10	1040	100	0.21
2 Aberdeen – Cruden Bay	**18.57**	**70**	**1300**	**2.68**
3 Firth of Forth	0.50	170	85	0.18
4 Lindisfarne	0.57	35	20	0.04
5 Durham coast	1.83	30	55	0.11
6 Wash	1.83	125	100	0.21
7 Oxford Ness	0.24	345	80	0.16
8 Thames Estuary, coast	1.10	210	230	0.47
9 North Foreland	0.56	1130	630	1.30
10 Dover Strait	0.20	720	150	0.31
11 Voordelta	1.02	1050	1070	2.21
12 Dutch mainland	1.03	285	300	0.62
13 West Frisian Island	**2.33**	**1350**	**3150**	**6.50**
14 East Frisian Island	**2.78**	**760**	**2100**	**4.33**
15 Süderoog	**11.40**	**670**	**7650**	**15.77**
16 Amrum Bank	**10.15**	**185**	**1900**	**3.92**
17 Eastern German Bight	**1.30**	**7750**	**10100**	**20.83**
18 Horns Rev	**1.75**	**2700**	**4750**	**9.79**
19 Southeast North Sea	0.28	42000	11800	24.33
20 Læsø north	0.17	745	125	0.26
21 Northwestern Kattegat	**0.39**	**2930**	**1150**	**2.37**
22 Halland coast	0.68	790	550	1.13
Residual			1100	2.27
Total			**48495**	**100.00**



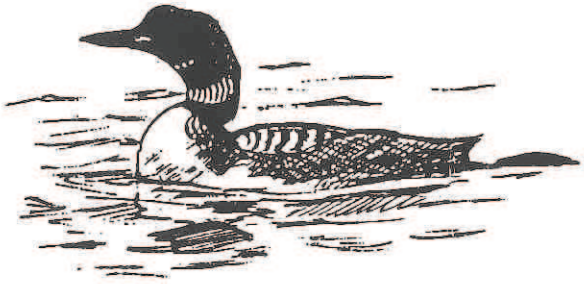
Distribution and density of Red-& Black-throated Diver Gavia stellata/arctica *in the North Sea, the Channel and the Kattegat from April to May 1980-1994.*

The average numbers of Red-& Black-throated Diver *Gavia stellata/arctica* in key areas from April to May 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Moray Firth	0.58	670	400	1.34
2 Aberdeen – Cruden Bay	**18.57**	**70**	**1300**	**4.36**
3 Firth of Forth	0.45	10	50	0.17
4 Ems Estuary	0.19	155	30	0.10
5 East Frisian Islands	0.38	70	25	0.08
6 Eastern German Bight	**1.81**	**13000**	**23500**	**78.86**
7 Southeastern North Sea	0.16	10500	1700	5.70
8 Danish Northwest Coast	**2.11**	**560**	**1200**	**4.03**
9 Tannisbugt	0.47	195	90	0.30
10 Northwestern Kattegat	0.25	1660	400	1.34
Residual			1100	3.69
Total			**29800**	**100.00**

Great Northern Diver *Gavia immer*

Great Northern Divers breed in Iceland, Greenland and arctic North America. The species breeds on inland lakes, feeding primarily on fish, but if necessary it will also take molluscs, crustaceans and other invertebrates. Great Northern Divers spend the winter at sea, in Europe mainly in areas with rocky coasts and clear, highly saline water. Little is known of winter diets, but they seem to take a variety of bottom-living animals, including flatfish and roundfish, and crabs, also pelagic fish, such as herring (King 1976, McIntyre 1989, Haney 1990, del Hoyo *et al.* 1992, Heubeck *et al.* 1993).



Importance of the North Sea

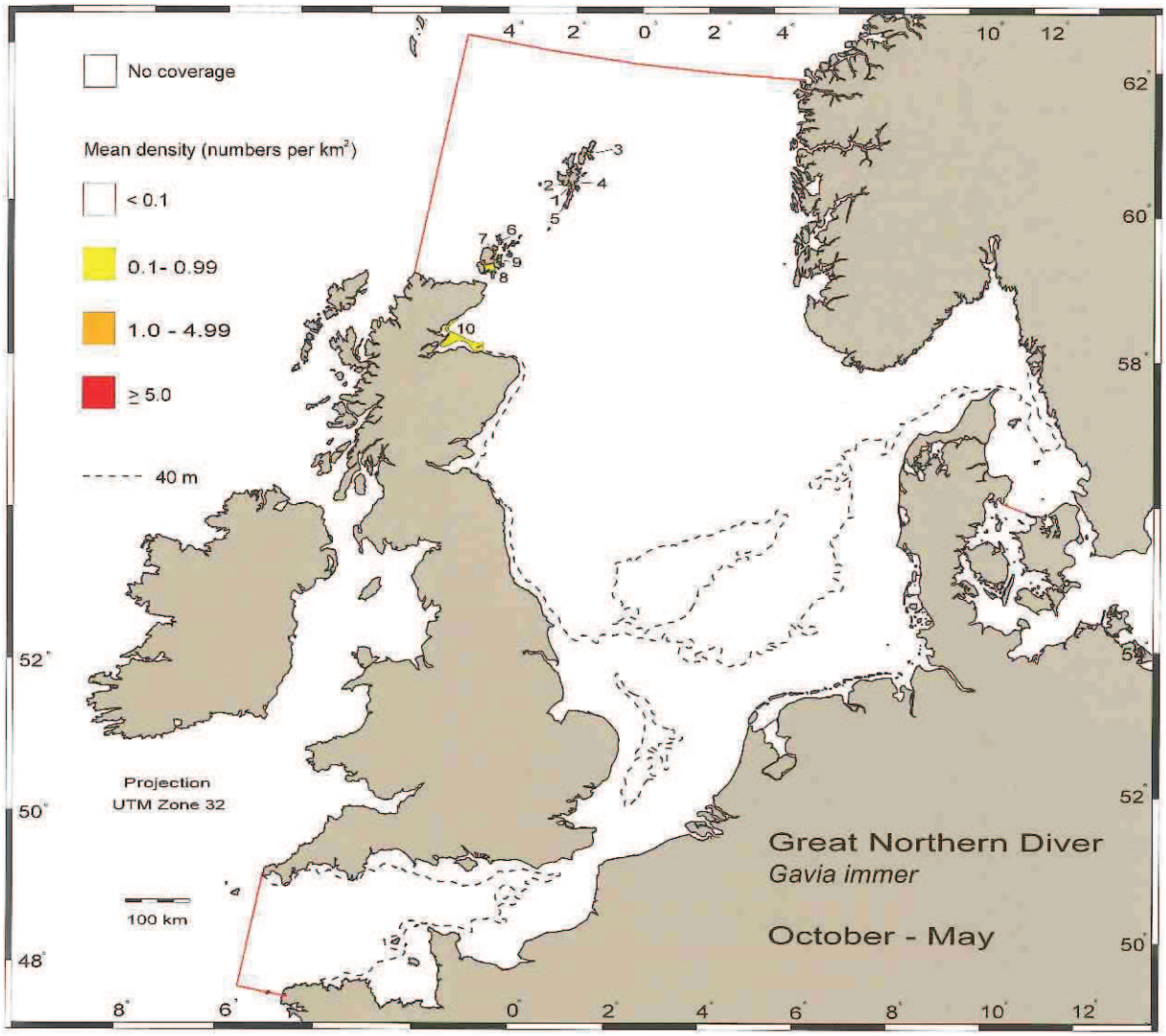
The total number wintering in Europe, as assessed from coastal counts, is about 5000; 1000-1500 in Scotland, another 2-3000 around other parts of Great Britain, and Ireland, 1000 in the Norwegian fjords and several hundreds off Brittany (Jones *et al.* 1978, Heubeck *et al.* 1993, Rose & Scott 1994). Compared to a world population of 505,000 birds (Rose & Scott 1994), the importance of the North Sea is obviously limited on a global scale. The origin of the Great Northern Divers that winter in the North Sea and Channel is unknown, however. The breeding population of Iceland is too small to account for the numbers found in winter in Western Europe. Measurements of birds found dead in Shetland suggests that birds from Greenland and possibly Baffin Island (Canada) are also involved (Heubeck *et al.* 1993). The breeding numbers in these areas are unknown, but constitute probably only a small fraction of the world total. The study region appears to be of great significance for these populations.

Main areas

As Great Northern Divers remain mostly in inshore waters, often in fjord-like habitats, very few were counted during the offshore seabirds at sea counts. These counts have, however, confirmed that this species rarely occurs away from the coast (Stone *et al.* 1995). Great Northern Divers may be encountered in all months off Northeast Scotland (Buckland *et al.* 1990), but the highest estimated numbers were found from October to May inclusive. The largest proportion winter around Shetland and Orkney and in the Moray Firth. These areas hold internationally important numbers in these months, relative to the European wintering population. There were no data from France or Norway.

Distribution patterns

Great Northern Divers are mainly found off the rocky coasts of Scotland. Off the USA Great Northern Divers prefer clear waters over more turbid waters near rocky shores, and they may use areas deeper than those used by Red-and Black-throated Divers (Haney 1990).



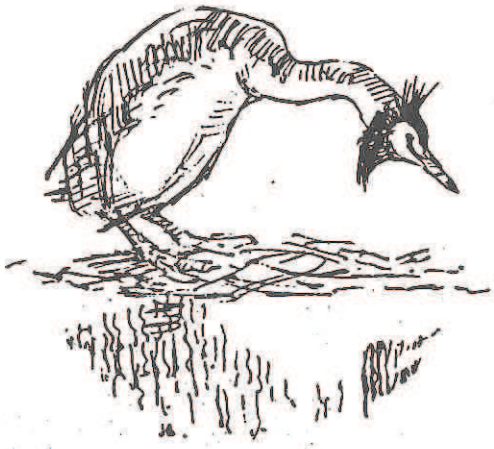
Distribution and density of Great Northern Diver Gavia immer *in the North Sea, the Channel and the Kattegat from October to May 1980-1994.*

The average numbers of Great Northern Diver *Gavia immer* in key areas from October to May 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Scalloway	3.00	15	45	4,97
2 Weisdale Voe	2,33	15	35	3,87
3 Bluemull Sound	**1,80**	**30**	**55**	**6,08**
4 Lamgarth Head	1,67	15	25	2,76
5 Bay of Quendale	**5.00**	**10**	**50**	**5,52**
6 Westray	**2.00**	**35**	**70**	**7,73**
7 Eynhallow, Gairsay & Rousay	**2,33**	**60**	**140**	**15,47**
8 Scapa Flow	**0,95**	**210**	**200**	**22,10**
9 Shapinsay Sound	0,39	40	15	1,66
10 Inner Moray Firth	**0,13**	**865**	**110**	**12,15**
Residual, Shetland			85	9,39
Residual, other areas			75	8,29
Total			**905**	**100,00**

Great Crested Grebe *Podiceps cristatus*

Great Crested Grebes breed in wetlands throughout Eurasia. During the breeding season, the species is essentially confined to fresh water habitats. After breeding, the birds concentrate on several large lakes to moult. Such concentrations may number 40,000 birds, but are more typically in the order of several hundred to 10,000 birds (Vlug 1983, Piersma *et al.* 1986). In winter the birds seek out ice-free waters and in this period marine areas are also used. Studies show, that birds breeding in Fennoscandia winter mainly in Southeast Europe, but also in the Baltic and around the Wadden Sea; birds breeding in Denmark, Germany, The Netherlands and Belgium winter mainly in central-west Europe (France, Austria, Switzerland), but also locally in fresh water, brackish and marine habitats around the southern North Sea and Channel; British birds were all recovered within that country (Adriaensen *et al.* 1993). The diet consists mostly of small roundfish (Bauer & Glutz 1966).



Importance of the North Sea

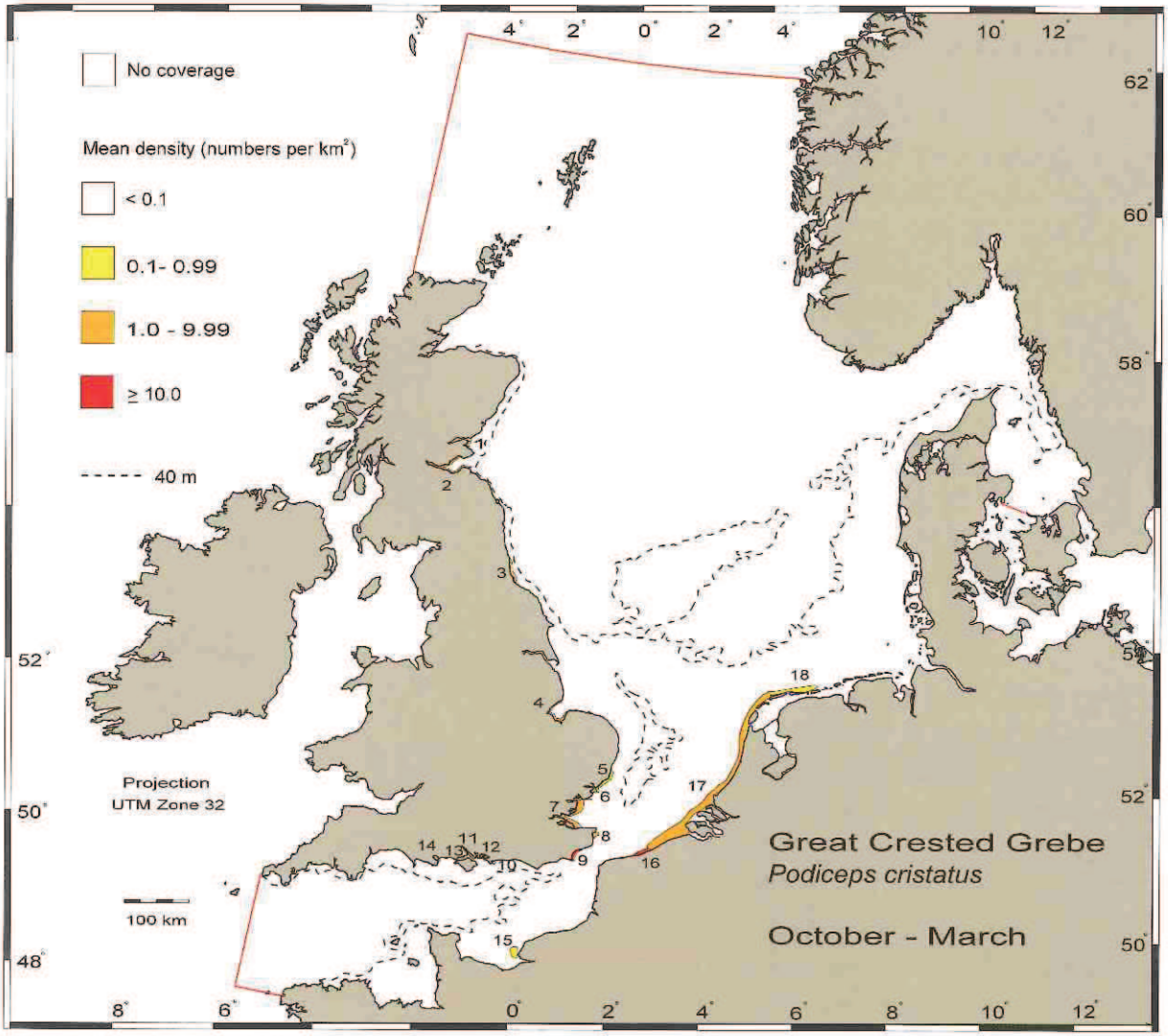
Precise estimates of the size of the breeding population are lacking for this species. Numbers and range have increased recently and the current total European breeding population could be in the order of 100,000 pairs (Adriaensen *et al.* 1993). The Northwest European winter population is around 100,000 birds (Fjeldså & O'Dunnell *in press*). Important concentrations are found in winter in the Baltic (11,000, Durinck *et al.* 1994b), IJsselmeer and the Delta area, The Netherlands (up to 18,000, van den Bergh 1988). An average of 14,000 Great Crested Grebes is found in the study region from October through March (14% of Northwest European winter population).

Main areas

The largest numbers are found in the southern North Sea; the Belgian and Dutch coast between Nieuwport and Terschelling support 75% of the North Sea total. Both areas are internationally important. The core areas are along the Continental coast from IJmuiden to the Hook van Holland, the Voordelta (both in The Netherlands) and Nieuwpoort-De Panne in Belgium. Together, these areas support around 50% of all Great Crested Grebes in the North Sea. Coastal counts in Great Britain have shown that several sheltered parts of coastline, notably the Thames Estuary and the Firth of Forth, hold relatively large numbers in winter. Further concentrations are found around the Isle of Wight and in the Baie de la Seine.

Distribution patterns

The first birds arrive in the North Sea in October, the last leave in March. Peak numbers are found in the North Sea during coldspells in winter, when inland sites freeze over. This forces the birds out to sea, but many perish under such conditions (Camphuysen & Derks 1989). Great Crested Grebes are only found in inshore waters. Migration into and away from the southern North Sea occurs mainly overland: numbers seen along the coast further north are considerably lower (Jakobsen 1988, Platteeuw *et al.* 1994). The south-eastern North Sea is an integrated part of the wintering area in The Netherlands (Camphuysen & Derks 1989, Camphuysen & Leopold 1994). Many British birds move to the sealochs and fjords in winter.



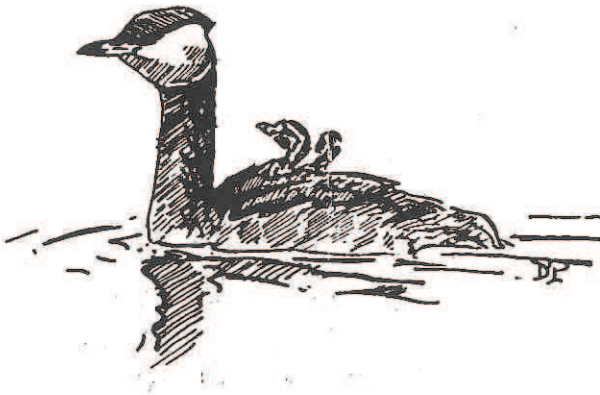
Distribution and density of Great Crested Grebe Podiceps cristatus *in the North Sea, the Channel and the Kattegat from October to March 1980-1994.*

The average numbers of Great Crested Grebe *Podiceps cristatus* in key areas from October to March 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Eden Estuary	1.33	15	20	0.14
2 Firth of Forth	6.36	140	890	6.40
3 Durham coast & Tees Estuary	1.38	40	55	0.40
4 Wash	1.25	80	100	0.72
5 Alde Complex	0.67	30	20	0.14
6 Orwell & Deben estuaries	2.50	20	50	0.36
7 Thames Estuary	4.21	210	885	6.37
8 Pegwell Bay	4.17	6	25	0.18
9 Dungeness	38.67	15	580	4.17
10 Pagham Harbour	4.17	6	25	0.18
11 Southampton Water	2.20	25	55	0.40
12 Langstone & Chichester Harbours	1.73	55	95	0.68
13 Needs Oar Point & northwest Solent	1.33	15	20	0.14
14 Poole Harbour	0.63	40	25	0.18
15 Baie de la Seine	0.82	160	130	0.94
16 Nieuwpoort – De Panne	**40.00**	**25**	**1000**	**7.19**
17 De Panne – Terschelling	**3.00**	**3170**	**9500**	**68.35**
18 Terschelling – Schiermonnikoog	0.32	400	130	0.94
Residual			300	2.16
Total			**13900**	**100.00**

Red-necked Grebe *Podiceps grisegena*

Red-necked Grebes breed in small wetlands throughout central and east Europe. In West Europe, Sweden (600 pairs), Denmark (900) and Schleswig-Holstein, Germany (700) have relatively large populations (del Hoyo *et al.* 1992, Fjeldså & O'Dunnell *in press*). Germany used to be at the western limit of the breeding range, but the species has recently extended its range further to the south-west and is now breeding in The Netherlands (van Dijk *et al.* 1994). Red-necked Grebes winter in coastal waters of the Aegean, Black, Caspian and Aral seas in Southern Eurasia. In Northwest Europe wintering grounds are in the South-western Baltic, along the west coast of Norway and in the Eastern North Sea (Nygård 1985, del Hoyo *et al.* 1992, Durinck *et al.* 1994b). During summer, much of the food consists of aquatic arthropods and insects; a larger proportion of fish is taken in winter (Fjeldså 1982, Piersma 1988, Vlug 1993).



Importance of the North Sea

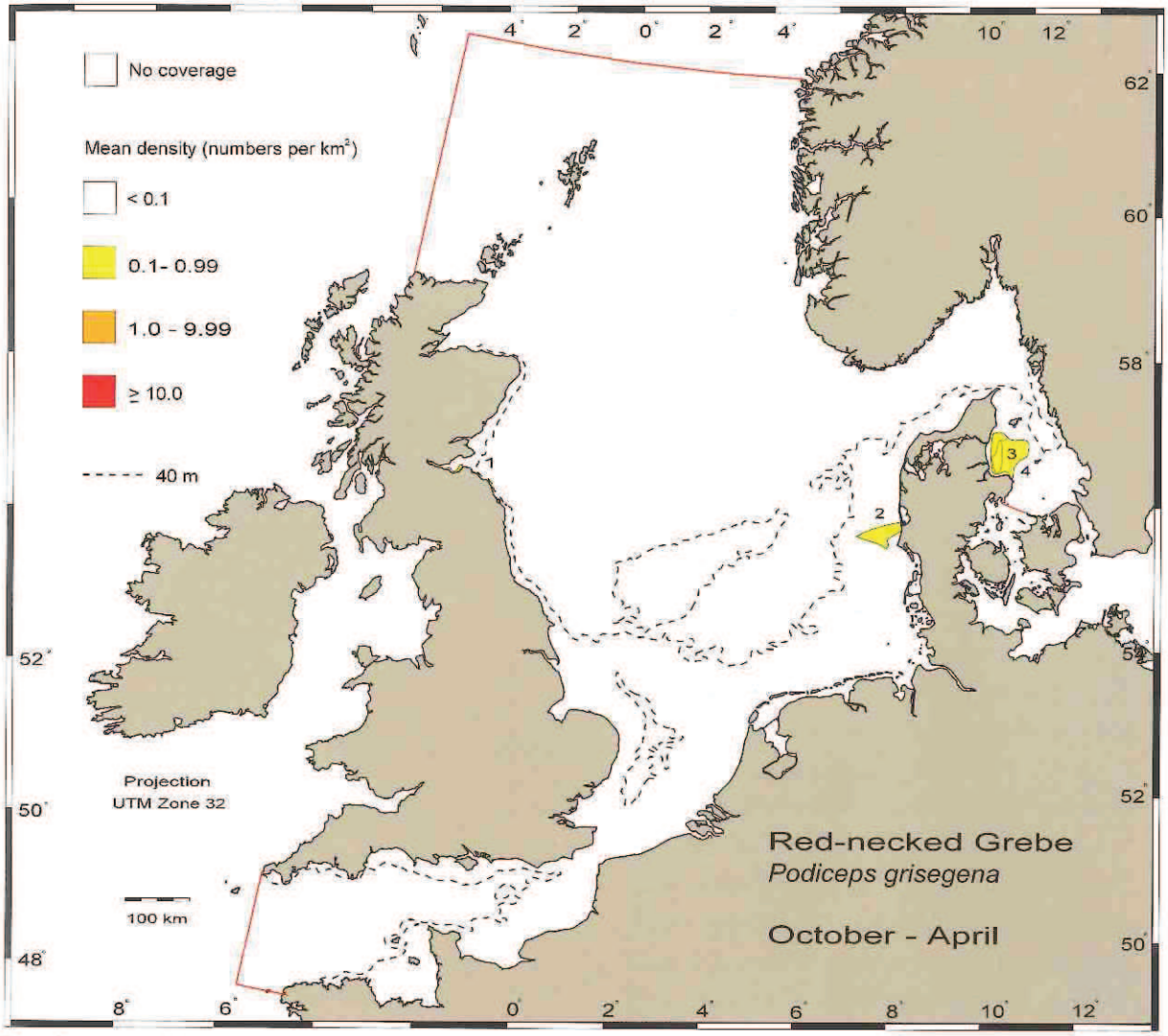
The size of the total European breeding population is not known, probably around 5,000 pairs (del Hoyo *et al.* 1992). The size of the European wintering population is estimated at 15,000 birds (Fjeldså & O'Dunnell *in press.*). Of these, 3,200 winter in the Northwestern Kattegat (Durinck *et al.* 1994b) and 2000-3000 off West Norway (Nygård 1985). The total for the North Sea and the Kattegat may then be as much as 41% of the European wintering population. In the coldest winters, birds from the Baltic may move to the North Sea, arriving in waters off Britain and Ireland (Chandler 1981, Camphuysen 1989).

Main areas

Only two areas are of international importance within the study region. The Northwestern Kattegat and the Horns Rev off Western Denmark. Averaged over the winter (October through April) these areas hold 10% and 1% of the European wintering population, respectively. Coastal counts in Britain indicate that about 100 birds spend the winter dispersed along the eastern and southern coasts of Britain (Chandler 1986). Another 100 birds or so may be found dotted along the Continental coasts of the North Sea and inshore in the Skagerrak-Kattegat area. The population wintering off Norway was not assessed during this study.

Distribution patterns

Red-necked Grebes are found in inshore as well as offshore waters shallower than 20 m. A few birds arrive as early as July, probably on their way to moulting areas such as the Dutch Delta area where small parties are known to occur in summer (Ouweneel 1990). Numbers observed along the coast in Denmark and The Netherlands start to increase from September and remain relatively high until spring migration in April (Jakobsen 1988, Platteeuw *et al.* 1994). Most birds wintering off Norway originate in Scandinavia and reach that area over land (Størkersen 1985).



Distribution and density of Red-necked Grebe Podiceps grisegena *in the North Sea, the Channel and the Kattegat from October to April 1980-1994.*

The average numbers of Red-necked Grebe *Podiceps grisegena* in key areas from October to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Firth of Forth	0.77	30	25	1.27
2 Horns Rev	**0.14**	**1320**	**200**	**10.13**
3 Northwest Kattegat, medium	**2.06**	**480**	**1000**	**50.63**
4 Northwest Kattegat, low	**0.24**	**2345**	**550**	**27.85**
Residual			200	10.13
Total			**1975**	**100.00**

Cormorant *Phalacrocorax carbo*

The Cormorant is distributed widely around the planet and breeds in Europe, Greenland, Africa, Asia and Australia. In Europe, large breeding colonies of the continental subspecies *P.c. sinensis* have reestablished mostly in inland areas in The Netherlands, Germany and Denmark after prolonged periods of persecution. The Atlantic form *P.c. carbo* breeds mostly on the coasts of mid and north Norway, Britain, Ireland and France. The Cormorant is partially migratory. The north European population of the continental subspecies is 100,000 pairs and the northwest European population of the Atlantic form is 60,000 pairs (Rose & Scott 1994). It is a gregarious species and flocks of several thousands birds are sometimes formed in its prime habitat along sheltered coasts and in estuaries, while few birds venture out to the open sea. Cormorants feed mainly on small fish, especially sandeels, clupeids and gadids (Barrett *et al.* 1990).

Importance of the North Sea

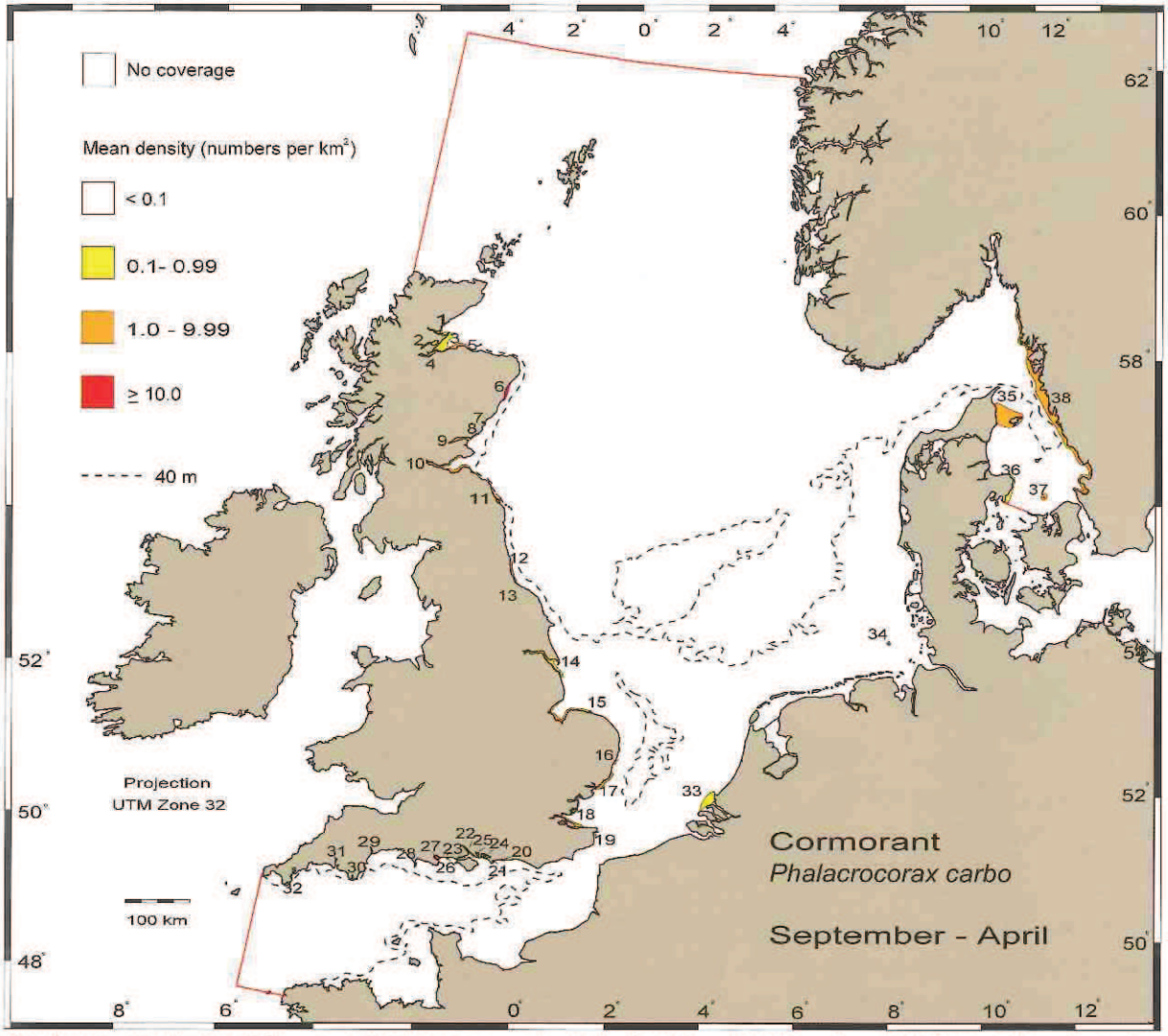
The breeding population of Cormorants found on the east British coast and in Shetland and Orkney and in the Channel comprises few thousand pairs (Lloyd *et al.* 1991). During the breeding season 6700 birds are estimated at sea, while during the non-breeding season when birds from Norwegian colonies enter the Kattegat, 14,000 birds are estimated for the region (4.4% of the north European population).

Main areas

Throughout the year, several concentrations are found in British estuaries, in the Voordelta, along the coast of the Wadden Sea islands and in shallow areas of the northwestern Kattegat. However, only the concentration of wintering cormorants found on the Swedish westcoast is of international importance.

Distribution patterns

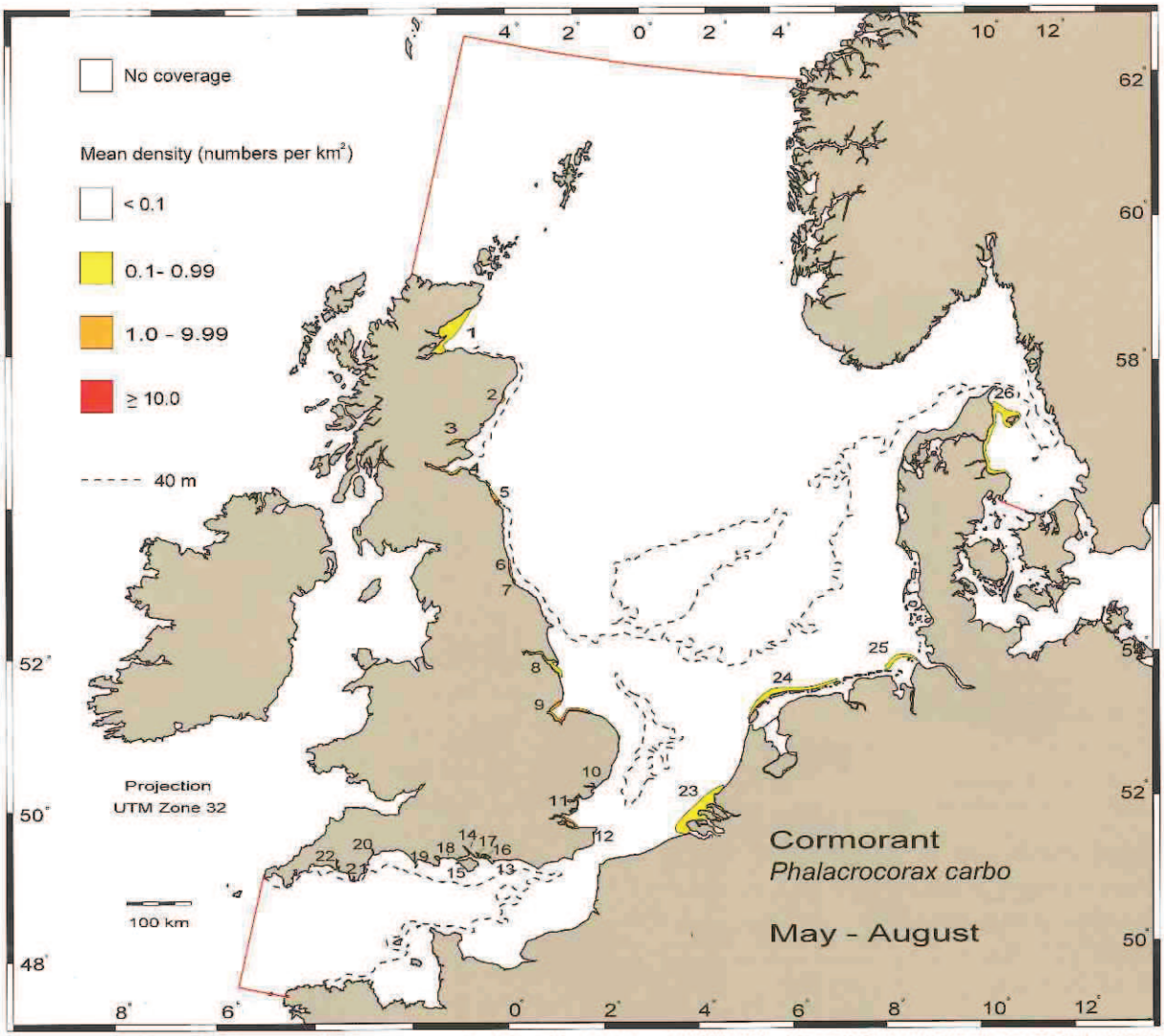
Depending on the severity of the winter, many *P.c. sinensis* migrate south of the region in winter, while the population of *P.c. carbo* which breeds in the study region is non-migratory and only forms extensive coastal and inland dispersal (Cramp & Simmons 1977). Except for the extensive shallow area of the northwestern Kattegat, Cormorants were never observed more than 5 km from land, and only in waters less than 10 m deep.



Distribution and density of Cormorant Phalacrocorax carbo *in the North Sea, the Channel and the Kattegat from September to April 1980-1994.*

The average numbers of Cormorant *Phalacrocorax carbo* from September to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Dornoch Firth & Embo-Brora	2.33	60	140	0.98
2 Cromarty Firth	0.80	75	60	0.42
3 North Moray Firth	0.12	1130	150	1.05
4 Inner Moray Firth	7.29	85	620	4.33
5 Burghead – Buckie	4.11	45	185	1.29
6 Collieston – Aberdeen	16.17	30	485	3.39
7 Montrose Basin	7.10	10	70	0.49
8 Arbroath	3.67	15	55	0.38
9 Firth of Tay	2.18	55	120	0.84
10 Firth of Forth	6.57	140	920	6.43
11 Lindisfarne	6.43	35	225	1.57
12 Durham coast	3.67	30	110	0.77
13 Tees Estuary	21.50	10	215	1.50
14 Humber Estuary	0.86	145	125	0.87
15 Wash	2.80	125	350	2.44
16 Blyth Estuary	4.17	6	25	0.17
17 Orwell Estuary – Alde Complex	6.30	50	315	2.20
18 Thames Estuary	7.42	240	1780	12.43
19 Pegwell Bay	5.83	6	35	0.24
20 Clymping	5.00	6	30	0.21
21 Pagham Harbour	15.83	6	95	0.66
22 Southampton Water	4.60	25	115	0.80
23 Needs Oar Point & Northwest Solent	3.33	15	50	0.35
24 Langstone & Chichester Harbours	1.32	155	205	1.43
25 Portsmouth Harbour	3.00	15	45	0.31
26 Christchurch Harbour	11.00	5	55	0.38
27 Poole Harbour	9.63	40	385	2.69
28 Portland Harbou	2.00	10	20	0.14
29 Exe Estuary	5.00	20	100	0.70
30 Salcombe Estuary	4.50	10	45	0.31
31 Tamar Complex	2.25	40	90	0.63
32 Fal Complex	0.83	30	25	0.17
33 North Voordelta	0.77	260	200	1.40
34 Helgoland	0.62	65	40	0.28
35 Læsø	1.00	1000	1000	6.99
36 Fornæs	0.15	620	90	0.63
37 Hesselø	8.50	40	340	2.38
38 Swedish West Coast	**3.00**	**1400**	**4200**	**29.34**
Residual			1200	8.38
Total			**14315**	**100.00**



The average numbers of Cormorant *Phalacrocorax carbo* from May to August 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Distribution and density of Cormorant Phalacrocorax carbo *in the North Sea, the Channel and the Kattegat from May to August 1980-1994.*

Locality	Density	Km²	Estimate	%
1 West Moray Firth	0.12	1130	150	2.24
2 Aberdeen	6.47	15	100	1.50
3 Firth of Tay	1.24	55	70	1.05
4 Firth of Forth	2.80	140	390	5.83
5 Lindisfarne	1.57	35	55	0.82
6 Durham coast	7.03	30	210	3.14
7 Tees Estuary	20.00	10	200	2.99
8 Humber Estuary	0.21	145	30	0.45
9 Wash	1.92	125	240	3.59
10 Orwell Estuary – Alde Complex	1.70	50	85	1.27
11 Thames Estuary	3.62	210	760	11.37
12 Pegwell Bay	3.50	6	20	0.30
13 Pagham Harbour	4.33	6	85	1.27
14 Southampton Water	2.40	25	60	0.90
15 Needs Oar Point & Northwest Solent	1.67	15	25	0.37
16 Langstone & Chichester harbours	0.68	155	105	1.57
17 Portsmouth Harbour	2.33	15	35	0.52
18 Christchurch Harbour	11.20	5	55	0.82
19 Poole Harbour	5.63	40	225	3.37
20 Exe Estuary	4.00	20	80	1.20
21 Salcombe Estuary	2.00	10	20	0.30
22 Tamar Complex	3.43	40	135	2.02
23 Voordelta	0.81	1500	1050	15.71
24 West Frisian Islands	0.56	1100	600	8.98
25 Elbe Mouth	0.26	600	150	2.24
26 Northwest Kattegat	0.96	1400	1350	20.19
Residual			400	5.98
Total			**6685**	**100.00**

Shag *Phalacrocorax aristotelis*

Shags are generally coastal birds. The nominate subspecies *aristotelis* breeds on rocky coasts in the Northeast Atlantic, from the British Isles east to Northwest Russia and south to Gibraltar and numbers 125,000 pairs (Rose & Scott 1994). Outside the breeding season the birds remain in coastal waters, but may disperse along the coast, seeking good feeding grounds and shelter. Birds of northern Norway are relatively migratory, moving largely to SW Norway in winter (Galbraith *et al.* 1986, Lloyd *et al.* 1991). Shags feed mainly on small fish, especially sandeels, clupeids and gadids (Barrett *et al.* 1990).

Importance of the North Sea

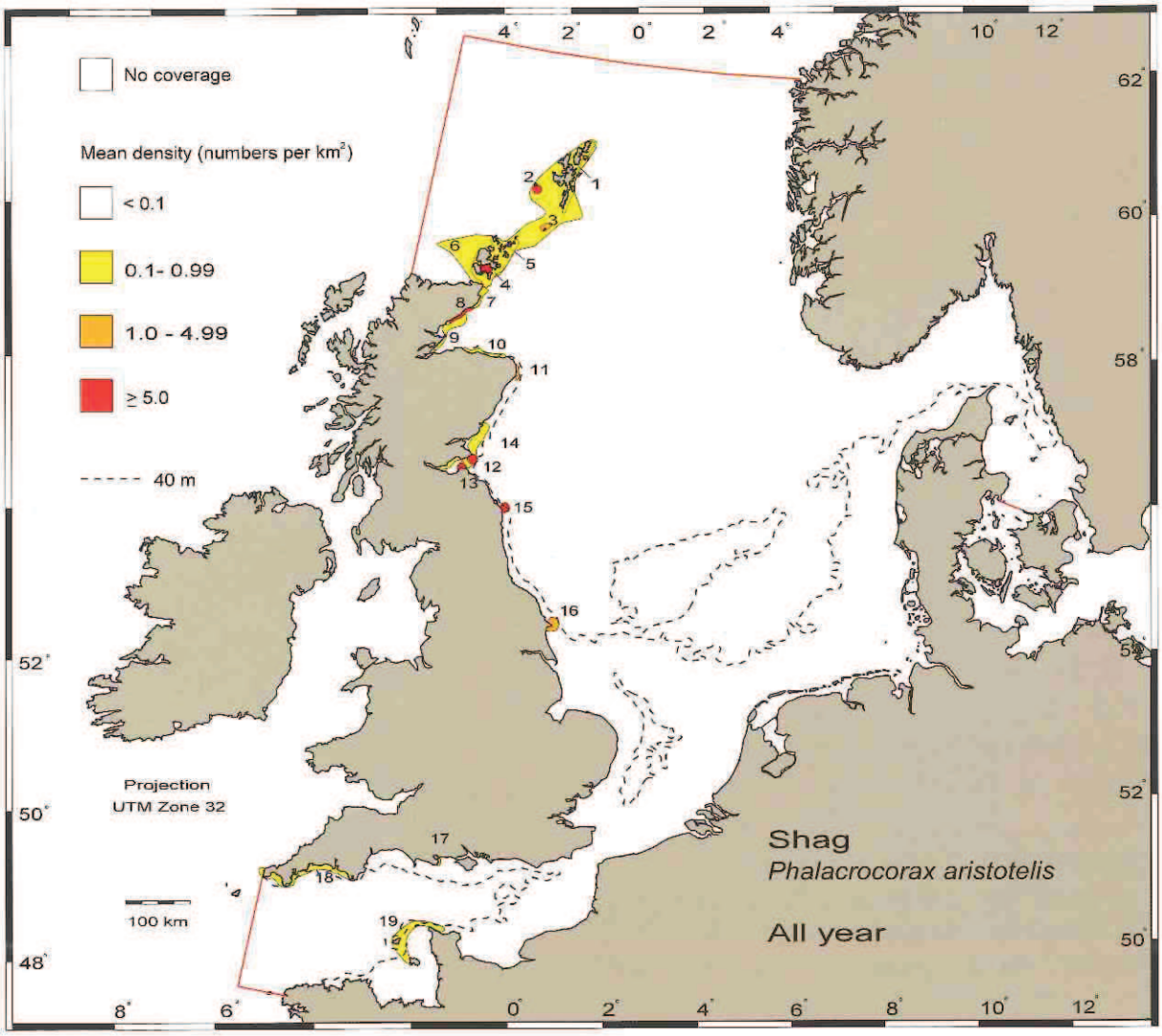
Around 22,500 pairs of Shags breed in the North Sea, Skagerrak and Channel, about 18% of the Northeast Atlantic population. The majority of these, some 15,000 breed in Northeast Scotland, 1750 in SW and W Norway and 2400 pairs in the Channel (Tasker *et al.* 1987, Lloyd *et al.* 1991, Stone *et al.* 1995). The yearly average of numbers at sea in the study region is estimated at nearly 30,000 birds. However, as all Shags in the study region, including the juveniles, must rely on the sea for their food and the local birds largely remain in the study area, at least twice this number must be present. Unlike most seabirds in the region, Shags must roost out of water during the night.

Main areas

Apart from some stragglers, all the Shags have been found in coastal waters near colonies. The Shetland-Orkney area is the most important region, with 50% of all Shags estimated in the study region. Major breeding and wintering areas have been found here, of which Foula and the Scapa Flow are of international importance. Relatively large numbers of Shags reside all along the Scottish Northeast coasts and a second area of concentration is found in the Firth of Forth, where the Isle of May and North Berwick are of international importance. Further south, the Farne Islands colony is of international importance. Nowhere in the Channel do numbers meet the MCC criterion.

Distribution patterns

As Shags are largely sedentary inshore birds within the study region, their distribution at sea reflects the distribution of colonies at all times of year. Shags are thus found off Scotland, in the Channel and presumably off Norway, and are rare elsewhere at all times. It should be noted that coastal areas in France and Norway have been under-represented as counts of shags were not available from these areas.



Distribution and density of Shag Phalacrocorax aristotelis *in the North Sea, the Channel and the Kattegat all year 1980-1994.*

The average numbers of Shag *Phalacrocorax aristotelis* in key areas all year 1980-1994. Areas marked with bold are of international importance (MCC criteria).

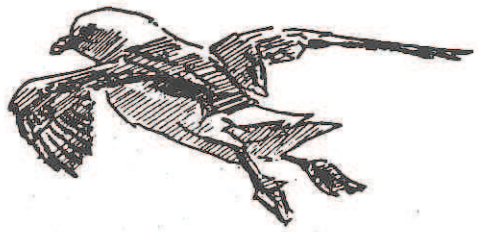
Locality	Density	Km²	Estimate	%
1 Shetland mainland	0.91	1440	1300	4.47
2 Foula	**26.70**	**180**	**4800**	**16.49**
3 Fair Isle	3.99	265	1050	3.61
4 Scapa Flow	**14.00**	**200**	**2800**	**9.62**
5 Orkney	0.82	2800	2300	7.90
6 Orkney – Shetland, low	0.29	9795	2850	9.79
7 Duncansby Head – Wick	0.75	300	225	0.77
8 Wick – Helmsdale	**26.24**	**170**	**4450**	**15.28**
9 Dornoch Firth	0.48	690	330	1.13
10 Lossiemouth – Kinnaird Head	0.58	420	245	0.84
11 Peterhead	1.15	100	115	0.39
12 Isle of May	**14.00**	**180**	**2520**	**8.66**
13 N Berwick	**14.00**	**180**	**2520**	**8.66**
14 Firth of Forth – Tay Bay	0.95	1500	1400	4.81
15 Farne Islands	28.90	45	1300	4.47
16 Flamborough Head	1.05	40	40	0.14
17 Poole Bay	0.35	50	20	0.07
18 Southern Cornwall	0.37	1500	550	1.89
19 Channel Islands – North Normandy	0.19	1590	300	1.03
Residual			0	0
Total			**29115**	**100.00**

Fulmar *Fulmarus glacialis*

Fulmars are very abundant in the North Atlantic. The Atlantic breeding population is estimated to be over 10 million pairs, the largest proportions of which breed in Iceland (Lloyd *et al.* 1991). There is also a huge number of sub-adults, as Fulmars do not start breeding until they are about 10 (males) and 12 (females) years old (Dunnet 1991), which makes this species the most abundant seabird of the region. Fulmars have shown a spectacular increase in numbers and range during the last 150 years, a trend that is still continuing (Walsh *et al.* 1994). Fulmars range widely when feeding; and even active breeders have been observed hundreds of kilometers from their colonies. Non-breeders from Britain have been found over much of the North Atlantic (Lloyd *et al.* 1991). Fulmars eat a variety of organisms taken from the uppermost waterlayer, mainly planktonic crustaceans, cephalopods and small fish (Fisher 1956). Fishery waste supplements this diet (Camphuysen *et al.* 1995).

Importance of the North Sea

Almost all of the North Sea breeding population of 310,000 pairs is found in Shetland, Orkney and northern Scotland. Several thousands of pairs are found in England, about 1,100 pairs in France while only tens of pairs breed in Southwest Norway and Helgoland (Tasker *et al.* 1987, Lloyd *et al.* 1991, Yeatman *et al.* 1995). Over 3 million birds may occur in the study region after the breeding season (about 20% of Northeast Atlantic breeding population). In winter there is a noticeable influx of birds from the high arctic (Tasker *et al.* 1987, Camphuysen & Leopold 1994). Birds from lower arctic regions (West Greenland, Iceland, Faroe Islands and Jan Mayen) may also use the study region after



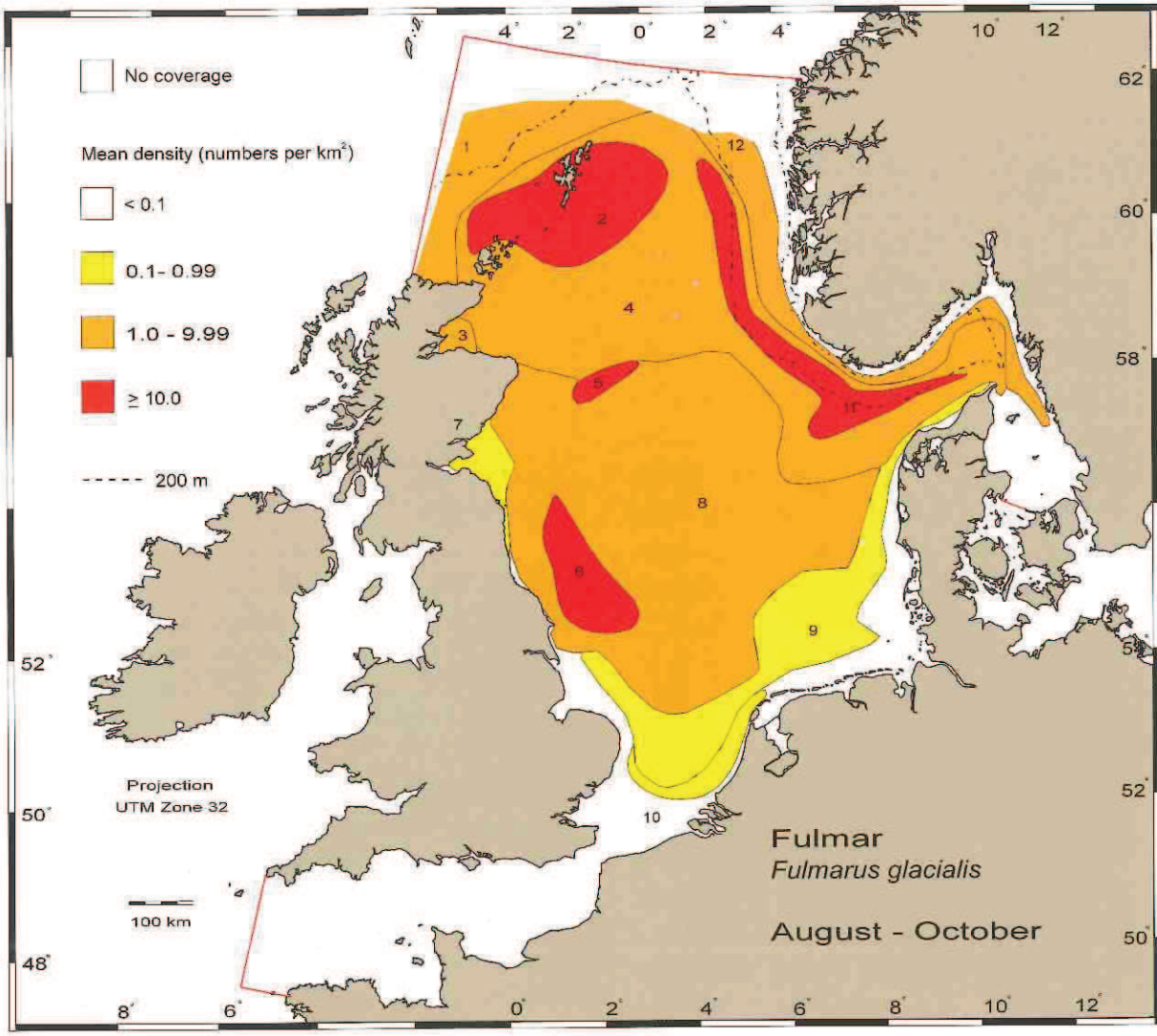
breeding but their provenance cannot be recognised at sea.

Main areas

Fulmars occur over vast areas in all seasons and at no time is a single area of international importance. The species is most numerous in the Northern North Sea at all times of the year.

Distribution patterns

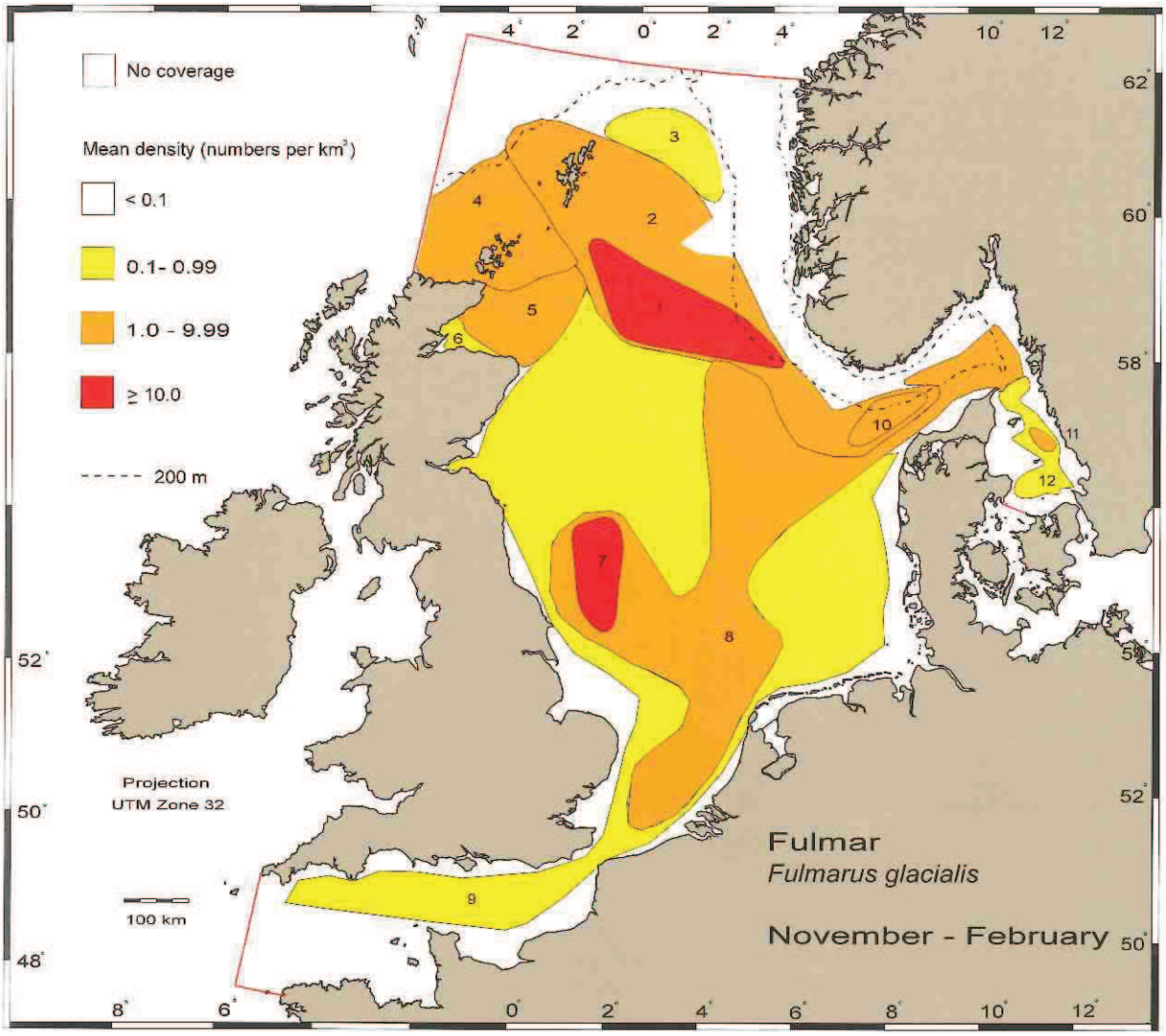
Typically, Fulmars have a dispersed distribution at medium densities, with increased densities in the more oceanic northern parts. In the North Sea they prefer stratified and highly saline waters and frontal zones between water masses (Joiris 1978, Skov *et al.* 1994b). In spring the birds are more or less concentrated in areas around Shetland, while during summer (May-July) the birds are most concentrated at the shelf break in the northwest. During autumn and winter high densities occur away from the colonies in some well-defined areas: the Aberdeen Bank, Dogger Bank and at the southern and western edges of the Norwegian Trench. Fulmars are one of the most numerous birds attending active trawlers and this may have a local effect throughout the study region. The Channel is near the southern limit of the range of the species (Stone *et al.* 1995) and this, as well as the adjacent Southern Bight, support relatively few Fulmars. The coastal, less saline waters in the eastern half of the study region are not preferred (Durinck *et al.* 1993b).



Distribution and density of Fulmar Fulmarus glacialis *in the North Sea, the Channel and the Kattegat from August to October 1980-1994.*

The average numbers of Fulmar *Fulmarus glacialis* in key areas from August to October 1980-1994. Areas marked with bold are of international importance (MCC criteria).

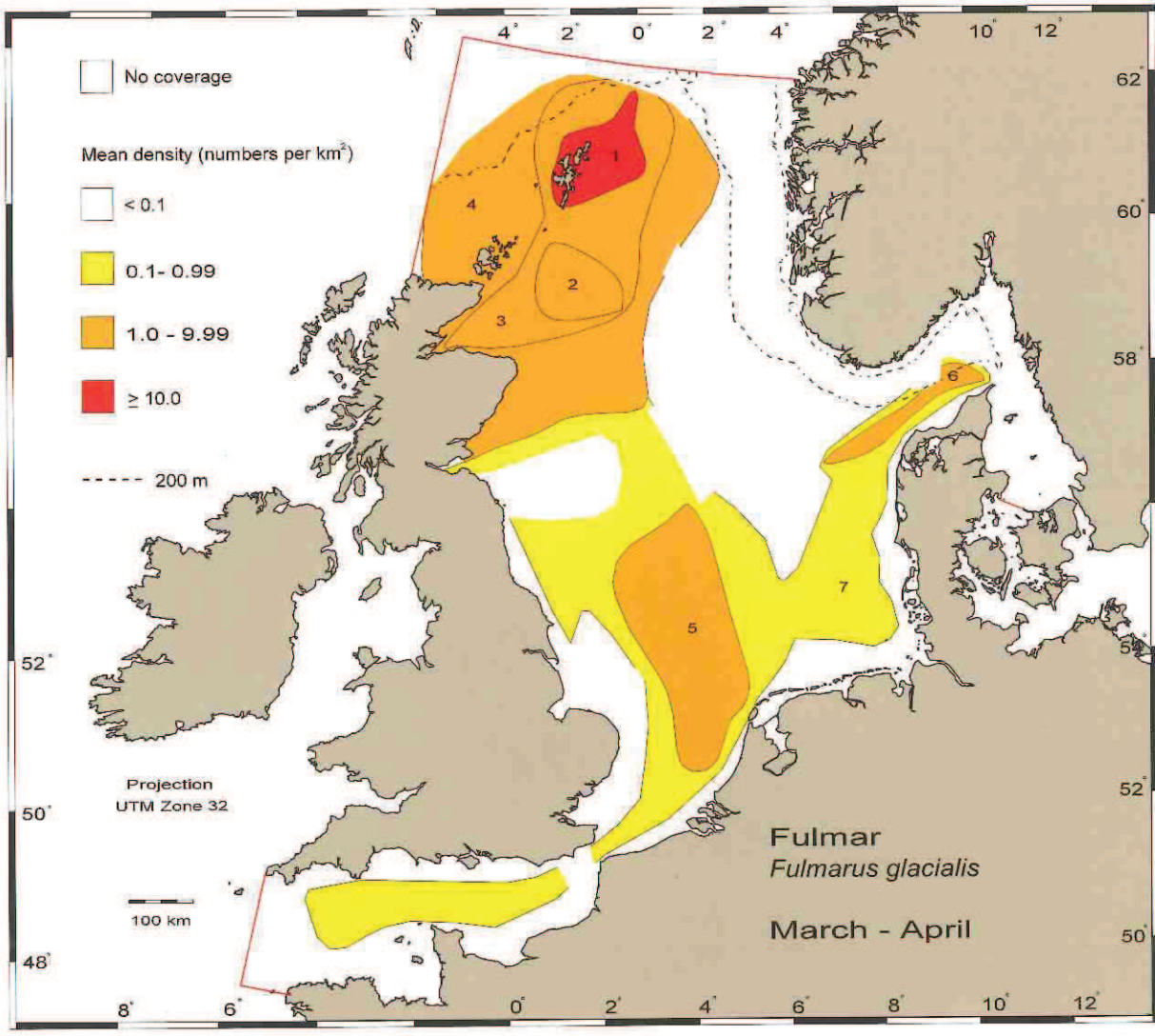
Locality	Density	Km²	Estimate	%
1 Orkney – Shetland northwest	1.85	44500	82000	2.55
2 Shetland – Fair Isle Channel	16.90	37500	634000	19.59
3 Moray Firth	1.16	2750	3200	0.10
4 Northern North Sea	6.99	118000	825000	25.50
5 Aberdeen Bank	21.17	7300	155000	4.78
6 North East Bank – Hills	8.21	23600	194000	5.99
7 Firth of Forth	0.45	6500	2900	0.09
8 Central North Sea	2.70	206000	556000	17.20
9 Southeastern North Sea. low	0.72	45000	32000	1.00
10 Southeastern North Sea. very low	0.18	8750	1600	0.05
11 Southwest Norwegian Trench	25.68	27300	701000	21.67
12 Northeast Norwegian Trench	1.11	32400	36000	1.11
Residual			12000	0.37
Total			**3235000**	**100.00**



Distribution and density of Fulmar Fulmarus glacialis *in the North Sea, the Channel and the Kattegat from November to February 1980-1994.*

The average numbers of Fulmar *Fulmarus glacialis* in key areas from November to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

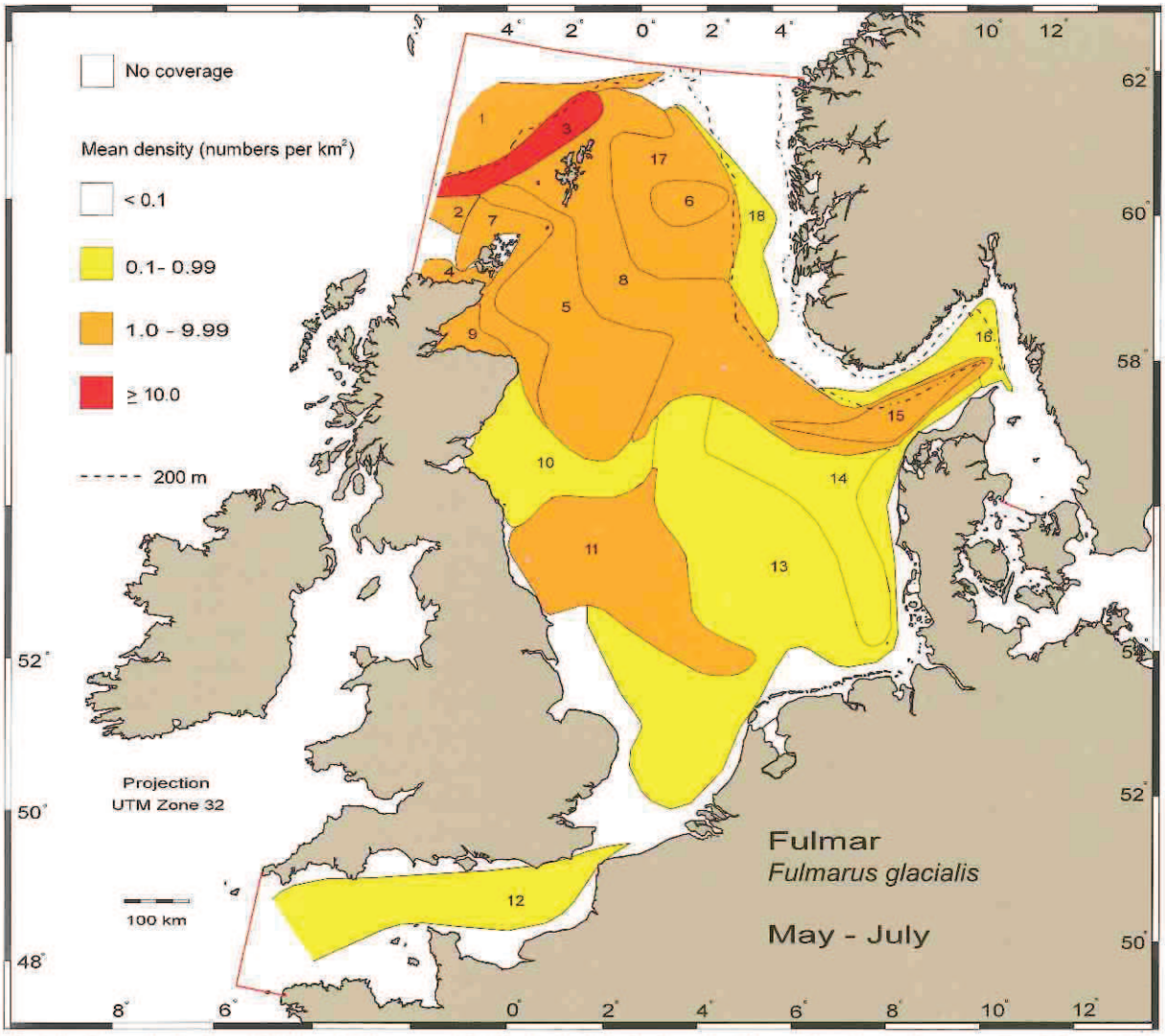
Locality	Density	Km²	Estimate	%
1 Bressay Bank-Norwegian Trench	23.62	34285	810000	43.26
2 Northern North Sea, medium	3.36	80685	217000	14.48
3 Halibut Bank	0.95	2930	13000	0.66
4 Orkney	1.30	33600	44000	2.33
5 Moray Firth – Little Halibut Bank	2.43	20350	50000	2.64
6 West Moray Firth	0.38	2050	800	0.04
7 North East Bank – Hills	28.66	13490	387000	20.66
8 North Sea, low	1.40	141000	197000	10.55
9 Channel - North Sea	0.25	76390	19000	1.02
10 Little Fisher Bank – Skagerrak	9.51	7030	67000	3.57
11 Middelgrundene	1.56	1315	2000	0.11
12 Kattegat	0.19	7735	1500	0.08
Residual			500	0.03
Total			**1872000**	**100.00**



Distribution and density of Fulmar Fulmarus glacialis *in the North Sea, the Channel and the Kattegat from March to April 1980-1994.*

The average numbers of Fulmar *Fulmarus glacialis* in key areas from March to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Shetland	25.66	18640	478000	46.75
2 Little Halibut Bank	9.30	15500	144000	14.09
3 Northern North Sea, medium	1.76	43860	7700	7.55
4 Northern North Sea, low	1.06	123600	131000	12.81
5 Brown Ridge – Dogger Bank	1.63	58880	96000	9.38
6 Little Fisher Bank – Skagerrak	1.35	10500	14000	1.39
7 North Sea – Channel	0.29	280000	81000	7.94
Residual			1000	0.10
Total			**1023000**	**100.00**



Distribution and density of Fulmar Fulmarus glacialis *in the North Sea, the Channel and the Kattegat from May to July 1980-1994.*

The average numbers of Fulmar *Fulmarus glacialis* in key areas from May to July 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Shetland – Faroe Channel	1.67	40000	67000	3.89
2 Papa Bank	1.03	3600	3700	0.22
3 Northwest Continental Shelf	30.66	17000	521000	30.34
4 Pentland Firth – Cape Wrath	2.85	3370	10000	0.56
5 Fair Isle Channel – Aberdeen Bank	5.59	53430	299000	17.39
6 Bergen Bank	5.08	9700	49000	2.87
7 Orkney – Bosies Bank	4.01	20300	81000	4.74
8 Shetland – Skagerrak	3.05	103000	314000	18.29
9 Moray Firth	1.10	4200	4600	0.27
10 Firth of Forth – Devils Hole	0.79	27800	22000	1.28
11 Dogger Bank	1.50	54800	82000	4.79
12 The Channel	0.28	53000	15000	0.86
13 North Sea, low	0.47	92660	43550	2.54
14 German Bight – Great Fisher Bank	0.83	34800	44000	1.68
15 Little Fisher Bank – Skagerrak	8.25	13600	29000	6.53
16 Skagerrak, low	0.98	11400	112000	0.65
17 Utsira Hole – Viking Bank	1.52	29850	45000	2.64
18 Norwegian Trench, low	0.36	14350	5000	0.30
Residual			3000	0.17
Total			**1717800**	**100.00**

Gannet *Morus bassanus*

Gannets breed in few, but increasing numbers of colonies on both sides of the Atlantic. Large colonies are found in the United Kingdom, Ireland, France and Iceland. The North Sea and Channel are widely used throughout the year, as are the waters west of Britain. Most adults spend the winter in the area, while juveniles and subadults largely move south in winter, towards the tropics. Gannets plunge dive for shoaling fish and supplement this diet with discards from fishing vessels (Nelson 1978).

Importance of the North Sea

Two-thirds of the world population breed in the Northeast Atlantic, where the population in the mid. 1980s was estimated at 230,000 pairs (Tucker & Heath 1994). Numbers have been increasing by 2-3% per year in the past decades. Birds from Britain, the world's stronghold of the species, have colonised Norway, France and Germany. About 190,000 pairs, or 83% of the European population breed in the British Isles (Lloyd *et al.* 1991, Tasker 1994), with the North Sea and Channel holding 45,000 breeding pairs (20%). The study region holds approximately 160,000 Gannets throughout the year, which is equivalent of 35% of the Northeast Atlantic breeding population.

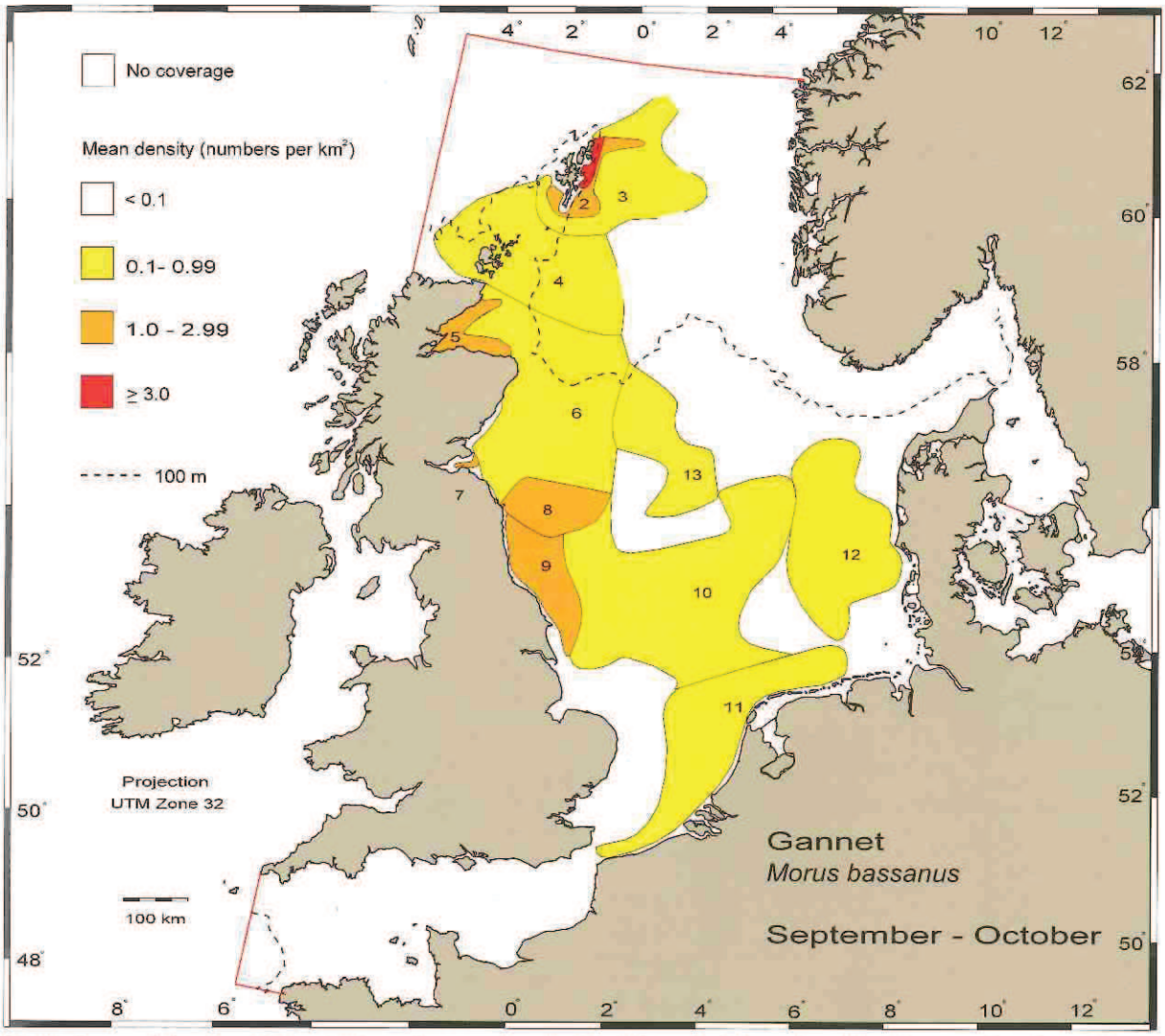
Main areas

For much of the year, the majority of Gannets at sea in the study region are dispersed outside areas of international significance. In the pre-breeding period (March-April) most were found around Shetland, in the vicinity of the main colonies in the north of the study region. The area north of Shetland is of international importance in this period. Sea areas around other important colonies (Bass Rock, the Channel Islands and Bretagne) were insufficiently surveyed, but a similar situation may be expected here. In the breeding season (May-August) core areas off Shetland and the Bass Rock together hold 17,4% of the birds in the North Sea, and are of international importance. However, as Gannets range widely in the breeding season (Tasker *et al.* 1985a), many birds are found at considerable distances from the colony.

In September-October, Gannets are widely distributed over the western half of the study region. The waters close to Shetland and the North East Bank have internationally important concentrations at this time. In winter (November-February) Gannets are also widespread, yet distinct concentrations of international importance are found in the Channel, in the Hills area west of the Dogger Bank and in the Reef area over the 100-m contour of the Norwegian Trench.

Distribution patterns

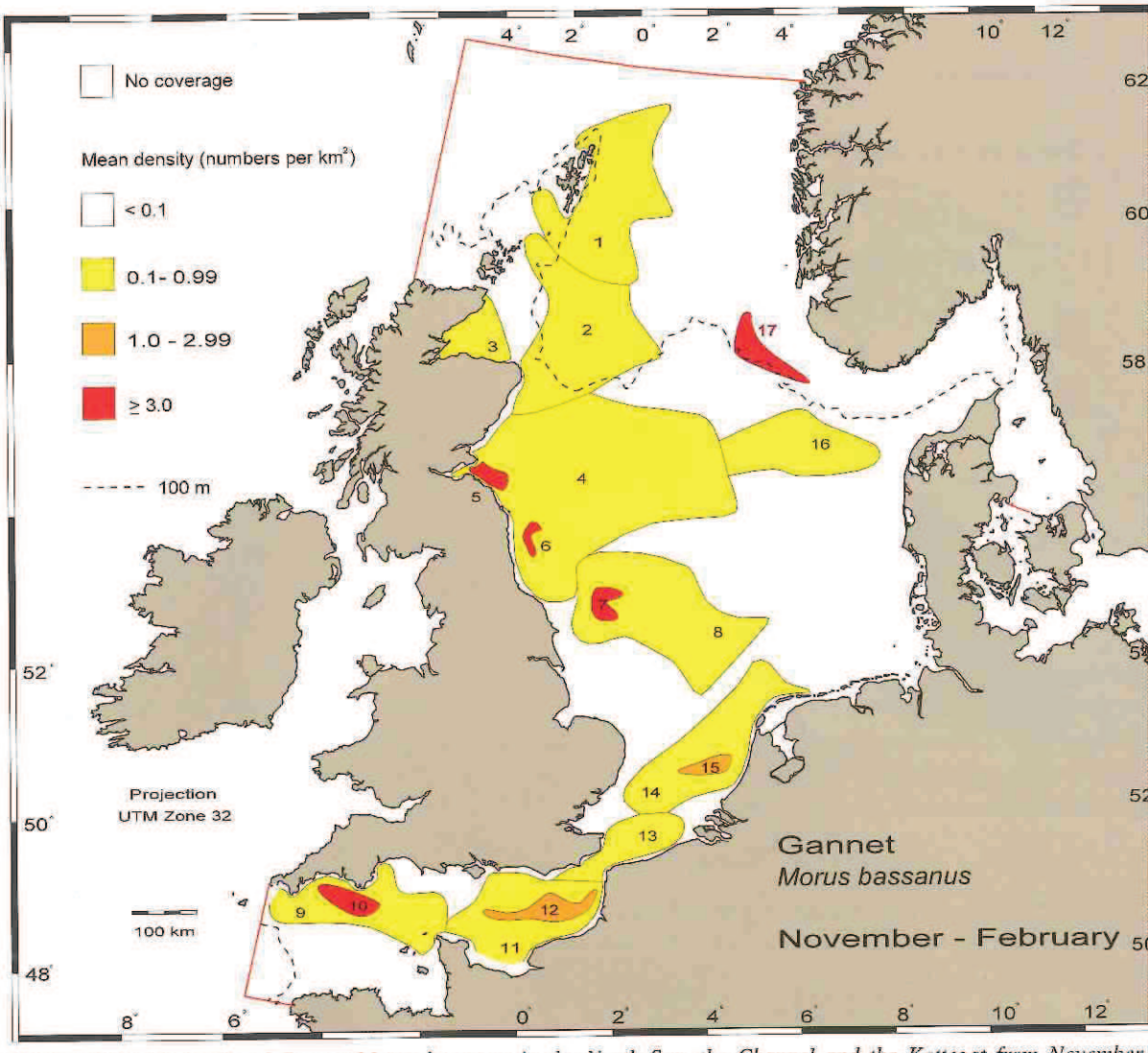
The study region is mainly of importance to immature birds in summer. As the birds mature the tendency to migrate southwards in winter decreases and the wintering quarters become more northerly each year, until adult life (Thompson 1974). Adult Gannets start to return to their colonies in February-March. Younger birds arrive several months later and also leave earlier in autumn (Tasker *et al.* 1987, Camphuysen & Leopold 1994). In general, the majority of the Gannets are dispersed in the western half of the study region, with comparatively few birds off the Norwegian coast, in the Skagerrak, Kattegat and in the German and Southern Bights. In summer there is an obvious association with the colonies but Gannets are still found over large areas of Britain. The species is most widely dispersed in the North Sea and adjacent waters in late summer and autumn, when some birds migrate while others might merely be seeking profitable feeding grounds (Leopold & Platteeuw 1987). The movement of birds from the North Sea to the Channel and further south is obvious in the figures. Those birds remaining in the North Sea (Tasker at al. 1987, Camphuysen & Leopold 1994), may be joined by others breeding to the north and west (Barrett 1988). For most of the year Gannets may attend fishing vessels (Camphuysen *et al.* 1995).



Distribution and density of Gannet Morus bassanus *in the North Sea, the Channel and the Kattegat from September to October 1980-1994.*

The average numbers of Gannet *Morus bassanus* in key areas from September to October 1980-1994. Areas marked with bold are of international importance (MCC criteria).

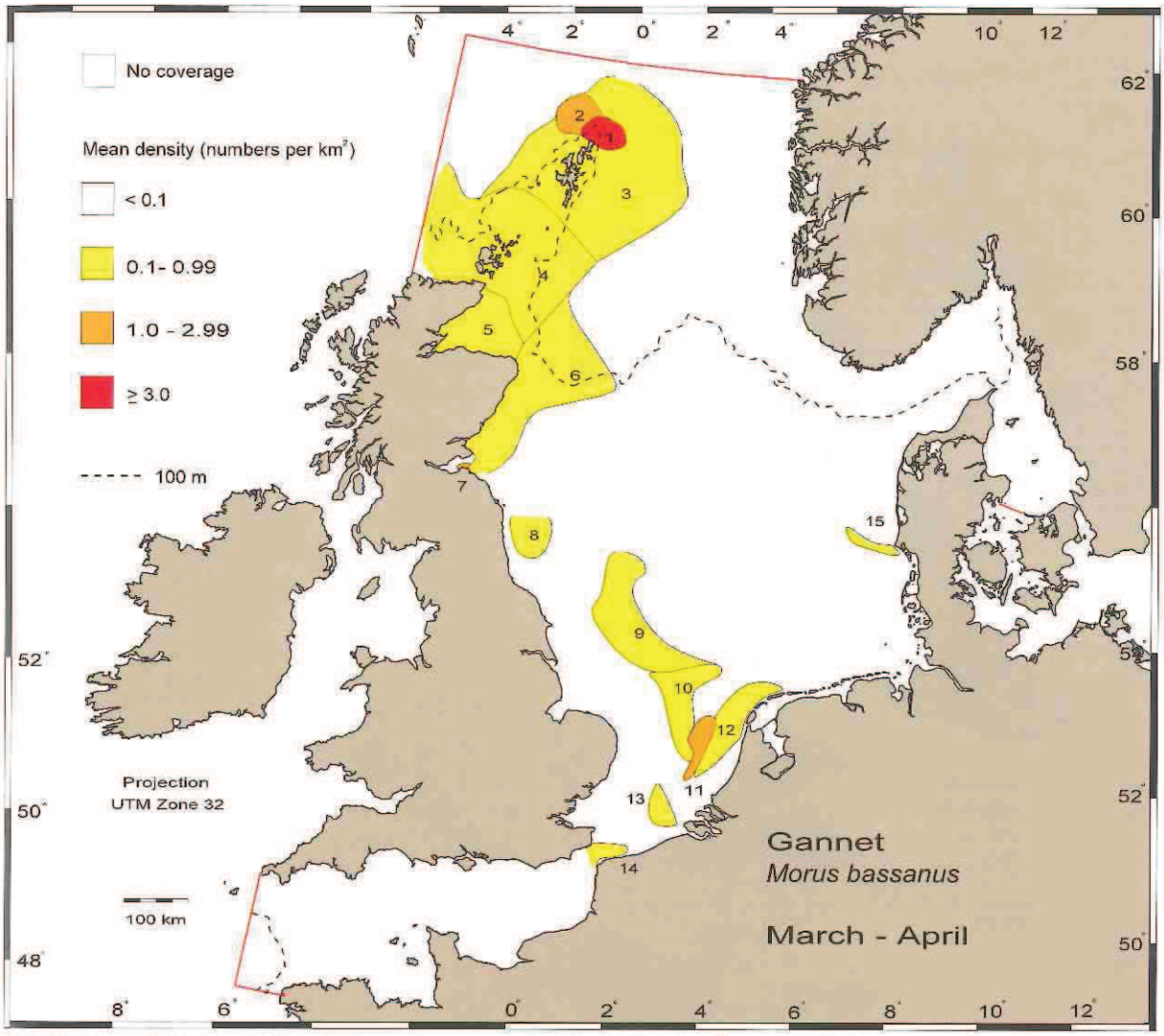
Locality	Density	Km²	Estimate	%
1 Northeast Shetland	**4.09**	**1250**	**5100**	**3.39**
2 Southeast Shetland	1.55	4000	6200	4.12
3 East Shetland	0.21	25000	5300	3.53
4 Orkney – Fladen Ground	0.38	37000	14000	9.31
5 Moray Firth coasts	1.02	4000	4000	2.66
6 Northeast Scotland	0.31	50800	16000	10.64
7 Firth of Forth	1.26	350	440	0.29
8 North East Bank	**2.08**	**10600**	**22000**	**14.63**
9 Barmade Bank – Spurn	1.11	12200	13500	8.98
10 Dogger Bank	0.54	69000	37000	24.61
11 Southeastern North sea	0.36	34000	12000	7.98
12 Eastern North sea	0.24	36500	8800	5.85
13 Lomond	0.23	20000	4500	2.99
Residual			1500	1.00
Total			**150340**	**100.00**



Distribution and density of Gannet Morus bassanus *in the North Sea, the Channel and the Kattegat from November - February 1980-1994.*

The average numbers of Gannet *Morus bassanus* in key areas from November to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

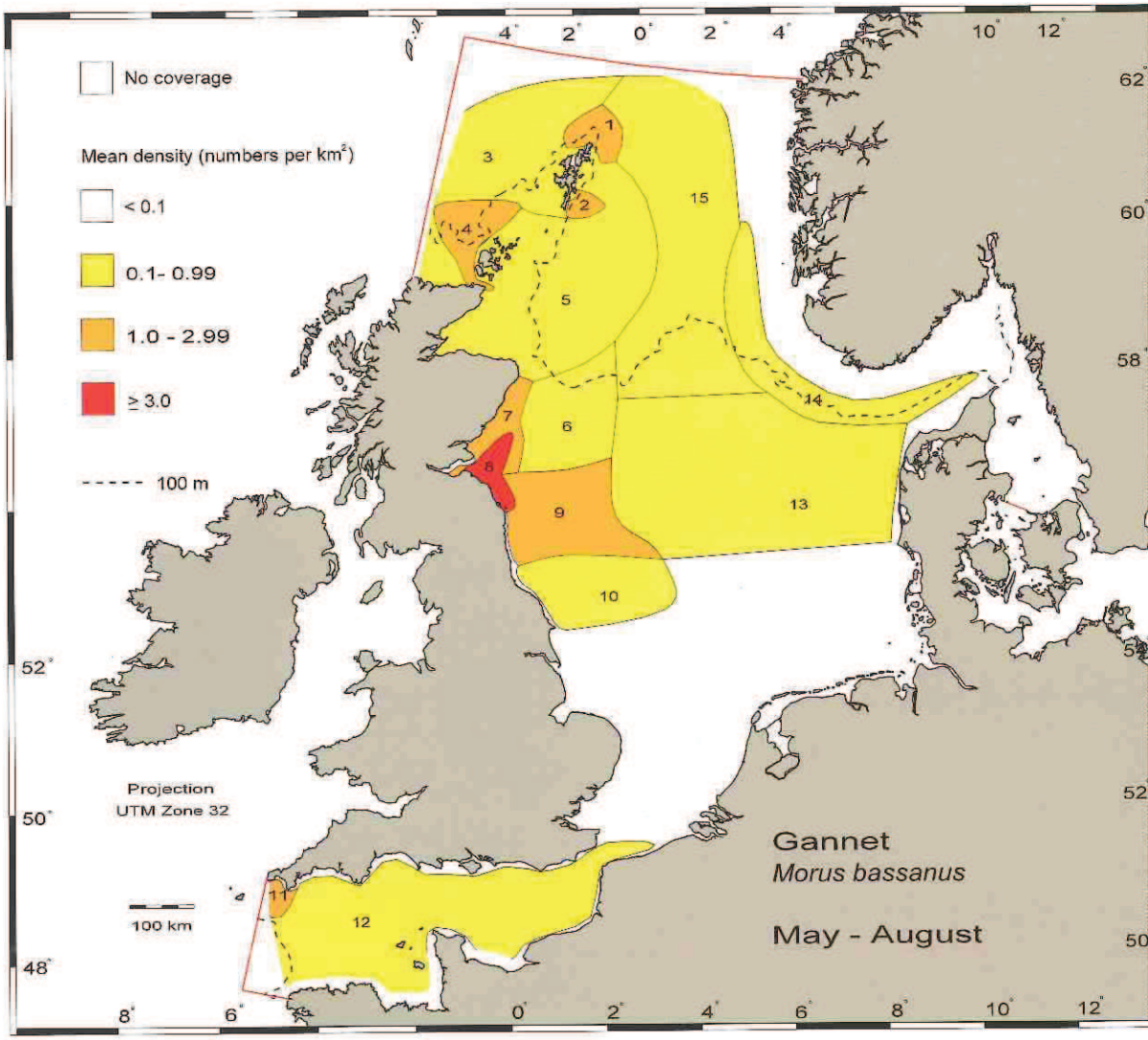
Locality	Density	Km²	Estimate	%
1 Shetland	0.29	32000	9300	5.89
2 Fladen Ground	0.26	32800	8500	5.39
3 Moray Firth	0.26	5800	1500	0.95
4 West Central North Sea	0.32	75900	24000	15.21
5 Firth of Forth	3.02	1350	4000	2.53
6 Farn Deeps	4.31	750	3200	2.03
7 Hills	**3.88**	**1750**	**6800**	**4.31**
8 Dogger Bank	0.32	34000	11000	6.97
9 Western Channel	0.40	16000	6400	4.06
10 Start Point	**14.21**	**2700**	**38000**	**24.08**
11 Channel east low	0.38	18000	6800	4.31
12 Channel east medium	**2.30**	**3900**	**9000**	**5.70**
13 Dover Strait	0.25	9000	2300	1.46
14 The Broad Fourteens	0.12	22200	2700	1.71
15 Brown Ridge	1.92	1600	3000	1.90
16 Fisher Banks – Jutland Bank	0.13	17600	2300	1.46
17 The Reef	**3.60**	**4000**	**14000**	**8.87**
Residual			5000	3.17
Total			**157800**	**100.00**



Distribution and density of Gannet Morus bassanus *in the North Sea, the Channel and the Kattegat from March to April 1980-1994.*

The average numbers of Gannet *Morus bassanus* in key areas from March to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 North Shetland	**4.93**	**2600**	**12800**	**14.07**
2 Northwest Shetland	1.07	3000	3200	3.52
3 Shetland	0.25	46400	11600	12.75
4 Orkney	0.44	42800	18800	20.67
5 Moray Firth	0.27	7900	2100	2.31
6 Long Forties	0.46	22400	10300	11.32
7 Bass Rock	2.18	180	400	0.44
8 Farn Deeps	0.23	3600	800	0.88
9 Southwest Dogger Bank	0.29	13200	3800	4.18
10 Indefatigable Banks	0.45	6800	3060	3.36
11 Brown Ridge	1.11	2300	2500	2.75
12 Broad Fourteens – Ameland	0.13	6000	800	0.88
13 Voordelta	0.13	1900	300	0.33
14 Dover Strait	0.17	1400	140	0.15
15 Horns Rev	0.29	1200	350	0.38
Residual			20000	21.99
Total			**90950**	**100.00**



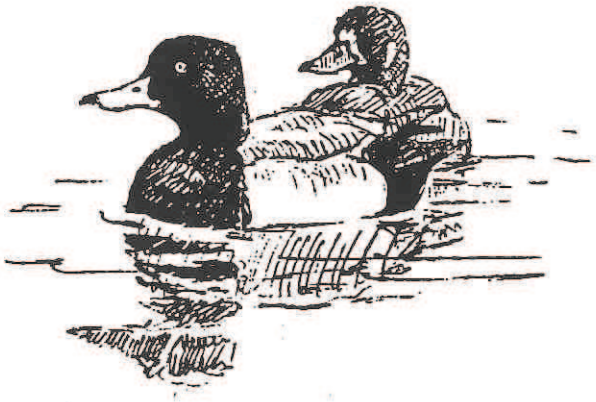
Distribution and density of Gannet Morus bassanus *in the North Sea, the Channel and the Kattegat from May to Augu 1980-1994.*

The average numbers of Gannet *Morus bassanus* in key areas from May to August 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Northern Shetland	**1.80**	**5300**	**9500**	**5.55**
2 Southern Shetland	1.62	1800	2900	1.69
3 Orkney – Shetland west	0.32	45800	14500	8.47
4 West Orkney	**1.54**	**9400**	**15000**	**8.76**
5 Northeast Scotland	0.23	66000	15000	8.76
6 Devils Hole	0.44	22000	9500	5.55
7 Scalp Bank	**1.28**	**5300**	**6800**	**3.97**
8 Outer Firth of Forth	**3.06**	**4400**	**13500**	**7.88**
9 North East Bank	1.00	25000	25000	14.60
10 Barmade Bank	0.33	22000	7200	4.20
11 Lands End	1.38	1980	2700	1.58
12 Channel	0.23	70000	16000	9.34
13 Central North Sea	0.10	97000	9700	5.66
14 Southwest Norwegian Trench	0.15	26000	3900	2.28
15 Northern North Sea	0.13	77000	10000	5.84
Residual			10000	5.84
Total			**171200**	**100.00**

Scaup *Aythya marila*

The Scaup breeds in the low-arctic parts of Scandinavia, Russia and North America. Small breeding populations are present also in Iceland and Estonia. In the Western Palearctic region about 75% of the Scaups are believed to winter in Northwest Europe (Laursen 1989). They are migratory, and form large aggregations in relatively few key wintering sites in inland and coastal areas of the Baltic, the North Sea, British Isles and the Channel.



They winter mainly in shallow bays, estuaries and along sheltered coasts. The largest concentrations in the northwestern Kattegat occur a few kilometers from the coast (Laursen *et al. in press*).

Importance of the North Sea

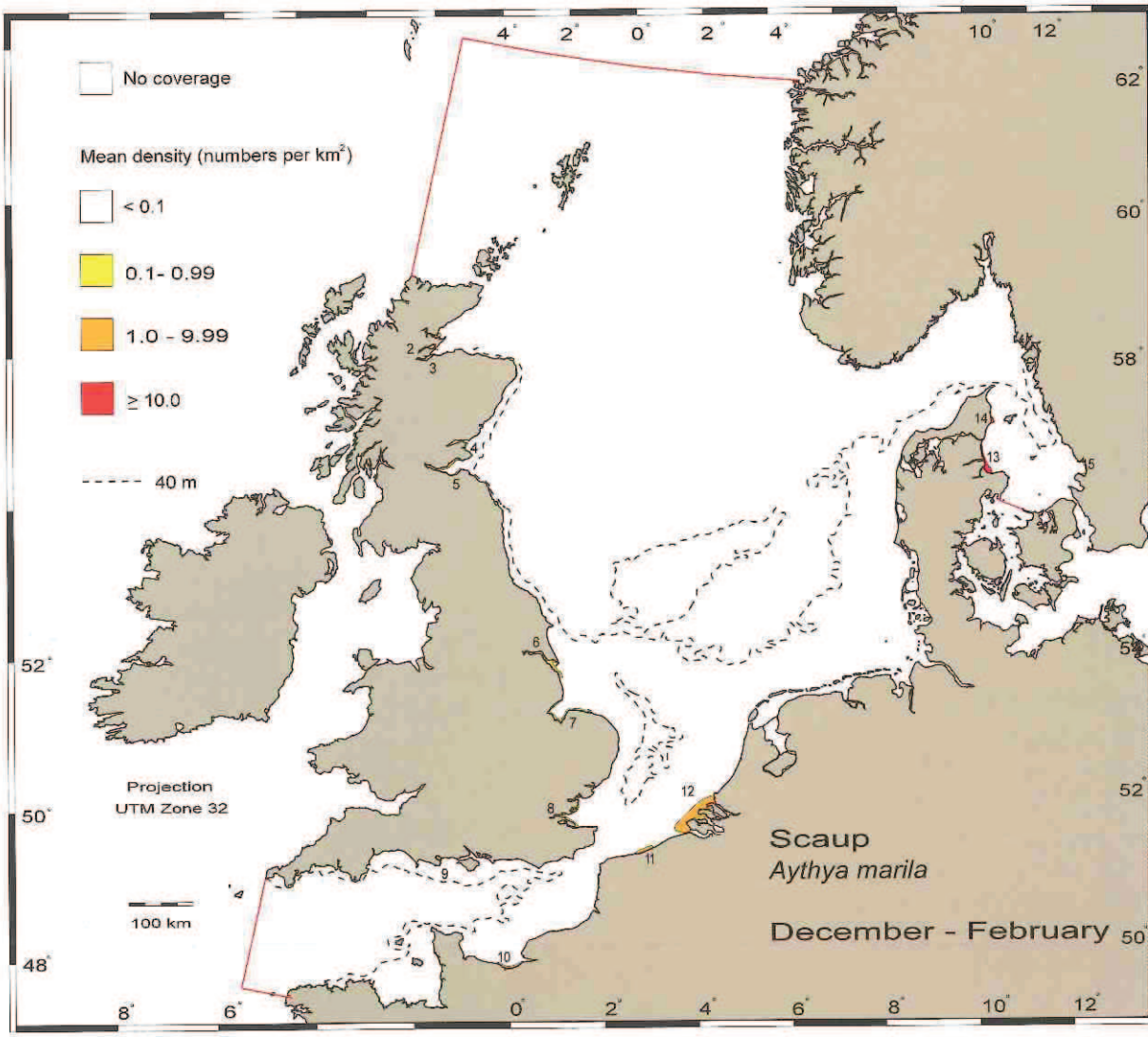
The number of Scaup wintering in Northwest European waters has been estimated at 310,000 birds (Rose & Scott 1994). An average of 4.4% of this population wintered in the North Sea during 1980-1993. This is much lower than during the 1960's and early 1970's when 20,000-30,000 birds were regularly present at distillery outfalls in the Firth of Forth (Campbell 1984). The main Scaup wintering areas are now in enclosed waterbodies of the Netherlands and in the Rügen-Szczecin lagoon system in the Baltic; both areas support about 100,000 Scaups in winter (Hustings 1987, Durinck *et al.* 1994b).

Important areas

Scaups are present in only a few areas of the North Sea during both winter and spring. Two areas in the northwestern part of the Kattegat support 65% of the total estimated number in the region, and 3.1% of the total winter population in Northwest Europe.

Distribution patterns

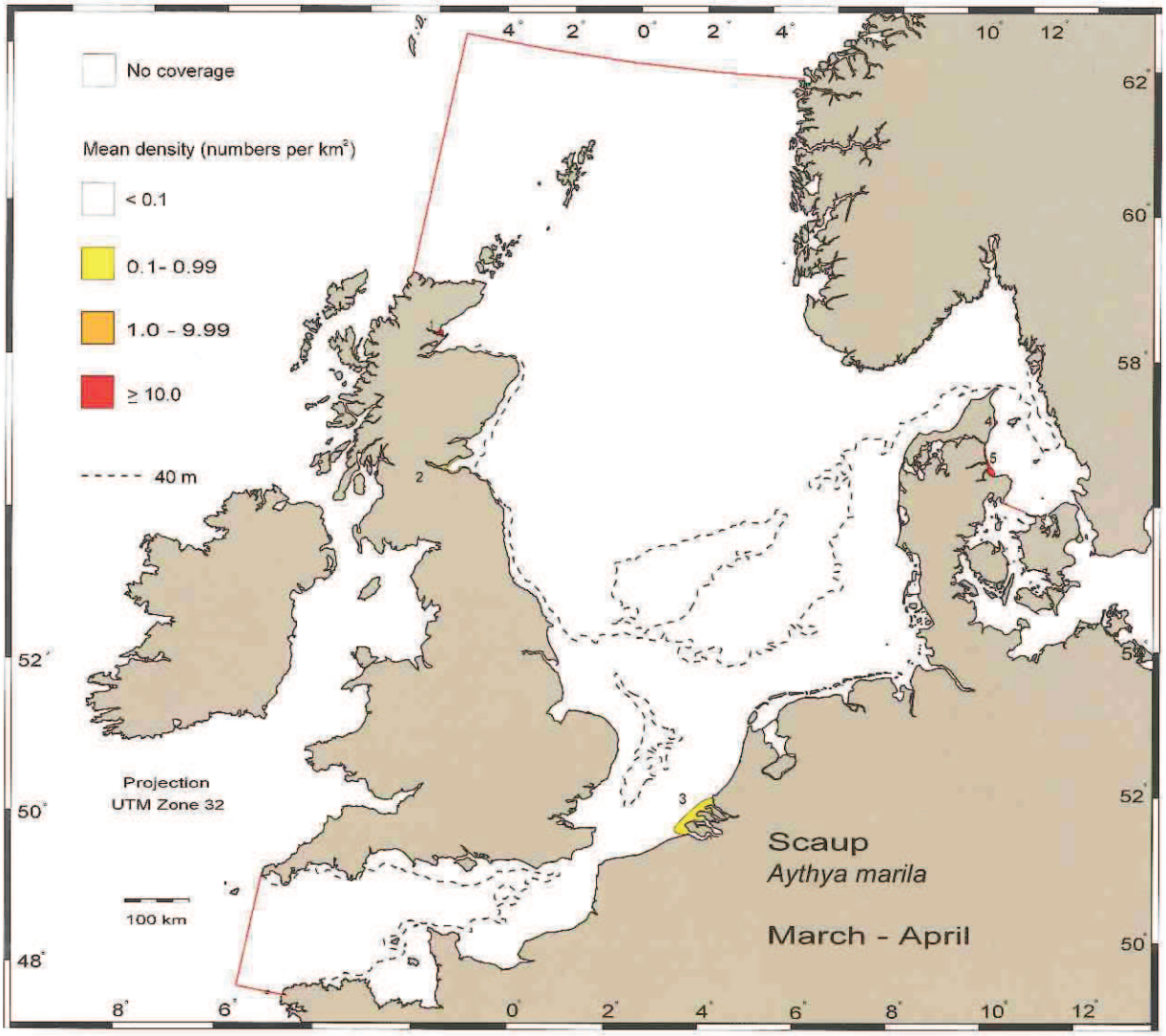
The majority of Scaups arrive in November and spring migration takes place in March and April.



Distribution and density of Scaup Aythya marila *in the North Sea, the Channel and the Kattegat from December to Februar 1980-1994.*

The average numbers of Scaup *Aythya marila* in key areas from December to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Dornoch Firth	6.00	35	210	1.54
2 Cromarty Firth	2.07	75	155	1.13
3 Moray Firth	0.65	100	65	0.48
4 Eden Estuary	6.00	15	90	0.66
5 Firth of Forth	8.57	140	1200	8.78
6 Humber Estuary	0.14	145	20	0.15
7 Wash	0.32	125	40	0.29
8 Thames Estuary	0.45	210	95	0.70
9 Poole Harbour	0.50	40	20	0.15
10 Baie de la Seine	1.44	45	65	0.48
11 De Panne – Nieuwpoort	2.60	25	65	0.48
12 Voordelta	1.44	1200	1750	12.81
13 Ålborg Bay	**16.80**	**250**	**4200**	**30.74**
14 Sæby coast	**270.00**	**20**	**5400**	**39.52**
15 Laholmsbugt	1.11	45	50	0.37
Residual			240	1.76
Total			**13665**	**100.00**



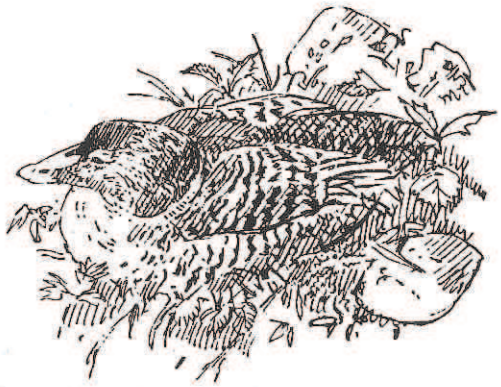
Distribution and density of Scaup Aythya marila *in the North Sea, the Channel and the Kattegat from March to April 1980-1994.*

The average numbers of Scaup *Aythya marila* in key areas from March to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Dornoch Firth	15.14	35	530	11.32
2 Firth of Forth	0.64	140	90	1.92
3 Voordelta	0.29	1200	345	7.37
4 Ålborg Bay	**12.40**	**250**	**3100**	**66.24**
5 Sæby coast	25.00	20	500	10.68
Residual			115	2.46
Total			**4680**	**100.00**

Common Eider *Somateria mollissima*

In Europe, the Common Eider breeds commonly along the coasts of Iceland, Britain, Scandinavia, Spitsbergen and on the arctic coast of Russia east to Novaya Zemlya. While the Icelandic, British and Danish breeders are mainly sedentary, large numbers of Common Eiders from Russia, Finland, Sweden and Norway are migratory, the largest winter concentrations are in the Baltic, along the west coast of Norway and in the Wadden Sea. The large concentrations wintering in the Kattegat originate from the breeding populations in southern Norway and the west coast of Sweden (Noer 1991). Common Eiders are highly gregarious during winter. They feed mainly on molluscs, especially blue mussels *Mytilus edulis* and the cockle *Cerastoderma edule*.



Importance of the North Sea

At least 100,000 pairs of Common Eider breed in the study region, of which 10,000 pairs breed in Scotland and Northeast England (Sharrock 1976), 58,000 on the west coast of Sweden (Pehrsson 1978) and 40,000 in Norway (Thingstad 1994). The Northwest European winter population of the Common Eider is estimated at 3 million birds (Rose & Scott 1994).

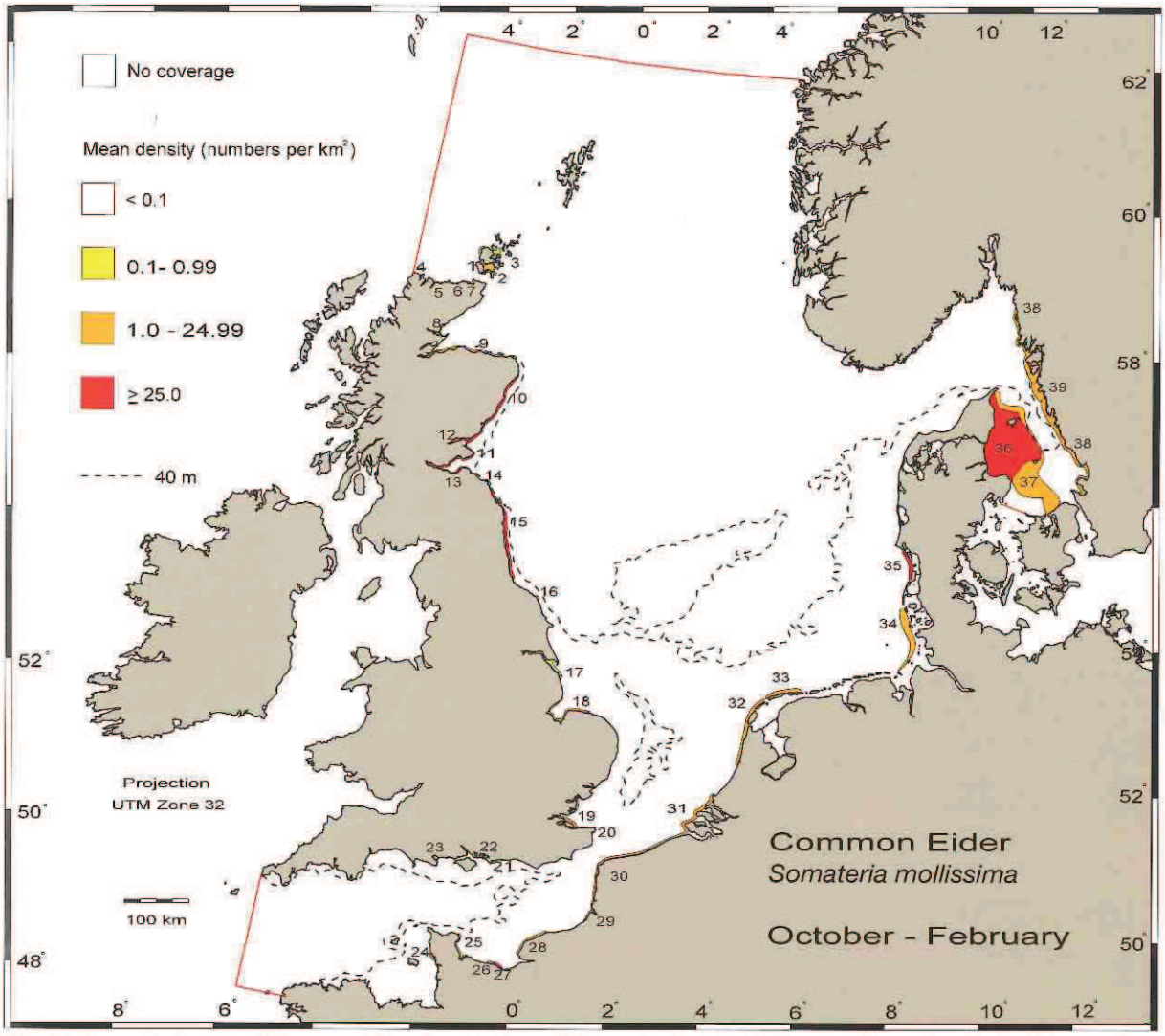
The surveyed areas support on average 4.6% of the Northwest European winter population of Common Eider in spring (March-April), 2.2% during moult (July-September) and 17.1% during winter (October-February). It should be noted, however, that this is an underestimate due to the absence of data from Norway and Shetland where respectively more than 40,000 and 7000 Common Eiders winter (Nygård *et al.* 1988, Suddaby 1992, Heubeck 1993).

Important areas

The entire area within the 20 m depth contour in the Northwestern Kattegat, including the waters around the islands of Læsø and Anholt, is of major international importance with 78,000 estimated in spring (2.6% of the total Northwest European winter population) and 264,000 in winter (8.8%). During late summer, the area of concentration is restricted to the shallow waters around Læsø with 31,000 (1.0%). During winter the inshore zone between Grådyb and Lister Deep off the northern Wadden Sea supports around 1% of the total Northwest European winter population. This area is an integral part of the important Wadden Sea area with 133,000 wintering birds (Meltofte *et al.* 1994). The Outer Firth of Tay holds a significant proportion of the birds counted along British coasts, but is not of international importance.

Distribution patterns

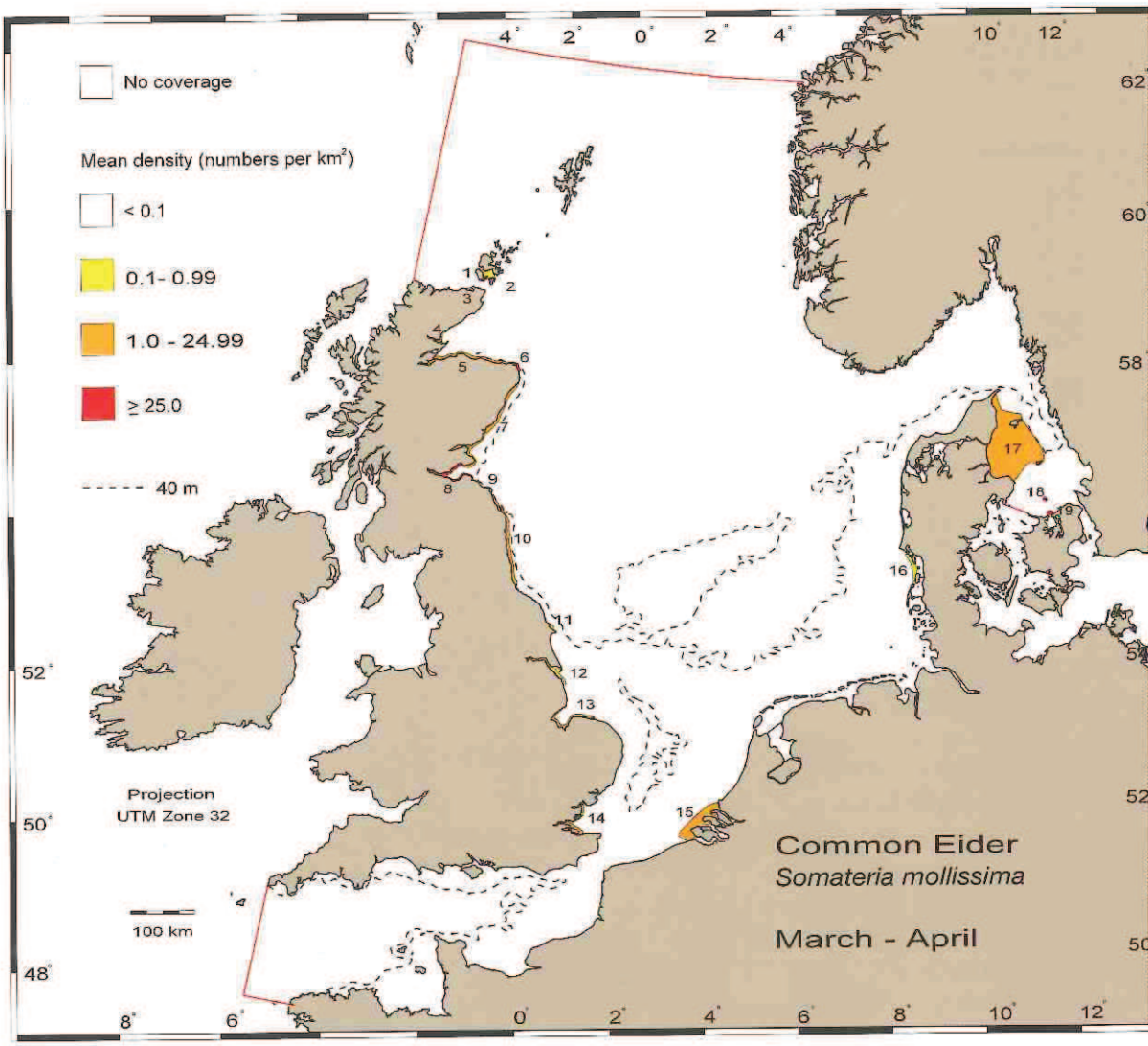
Most adult males leave the breeding grounds in May and June to form flocks with non-breeding immatures. Autumn migration from the breeding grounds in the northern and central parts of the Baltic to waters off Denmark and Germany begins in late September, continuing until January. Some of these Common Eiders pass Jutland and spend the first part of the winter in the Wadden Sea (Petersen 1974, Noer 1991). Wintering birds occur both inshore and offshore in the Kattegat but exclusively inshore in the rest of the region. In Britain, the majority of birds are found in estuaries and inshore waters in the northeast, while the majority of birds wintering on the continental side of the North Sea are found between the Dutch-Belgian border and Blåvandshuk in Denmark.



Distribution and density of Common Eider Somateria mollissima *in the North Sea, the Channel and the Kattegat from October to February 1980-1994.*

The average numbers of Common Eider *Somateria mollissima* in key areas from October to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

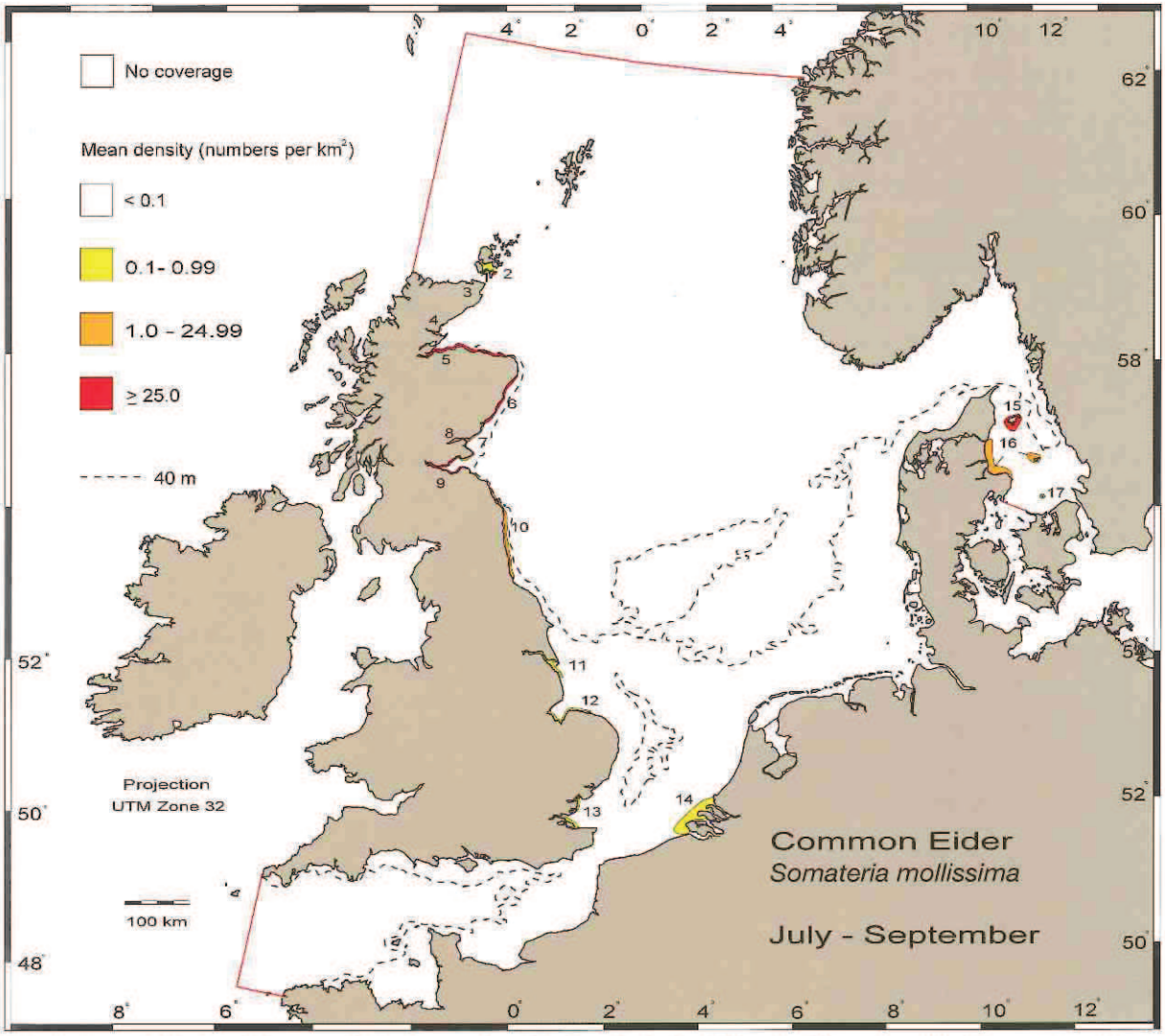
Locality	Density	Km²	Estimate	%
1 Scapa Flow	3.79	210	795	0.17
2 Newark Bay	6.25	4	25	0.01
3 Eynhallow Sound – Marwick	0.75	160	120	0.03
4 Faraid Head	54.00	1	55	0.01
5 Kyle of Tongue	1.00	20	20	0.00
6 Sandside Bay	80.00	2	160	0.03
7 Thurso bay	3.75	12	45	0.01
8 Dornoch Firth & Embo – Brora	21.00	60	1260	0.27
9 Moray Firth	1.97	150	295	0.06
10 Collieston – Montrose	65.58	95	6230	1.35
11 Montrose – Firth of Forth	33.13	80	2650	0.57
12 Firth of Tay	363.64	55	20000	4.32
13 Firth of Forth – Tyninghame	66.67	144	9600	2.08
14 Eyemouth	163.33	3	490	0.11
15 Berwick upon Tweed – Tees	28.57	140	4000	0.86
16 Whitby	3.75	8	30	0.01
17 Humber Estuary	0.14	145	20	0.00
18 Wash	3.12	125	390	0.08
19 Thames Estuary	1.55	210	325	0.07
20 Pegwell Bay	5.00	6	30	0.01
21 Pagham Harbour	5.00	6	30	0.01
22 Chichester Harbour	2.50	20	50	0.01
23 Poole Harbour	0.88	40	35	0.01
24 Cotentin, west coast	12.39	23	285	0.06
25 Cotentin, east coast	9.73	110	1070	0.23
26 Rade de Caen	3.44	16	55	0.01
27 Courseulles – Arro manches	54.38	8	435	0.09
28 Baie de Seine – Dieppe	0.64	55	35	0.01
29 Baie de la Somme	3.30	50	165	0.04
30 Nord pas de Calais coast	3.20	125	400	0.09
31 Voordelta – Belgian coast	6.25	800	5000	1.08
32 Vlieland – Ijmuiden	3.45	580	2000	0.43
33 Juist – Terschelling	20.00	250	5000	1.08
34 Wangerooge – Amrum	5.92	845	5000	1.08
35 Grådyb – Lister Deep	**85.71**	**350**	**30000**	**6.49**
36 Northwestern Kattegat, high	**40.66**	**6500**	**264270**	**57.13**
37 Northwestern Kattegat, medium	7.91	11600	91700	19.82
38 Swedish westcoast, medium	4.78	1050	5020	1.09
39 Göteborg Archipelago	11.43	350	4000	0.86
Residual			1500	0.32
Total			**462590**	**100.00**



Distribution and density of Common Eider Somateria mollissima *in the North Sea, the Channel and the Kattegat from Mar to April 1980-1994.*

The average numbers of Common Eider *Somateria mollissima* in key areas from March to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Scapa Flow	0.88	210	185	0.15
2 Newark Bay	17.50	4	70	0.06
3 Thurso bay	2.08	12	25	0.02
4 Dornoch Firth & Embo – Brora	10.83	60	650	0.52
5 Moray Firth	9.27	150	1390	1.11
6 Fraserburgh – Peterhead	80.00	15	1200	0.96
7 Collieston – Firth of Forth	10.87	230	2500	2.00
8 Firth of Forth – Tyninghame	55.56	144	8000	6.41
9 Eyemouth	43.33	3	130	0.10
10 Berwick upon Tweed – Tees	11.43	140	1600	1.28
11 Filey	5.00	8	40	0.03
12 Humber Estuary	0.17	145	25	0.02
13 Wash	1.84	125	230	0.18
14 Thames Estuary	1.12	210	235	0.19
15 Voordelta	2.08	1200	2500	2.00
16 Grådyb – Lister Deep	0.71	350	250	0.20
17 Northwestern Kattegat	**12.00**	**6500**	**78000**	**62.48**
18 Hesselø	500.00	40	20000	16.02
19 Hesselø Bay	70.00	50	3500	2.80
Residual			4300	3.44
Total			**124830**	**100.00**



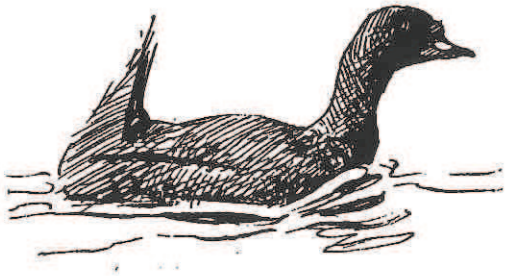
Distribution and density of Common Eider Somateria mollissima *in the North Sea, the Channel and the Kattegat from July to September 1980-1994.*

The average numbers of Common Eider *Somateria mollissima* in key areas from July to September 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Scapa Flow	0.19	210	40	0.06
2 Newark Bay	32.50	4	130	0.21
3 Thurso bay	4.17	12	50	0.08
4 Dornoch Firth & Embo – Brora	20.00	60	1200	1.95
5 Moray Firth	33.33	150	5000	8.12
6 Collieston – Montrose	68.42	95	6500	10.55
7 Montrose – Firth of Forth	5.00	80	400	0.65
8 Firth of Tay	12.73	55	700	1.14
9 Firth of Forth – Tyninghame	55.56	144	8000	12.99
10 Berwick upon Tweed – Tees	18.57	140	2600	4.22
11 Humber Estuary	0.17	145	25	0.04
12 Wash	0.80	125	100	0.16
13 Thames Estuary	0.43	210	90	0.15
14 Voordelta	0.75	1200	900	1.46
15 Læsø	**81.58**	**380**	**31000**	**50.34**
16 Northwestern Kattegat	3.88	1030	4000	6.50
17 Hesselø	10.00	40	400	0.65
Residual			450	0.73
Total			**61585**	**100.00**

Common Scoter *Melanitta nigra*

Common Scoters breed dispersed across the boreal and low arctic zones in Eurasia and North America. The *nigra* subspecies breeds in the Northeast Atlantic region from Iceland and Northwest Britain and Ireland to mid-Siberia. Outside the breeding season Common Scoters are highly gregarious, and the wintering population of subspecies *nigra* in Europe and Northwest Africa is estimated to be 1.3 million birds (Durinck *et al.* 1994b). Common Scoters occur mainly in marine habitats in winter, feeding on bivalves and other shellfish. In Northwest Europe they seem to prefer dense mussel *Mytilus edulis* beds and banks of the clam *Spisula subtruncata* (Madsen 1957, Durinck *et al.* 1993a, Offringa 1993, Leopold *et al.* 1995).



Importance of the North Sea

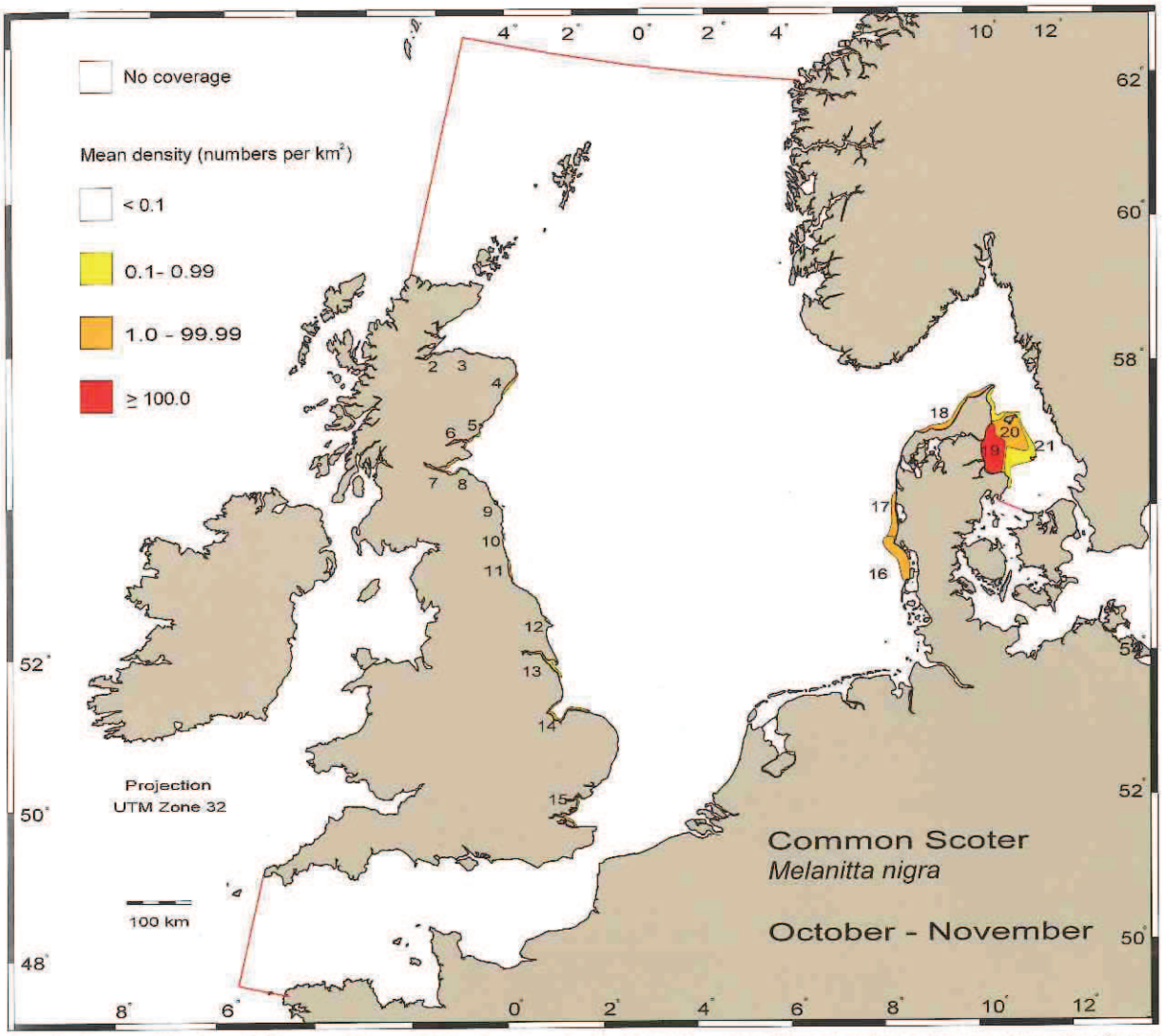
The majority of the European wintering population is found in the Baltic and Kattegat, where a total of nearly 930,000 birds were counted in January 1992 (Pihl *et al.* 1992). The main winter concentration is in the Kattegat, with smaller numbers to the west and southwest as well as to the east of this concentration. With each step further away from the Kattegat, average wintering numbers are smaller: in the eastern North Sea several hundreds of thousands winter (Skov *et al.* 1994b), with the British Isles, France and Portugal each supporting some 30,000 (Kirby *et al.* 1993, Berthelot & Jarry 1995, Rui Rufino, pers. comm.), while Northwest Africa has between 5000 and 10,000 birds (Rui Rufino pers. comm.). The study area forms the stronghold of the wintering population in Europe, with an estimated total of 525,000 to 570,000 birds, roughly 45% of the total population.

Main areas

During spring migration (March to May) short-lasting concentrations may be found anywhere along the continental seaboard (Petersen 1974, Platteeuw *et al.* 1994). Areas that support internationally important numbers are the coastal waters off the central west-Frisian Islands (Terschelling-Juist), the area off the northern Wadden Sea and the northwestern Kattegat. Areas that hold concentrations of Common Scoters in summer (June to September) are probably used for moulting. Internationally important moulting areas are found off the northern Wadden Sea and in the northwestern Kattegat. In October/November the numbers in the study area build up again with the Kattegat and northern Wadden Sea being the only areas of international importance. Numbers of Common Scoters and the number of areas of international importance are greatest in winter. Apart from the northwestern Kattegat and eastern German Bight off the northern Wadden Sea, which are important throughout the year, the areas off Terschelling to Juist and the Voordelta are also of international importance. Numbers in the study area are higher in cold winters, when more Common Scoters cross Jutland than in mild winters: in cold winters the Jammerbugt is of international importance, while numbers off the Wadden Sea and off mainland Holland (Leopold *et al. in press*) may likewise increase under these conditions. The northern Kattegat is probably the most important area in the world to this species.

Distribution patterns

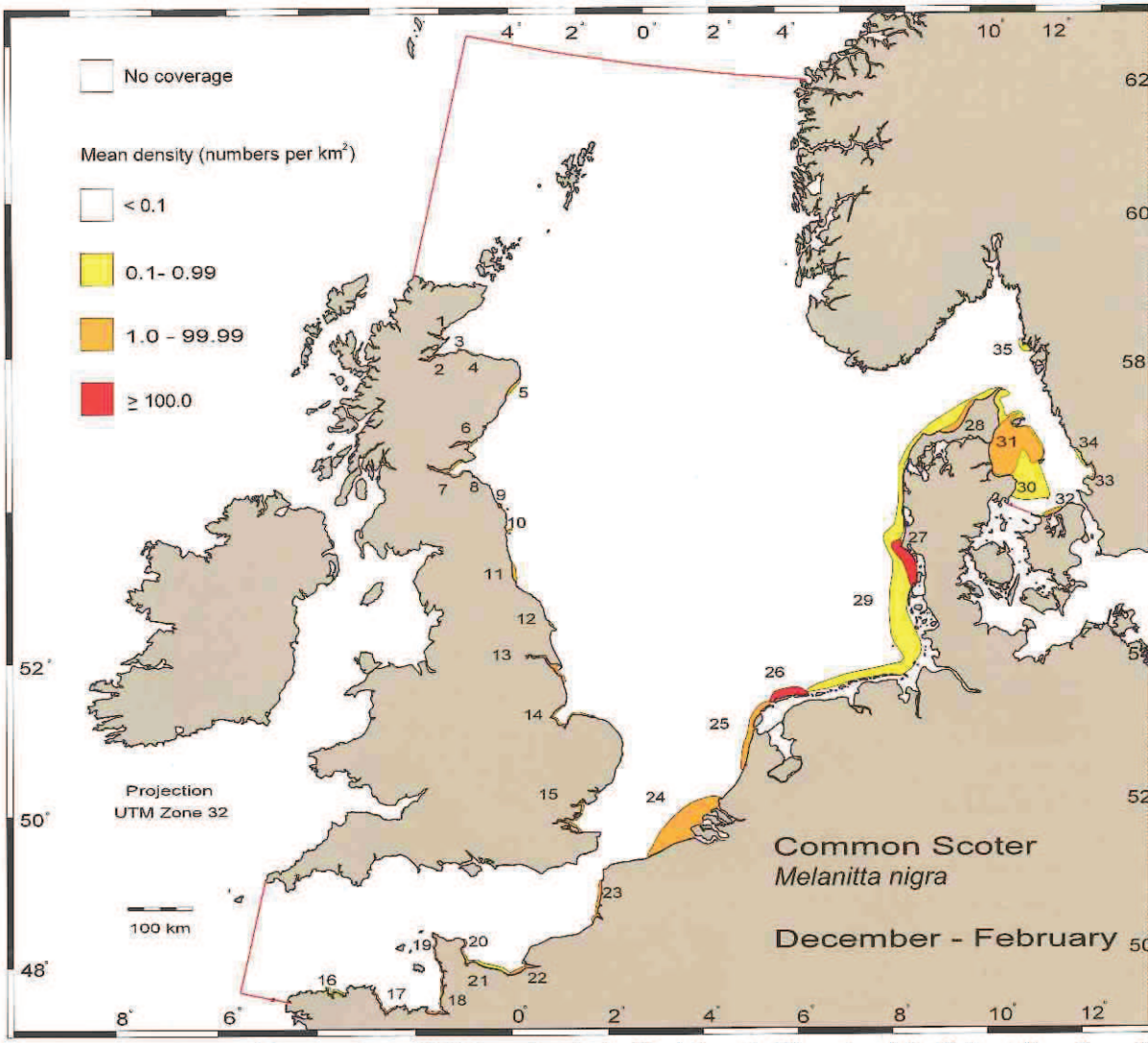
Common Scoters are found predominantly in waters 5 and 15 meters deep, and often in very large groups (up to hundreds of thousands). It is only during migration that these ducks are regularly found further offshore at sea, when they fly across the North Sea to wintering sites in the British Isles, or when they cut across stretches of indented coastline (Platteeuw 1990).



Distribution and density of Common Scoter Melanitta nigra *in the North Sea, the Channel and the Kattegat from October to November 1980-1994.*

The average numbers of Common Scoter *Melanitta nigra* in key areas from October to November 1980-1994. Areas marked with bold are of international importance (MCC criteria).

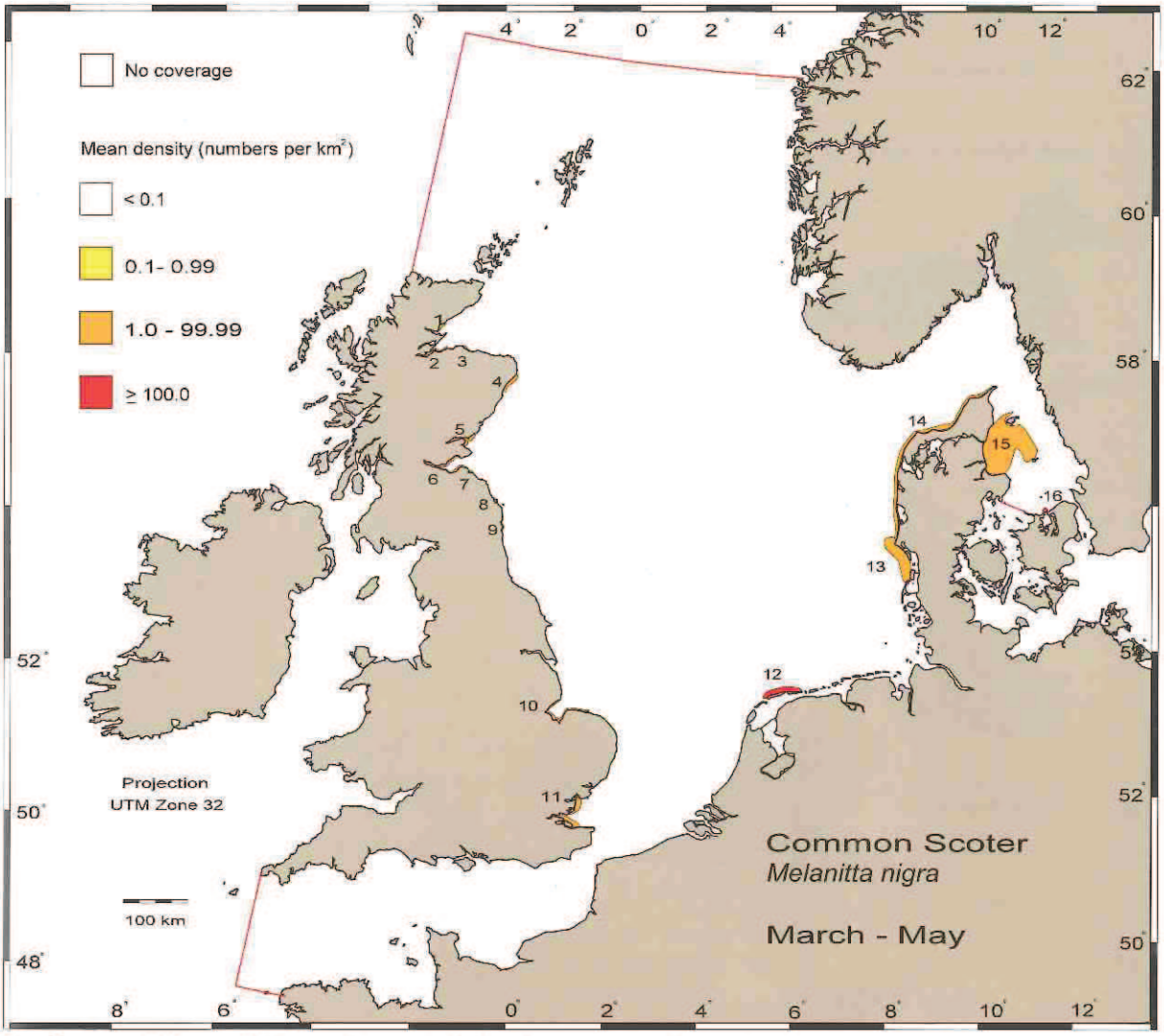
Locality	Density	Km²	Estimate	%
1 Dornoch Firth & Embo – Brora	1.00	60	60	0.01
2 Moray Firth	0.53	85	45	0.01
3 Spey Bay	10.75	20	215	0.04
4 Blackdog – Collieston	18.00	45	810	0.15
5 Carnoustie – Westhaven	3.18	11	35	0.01
6 Tay Bay	7.67	75	575	0.11
7 Firth of Forth	6.75	140	945	0.18
8 Tyninghame	11.25	4	45	0.01
9 Lindisfarne – Seahouses	9.00	50	450	0.09
10 Druridge Bay	15.00	10	150	0.03
11 Durham coast	7.00	30	210	0.04
12 Filey Bay	8.46	13	110	0.02
13 Humber Estuary	0.28	145	40	0.01
14 The Wash	4.16	125	520	0.10
15 Thames Estuary	0.83	210	175	0.03
16 Vejers – Lister Deep	**84.48**	**1000**	**84475**	**16.09**
17 Danish westcoast	4.70	750	3525	0.67
18 Jammerbugt & Tannisbugt	2.75	1000	2750	0.52
19 Northwestern Kattegat, high	**162.77**	**2400**	**390650**	**74.40**
20 Northwestern Kattegat, medium	**18.44**	**2000**	**36890**	**7.03**
21 Northwestern Kattegat, low	0.75	3000	2250	0.43
Residual			160	0.03
Total			**525085**	**100.00**



Distribution and density of Common Scoter Melanitta nigra *in the North Sea, the Channel and the Kattegat from Decemb to February 1980-1994.*

The average numbers of Common Scoter *Melanitta nigra* in key areas from December to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

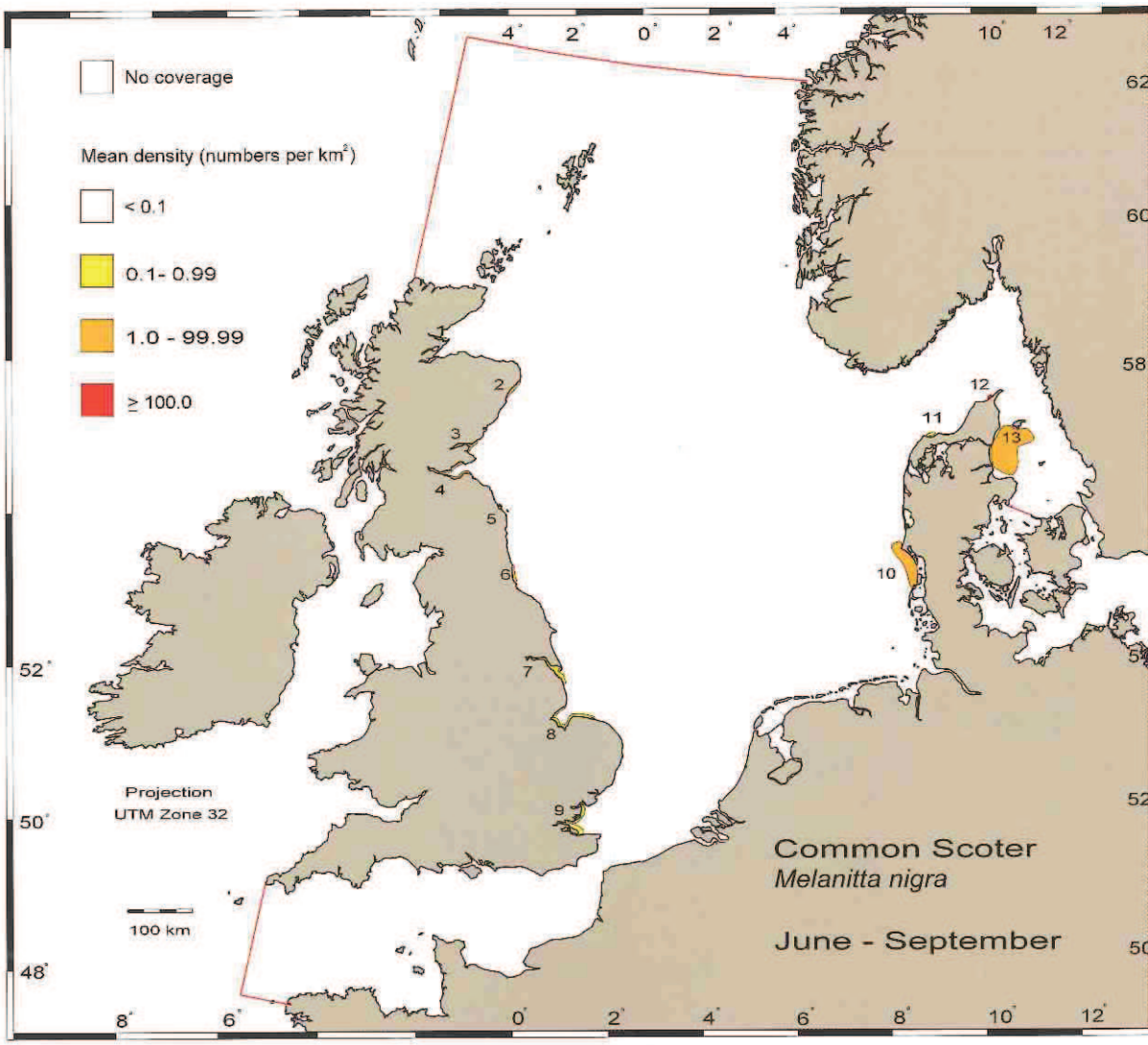
Locality	Density	Km²	Estimate	%
1 Dornoch Firth & Embo-Brora	6.92	60	415	0.07
2 Moray Firth	0.88	85	75	0.01
3 Burghead-Hopeman	18.33	6	110	0.02
4 Spey Bay	15.00	20	300	0.05
5 Blackdog-Collieston	8.44	45	380	0.07
6 Tay Bay	22.27	75	1670	0.29
7 Firth of Forth	10.00	140	1400	0.25
8 Tyninghame	16.25	4	65	0.01
9 Lindisfarne	20.43	35	715	0.13
10 Alnmouth Bay	3.13	8	25	0.00
11 Durham coast	2.00	30	60	0.01
12 Filey Bay	3.08	13	40	0.01
13 Humber Estuary	0.28	145	40	0.01
14 The Wash	6.84	125	855	0.15
15 Thames Estuary	0.55	210	115	0.02
16 Baie de Lannion	0.56	90	50	0.01
17 Baie de St.-Breuc	3.39	140	475	0.08
18 Baie du Mont St.-Michel	46.50	140	6510	1.14
19 Cotentin. west coast	25.02	210	5255	0.92
20 Cotentin. east coast	8.36	110	920	0.16
21 Plateau de Calvados	0.22	115	25	0.00
22 Deauville	69.50	130	9035	1.58
23 Baie de Somme-Boulogne	1.03	150	155	0.03
24 Voordelta-Belgium coast	**6.25**	**4000**	**25000**	**4.38**
25 Vlieland-IJmuiden	7.50	1000	7500	1.32
26 Juist-Terschelling	**113.64**	**440**	**50000**	**8.77**
27 Vejers-Lister Deep, mild winters	**53.50**	**1000**	**53500**	**9.38**
27 Vejers-Lister Deep, cold winters	**190.00**	**1000**	**190000**	**33.32**
28 Jammerbugt, cold winters	**57.14**	**875**	**50000**	**8.77**
29 Eastern North Sea, low	0.35	10000	3500	0.61
30 Northwestern Kattegat, low	0.67	2500	1675	0.29
31 Northwestern Kattegat, high	**84.35**	**4690**	**395600**	**69.37**
32 Sjælland, north coast	8.27	320	2645	0.46
33 Laholmsbugten	9.50	80	760	0.13
34 Falkenberg south	0.50	60	30	0.01
35 Lysekil north	0.36	140	50	0.01
Residual			3000	0.53
Total mild winter			**570310**	**100.00**



Distribution and density of Common Scoter Melanitta nigra *in the North Sea, the Channel and the Kattegat from March to May 1980-1994.*

The average numbers of Common Scoter *Melanitta nigra* in key areas from March to May 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Embo – Brora	6.25	20	125	0.05
2 Moray Firth	1.12	85	95	0.04
3 Spey Bay	19.25	20	385	0.16
4 Blackdog – Collieston	2.00	45	90	0.04
5 Tay Bay	5.73	75	430	0.18
6 Firth of Forth	13.57	140	1900	0.80
7 Tyninghame	7.50	4	30	0.01
8 Lindisfarne	8.29	35	290	0.12
9 Alnmouth Bay	3.75	8	30	0.01
10 Wash	1.64	125	205	0.09
11 Thames Estuary	0.67	210	140	0.06
12 Juist – Terschelling	**113.64**	**440**	**50000**	**20.92**
13 Vejers – Lister Deep	**30.00**	**1000**	**30000**	**12.55**
14 Danish westcoast	1.72	1425	2450	1.03
15 Northwestern Kattegat	**29.85**	**4690**	**140000**	**58.58**
16 Hesselø Bugt	318.75	40	12750	5.33
Residual			70	0.03
Total			**238990**	**100.00**



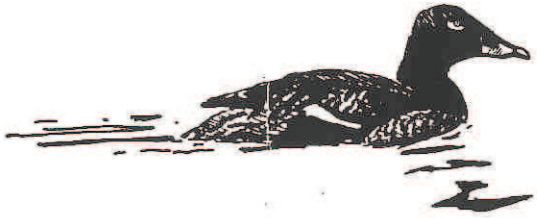
Distribution and density of Common Scoter Melanitta nigra *in the North Sea, the Channel and the Kattegat from June September 1980-1994.*

The average numbers of Common Scoter *Melanitta nigra* in key areas from June to September 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Dornoch Firth	4.14	35	145	0.19
2 Blackdog – Collieston	42.89	45	1930	2.48
3 Tay Bay	5.47	75	410	0.53
4 Firth of Forth	4.29	140	600	0.77
5 Lindisfarne	3.57	35	125	0.16
6 Durham Coast	2.33	30	70	0.09
7 Humber Estuary	0.24	145	35	0.04
8 Wash	0.32	125	40	0.05
9 Thames Estuary	0.48	210	100	0.13
10 Vejers – Lister Deep	**38.59**	**1000**	**38590**	**49.61**
11 Vigsø Bugt	0.60	50	30	0.04
12 Skiveren	500.00	20	10000	12.86
13 Northwestern Kattegat	**8.25**	**3110**	**25655**	**32.98**
Residual			50	0.06
Total			**77780**	**100.00**

Velvet Scoter *Melanitta fusca*

The subspecies *fusca* breeds from Scandinavia to central Siberia. In Europe, the Gulf of Riga and the Pomeranian Bay in the Baltic comprise the centre of distribution in winter. Both in the Baltic and North Sea, Velvet Scoters share winter habitats with Common Scoters, often occurring in mixed or adjacent flocks and consuming much the same food species. In the North Sea, *Spisula* clams are presumably an important food (Durinck *et al.* 1993a).



Several thousand birds leave the Baltic in late autumn to spend the winter around the North Sea and Channel, where they usually occur with wintering Common Scoters. In the region, Velvet Scoters occur in areas shallower than 20 m and are not confined to coastal waters.

Importance of the North Sea

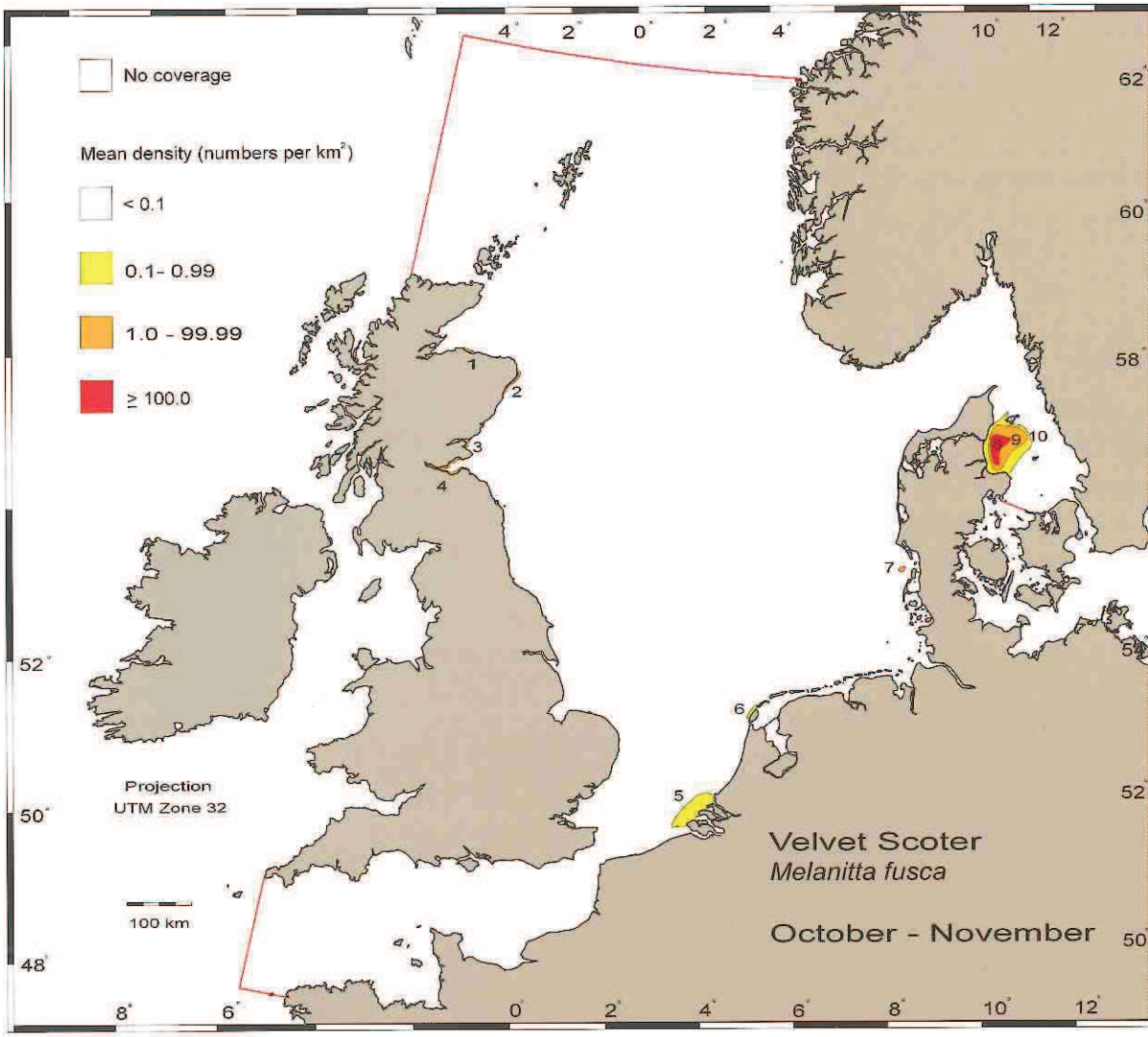
The wintering population has been estimated at 1 million birds (Durinck *et al.* 1994b). Over 90% of the Velvet Scoters winters in the Baltic. However, important numbers do occur off Norway, where 30,000 have been reported to winter (Nygård 1985). The British Isles and France are at the western end of the flyway, and total numbers do not normally reach the 1% level of 10,000 birds.

Main areas

Between 80% and 95% of the Velvet Scoters are found in the Northwestern Kattegat. In the core area, some 120,000 to 150,000 Velvet Scoters, or up to 15% of the total Northwest European wintering population, are present from October to February. In winter, flocks form in other locations in the study area, particularly along the continental and British coasts around the North Sea. None of these areas are, however, of international importance.

Distribution patterns

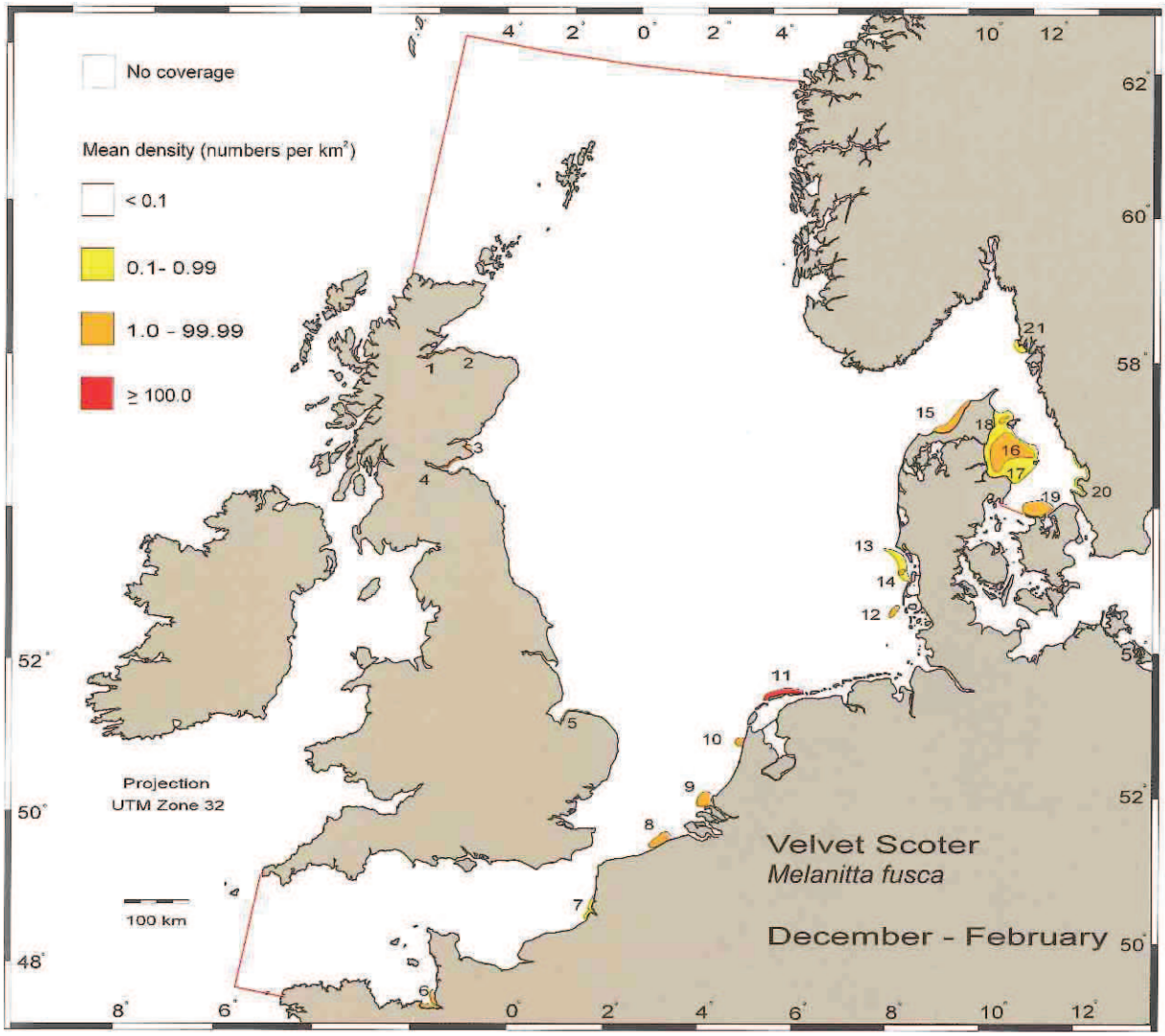
Velvet Scoters are mainly confined to the Baltic and Kattegat in winter, the northern end of Denmark being the limit of distribution in this area.



Distribution and density of Velvet Scoter Melanitta fusca *in the North Sea, the Channel and the Kattegat from October t November 1980-1994.*

The average numbers of Velvet Scoter *Melanitta fusca* in key areas from October to November 1980-1994. Areas marked with bold are of international importance (MCC criteria).

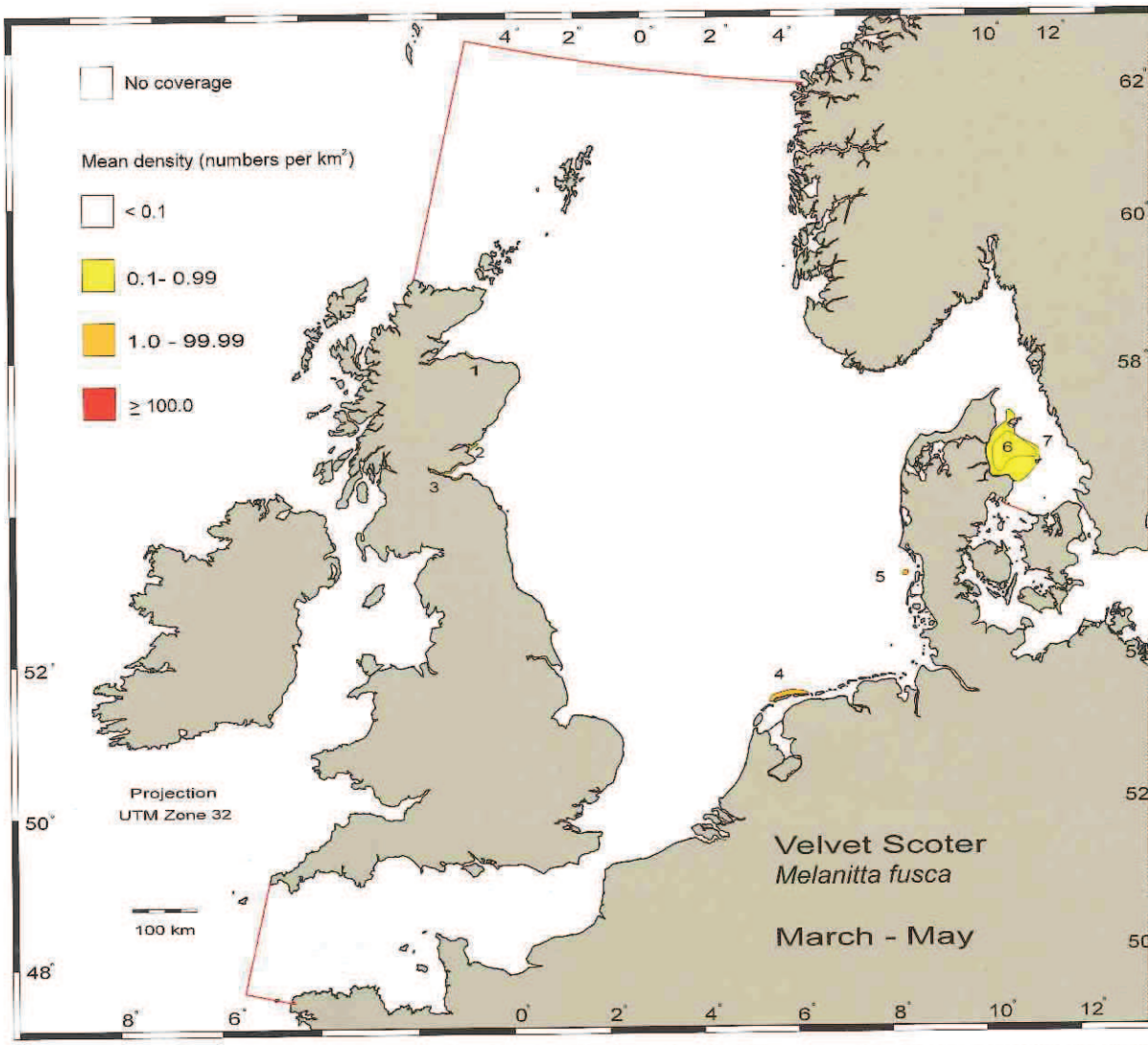
Locality	Density	Km²	Estimate	%
1 Spey Bay	1.50	20	30	0.02
2 Blackdog – Collieston	2.00	45	90	0.06
3 Eden Estuary	17.00	10	170	0.11
4 Firth of Forth	0.82	140	115	0.08
5 Voordelta	0.68	580	395	0.26
6 Texel	0.42	175	75	0.05
7 Røde Klit Sand	1.00	50	50	0.03
8 Northwest Kattegat, high	**10.18**	**910**	**93000**	**61.73**
9 Northwest Kattegat, medium	**23.36**	**2340**	**55000**	**36.51**
10 Northwest Kattegat, slow	0.94	1750	1600	1.06
Residual			160	0.11
Total			**150655**	**100.00**



Distribution and density of Velvet Scoter Melanitta fusca *in the North Sea, the Channel and the Kattegat from December to February 1980-1994.*

The average numbers of Velvet Scoter *Melanitta fusca* in key areas from December to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

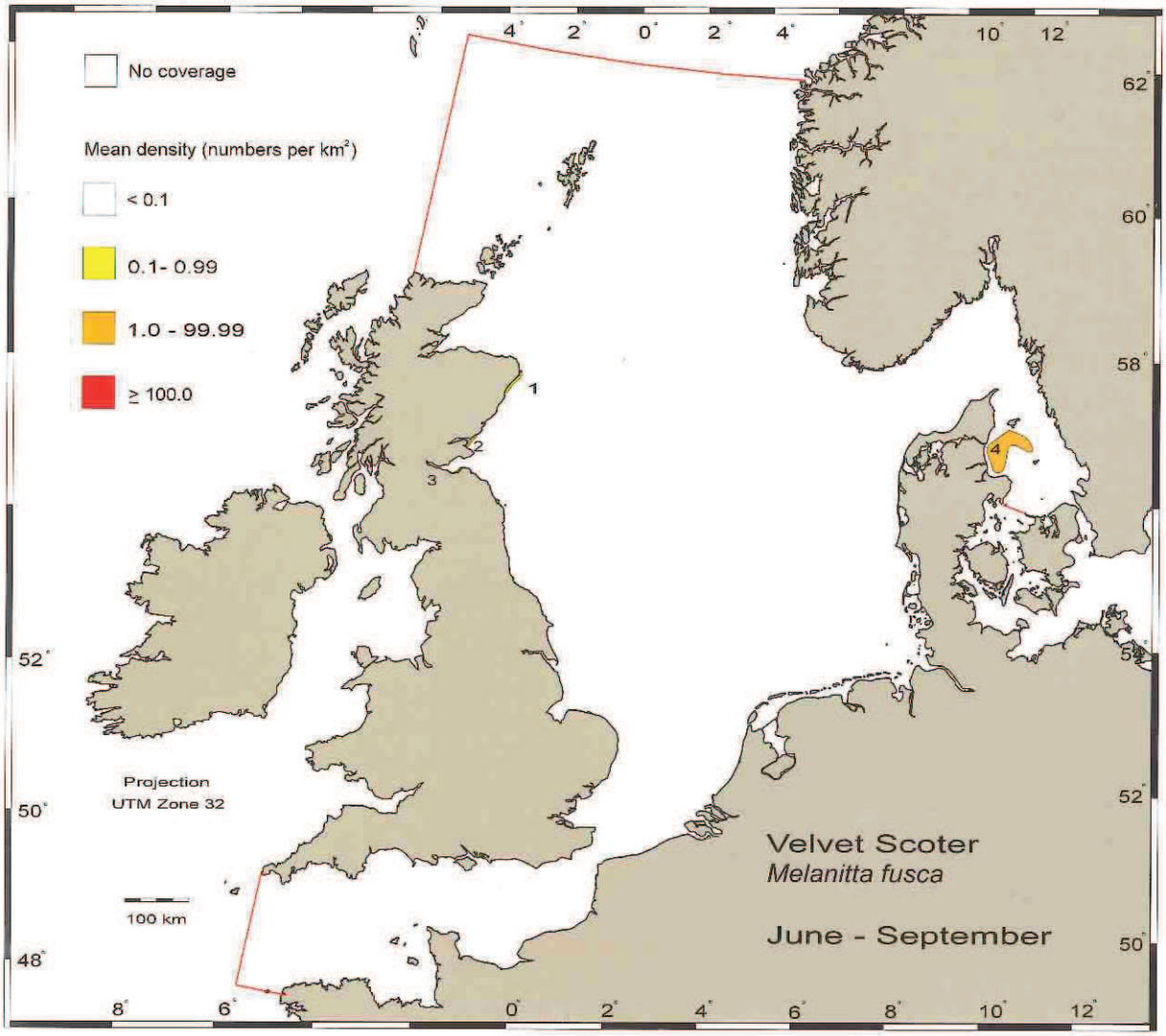
Locality	Density	Km²	Estimate	%
1 Moray Firth	0.29	85	25	0.02
2 Spey Bay	4.50	20	90	0.07
3 Eden Estuary	19.00	20	380	0.31
4 Firth of Forth	1.29	140	180	0.15
5 Wash	0.55	55	30	0.02
6 Deauville	18.23	130	2370	1.95
7 Baie de la Somme – Authie	0.25	100	25	0.02
8 Belgian coast	1.38	50	200	0.16
9 Voordelta	1.34	160	200	0.16
10 Dutch coast	2.23	60	130	0.11
11 Juist – Terschelling	113.64	440	6000	4.94
12 Amrum Bank	1.46	400	600	0.49
13 Off Danish Wadden Sea	0.42	820	345	0.28
14 Røde Klit Sand	5.10	50	255	0.21
15 Jammerbugt, cold winters	1.37	875	1200	0.99
16 Northwestern Kattegat, medium	**53.72**	**1820**	**98000**	**80.70**
17 Northwestern Kattegat, low	0.44	2780	1200	0.99
18 Læsø northwest	23.11	100	2300	1.89
19 Hesselø Bugt, cold winters	8.55	875	7485	6.16
20 Sweden, southwest coast	0.88	240	210	0.17
21 Lysekil north	0.18	140	25	0.02
Residual			180	0.15
Total			**121430**	**100.00**



Distribution and density of Velvet Scoter Melanitta fusca *in the North Sea, the Channel and the Kattegat from March to M 1980-1994.*

The average numbers of Velvet Scoter *Melanitta fusca* in key areas from March to May 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Spey Bay	4.00	20	80	1.99
2 Eden Estuary	7.50	10	75	1.86
3 Firth of Forth	1.68	140	235	5.83
4 Juist – Terschelling	2.27	440	1000	24.81
5 Røde Klit Sand	2.70	50	135	3.35
6 Northwestern Kattegat, low	0.15	2835	430	10.67
7 Northwestern Kattegat, medium	0.82	2425	2000	49.63
Residual			75	1.86
Total			**4030**	**100.00**



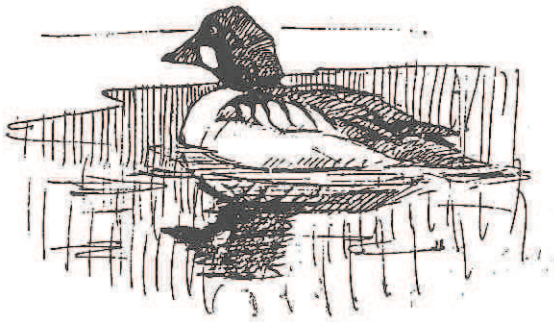
Distribution and density of Velvet Scoter Melanitta fusca *in the North Sea, the Channel and the Kattegat from June to September 1980-1994.*

The average numbers of Velvet Scoter *Melanitta fusca* in key areas from June to September 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Blackdog – Collieston	0.67	45	30	0.98
2 Eden Estuary	5.50	10	55	1.79
3 Firth of Forth	2.33	30	70	2.28
4 Northwestern Kattegat	1.30	2160	2800	91.35
Residual			110	3.59
Total			**3065**	**100.00**

Goldeneye *Bucephala clangula*

Goldeneyes breed in hollow trees close to lakes or rivers. The Northwest European subspecies is common in Fennoscandia and in the coniferous forest zone of Russia. Elsewhere in Europe, scattered populations are also found in the Baltic countries, Scotland and the Czech Republic. Breeding populations of Northern Europe and Northwest Russia are migratory, and mostly winter in the Baltic, Central Europe, the Netherlands and Britain. Goldeneyes rarely form large flocks but are usually scattered in coastal areas in small groups. In winter, the food mainly consists of molluscs and small crustaceans.



Importance of the North Sea

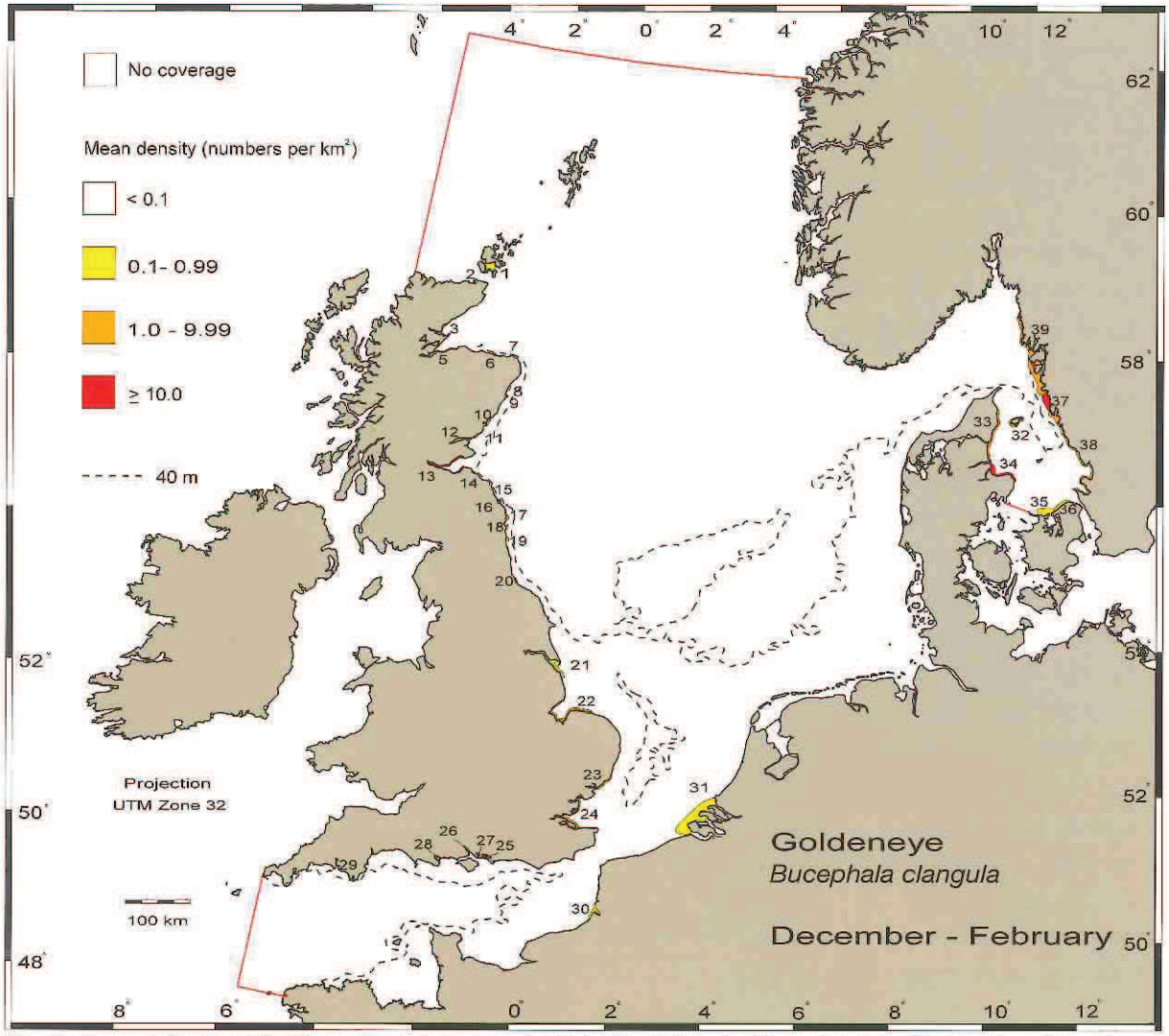
The average winter population of 16,400 birds in the study region represents 5% of the total Northwest European winter population. This is undoubtly an underestimate, as data from Norway were not available. More than 10,000 winter along the Norwegian coasts of the region (Nygård *et al.* 1988). The population wintering in the Baltic has been estimated at 210,000 birds (Pihl *et al.* 1995).

Main areas

British estuaries and the east-Swedish archipelago comprise the main areas for this species in the study region. Due to the dispersed distribution within these coastal areas, no areas are of international importance.

Distribution

Goldeneyes are restricted to sheltered waters less than 10 meters water depth, close to the shore. Goldeneyes arrive on the wintering grounds in November, and return movements start in February (Jensen 1993). In winter, the species is distributed throughout the study region. However along exposed areas of the continental coasts of the Voordelta the species is virtually absent, while it is numerous in lagoons and fjords.



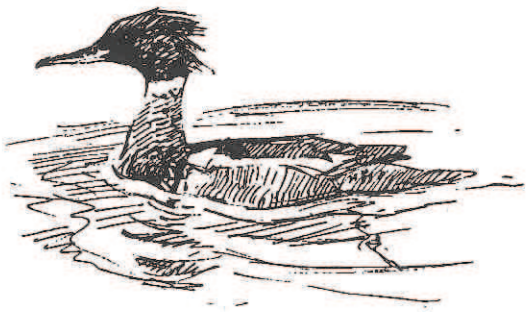
Distribution and density of Goldeneye Bucephala clangula *in the North Sea, the Channel and the Kattegat from December to February 1980-1994.*

The average numbers of Goldeneye *Bucephala clangula* in key areas from December to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Scapa Flow	0.71	210	150	0.91
2 Thurso bay	4.33	15	65	0.40
3 Dornoch Firth & Embo-Brora	2.00	60	120	0.73
4 Cromarty Firth	3.00	75	225	1.37
5 Moray Firth	5.00	100	500	3.05
6 Banff & Byondie bays	31.00	5	155	0.95
7 Rosehearty - Fraserburgh	14.17	6	85	0.52
8 Ythan Estuary	8.00	5	40	0.24
9 Aberdeen & Don Estuary	28.00	10	280	1.71
10 Montrose	3.00	25	75	0.46
11 Carnoustie - Westhaven	6.25	8	50	0.30
12 Firth of Tay & Eden Estuary	2.92	65	190	1.16
13 Firth of Fort	18.86	140	2640	16.10
14 Tyne Estuary	6.25	4	25	0.15
15 Lindisfarne	0.71	35	25	0.15
16 Tweed Estuary	62.00	5	310	1.89
17 Beadnell Bay	2.50	8	20	0.12
18 Cambois - Newbiggin	9.38	8	75	0.46
19 Newcastle	8.33	6	50	0.30
20 Tees Estuary	11.50	10	115	0.70
21 Humber Estuary	0.72	145	105	0.64
22 The Wash	2.84	125	355	2.16
23 Orwell - Deben & Alde Complex	2.70	50	135	0.82
24 Thames Estuary	3.88	210	815	4.97
25 Langstone & Chichester Harbours	3.07	44	135	0.82
26 Southampton Water	1.40	25	35	0.21
27 Portsmouth Harbour	3.33	15	50	0.30
28 Poole Harbour	3.13	40	125	0.76
29 Salcombe Estuary	3.50	10	35	0.21
30 Baie de la Somme	0.67	45	30	0.18
31 Voordelta	0.28	1200	340	2.07
32 Læsø	5.68	110	625	3.81
33 Northern Ålborg Bugt	6.65	85	565	3.45
34 Southern Ålborg Bugt	21.54	65	1400	8.54
35 Sjælland, northwest	0.12	260	30	0.18
36 Sjælland, northeast	0.22	185	40	0.24
37 Göteborg Skärgård	46.67	30	1400	8.54
38 Hallan coast	9.00	200	1800	10.98
39 Bohuslän coast	7.00	300	2100	12.80
Residual			1300	7.93
Total			**16400**	**100.00**

Red-breasted Merganser
Mergus serrator

Red-breasted Mergansers breed across the northern hemisphere, from the temperate to low arctic zones in both continents, reaching their southern limit in Ireland, Wales and the Netherlands (Carter 1993, Meininger & de Kraker 1992). Red-breasted Mergansers winter in marine habitats, in Europe mainly off Norway, around the British Isles, in the Baltic, Wadden Sea/IJsselmeer and in the eastern Mediterranean and Black Sea. Inland winter concentrations are found in several large lakes from The Netherlands to central Europe (del Hoyo *et al.* 1992). Red-breasted Mergansers feed on a wide variety of prey, such as small roundfish, shrimps and polychaetes (Madsen 1957).



Importance of the North Sea

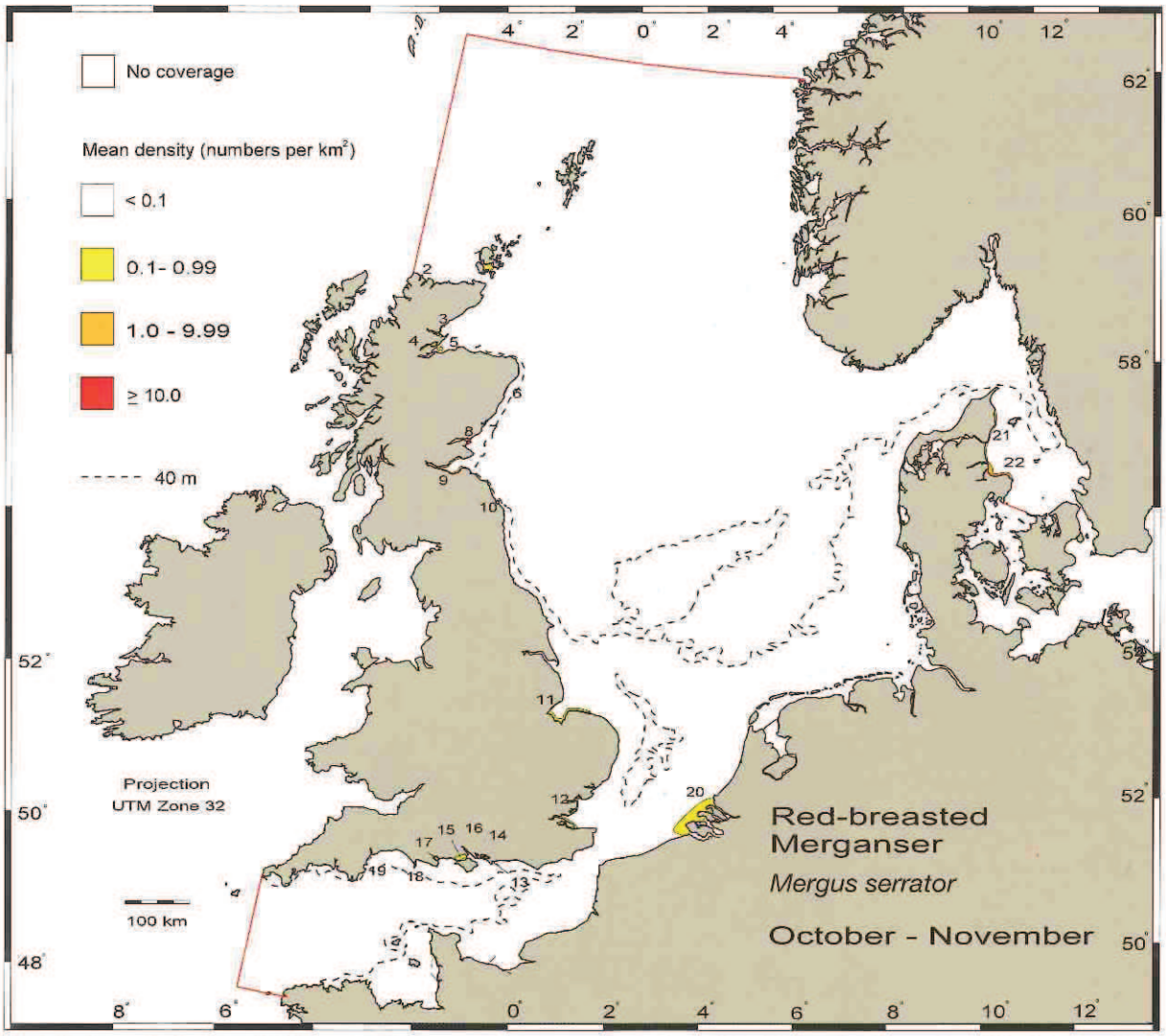
The bulk of the Red-breasted Mergansers wintering in the Western Palaearctic are found in Northwest Europe where an estimated 100,000 birds occur (Rose & Scott 1994). Several important wintering areas are known in Northwest Europe: 20,000-25,000 winter off Norway (Nygård 1985), 44,000 in the Baltic (Durinck *et al.* 1994b), up to 20,000 in the western Wadden Sea and IJsselmeer (Platteeuw 1985, 1987a) and nearly 6,000 in the Dutch Delta area (Meininger *et al.* 1994). Some 10,000 winter around the British Isles (Kirby *et al.* 1993). The North Sea, Skagerrak and Channel support about 10,000 birds in winter (15% of the Northwest European winter population).

Main areas

The inner Moray Firth, Montrose Bay and the Firth of Tay in east Scotland are of international importance (supporting more than 1000 birds) in winter. Furthermore, Montrose Bay is an important area in autumn.

Distribution patterns

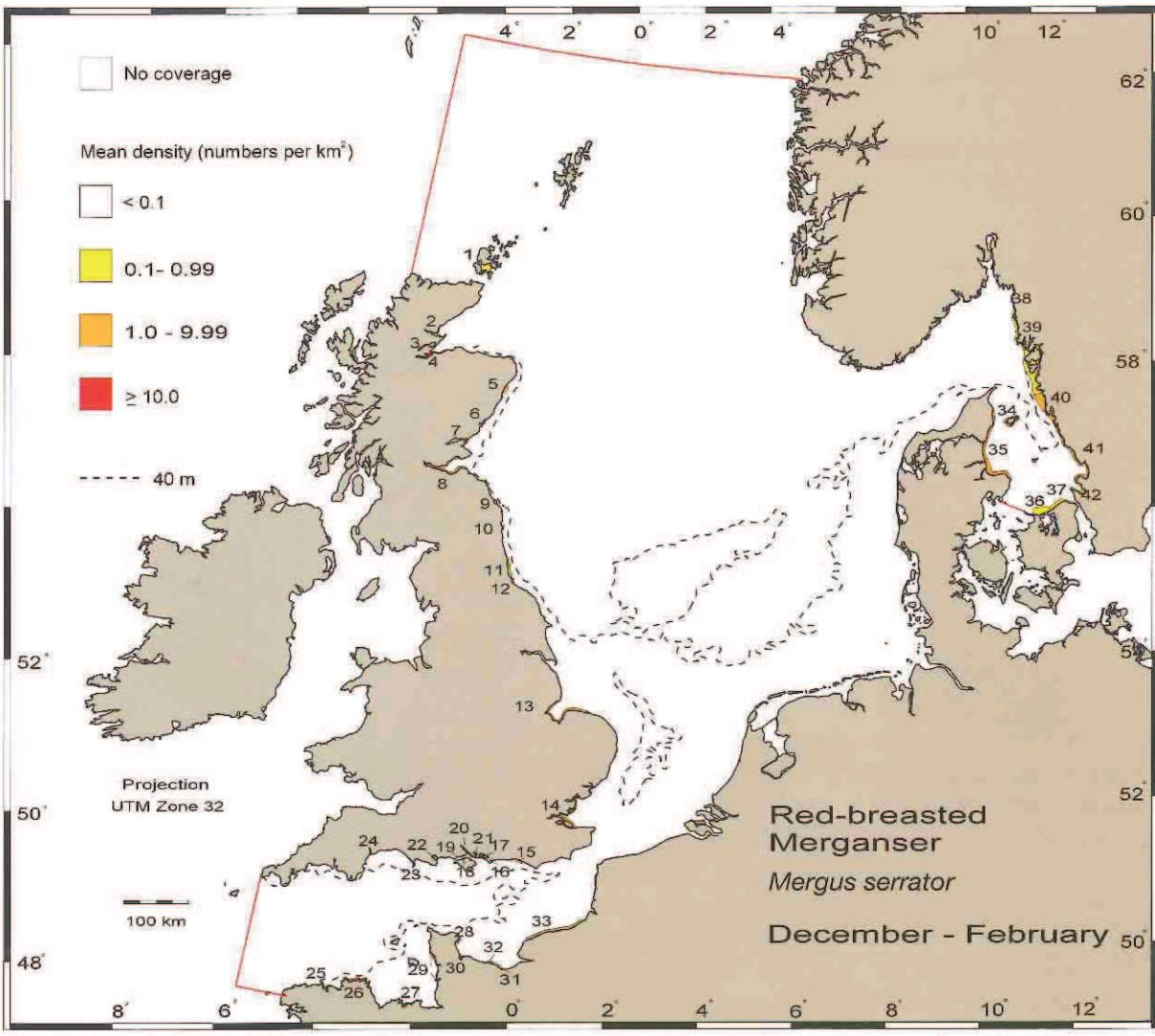
Red-breasted Merganser is typically an inshore species. It is found along most sheltered coasts in the study region, almost thoughout the year, but especially in winter. It should be noted that no data were available from Shetland and Norway where the species is a common winter visitor (Suddaby 1992). In the eastern North Sea, they apparently prefer inland areas such as the Limfjord, IJsselmeer and the Delta area to marine wintering habitats. The number of birds wintering in the North Sea may be higher during cold winters, as birds from around the Baltic fly to the United Kingdom (Chandler 1981).



Distribution and density of Red-breasted Merganser Mergus serrator *in the North Sea, the Channel and the Kattegat from October to November 1980-1994.*

The average numbers of Red-breasted Merganser *Mergus serrator* in key areas from October to November 1980-1994. Areas marked with bold are of international importance (MCC criteria).

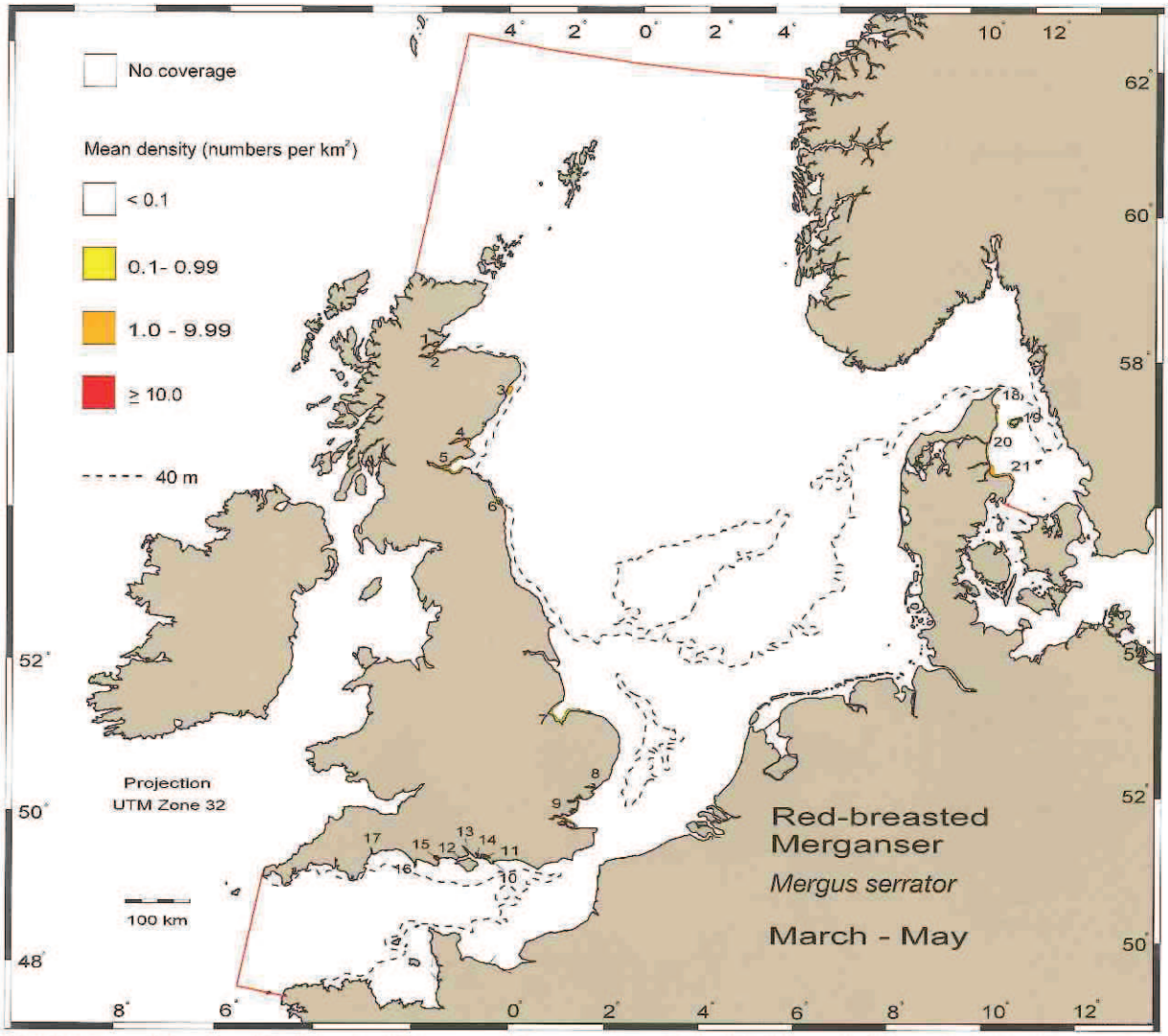
Locality	Density	Km²	Estimate	%
1 Scapa Flow	0.24	210	50	1.22
2 Loch Eriboll	1.00	20	20	0.49
3 Dornoch Firth & Embo – Brora	1.83	60	110	2.69
4 Cromarty Firth	1.33	75	100	2.44
5 Inner Moray Firth	8.67	45	390	9.52
6 Blackdog – Ythan	2.08	12	25	0.61
7 Montrose Bay	**66.67**	**15**	**1000**	**24.42**
8 Firth of Tay mouth	32.00	15	480	11.72
9 Firth of Forth	5.36	140	750	18.32
10 Lindisfarne	1.14	35	40	0.98
11 Wash	0.96	125	120	2.93
12 Thames Estuary	0.62	210	130	3.17
13 Pagham Harbour	3.33	6	20	0.49
14 Langstone & Chichester harbours	3.86	44	170	4.15
15 Needs Oar Point & Northwest Solent	1.33	15	20	0.49
16 Portsmouth Harbour	1.67	15	25	0.61
17 Poole Harbour	5.88	40	235	5.74
18 Portland Harbour	4.50	10	45	1.10
19 Exe Estuary	2.25	20	45	1.10
20 Voordelta	0.12	1200	145	3.54
21 Northern Ålborg Bugt	0.41	85	35	0.85
22 Southern Ålborg Bugt	2.15	65	140	3.42
Residual			510	12.45
Total			**4095**	**100.00**



Distribution and density of Red-breasted Merganser Mergus serrator *in the North Sea, the Channel and the Kattegat from December to February 1980-1994.*

The average numbers of Red-breasted Merganser *Mergus serrator* in key areas from December to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

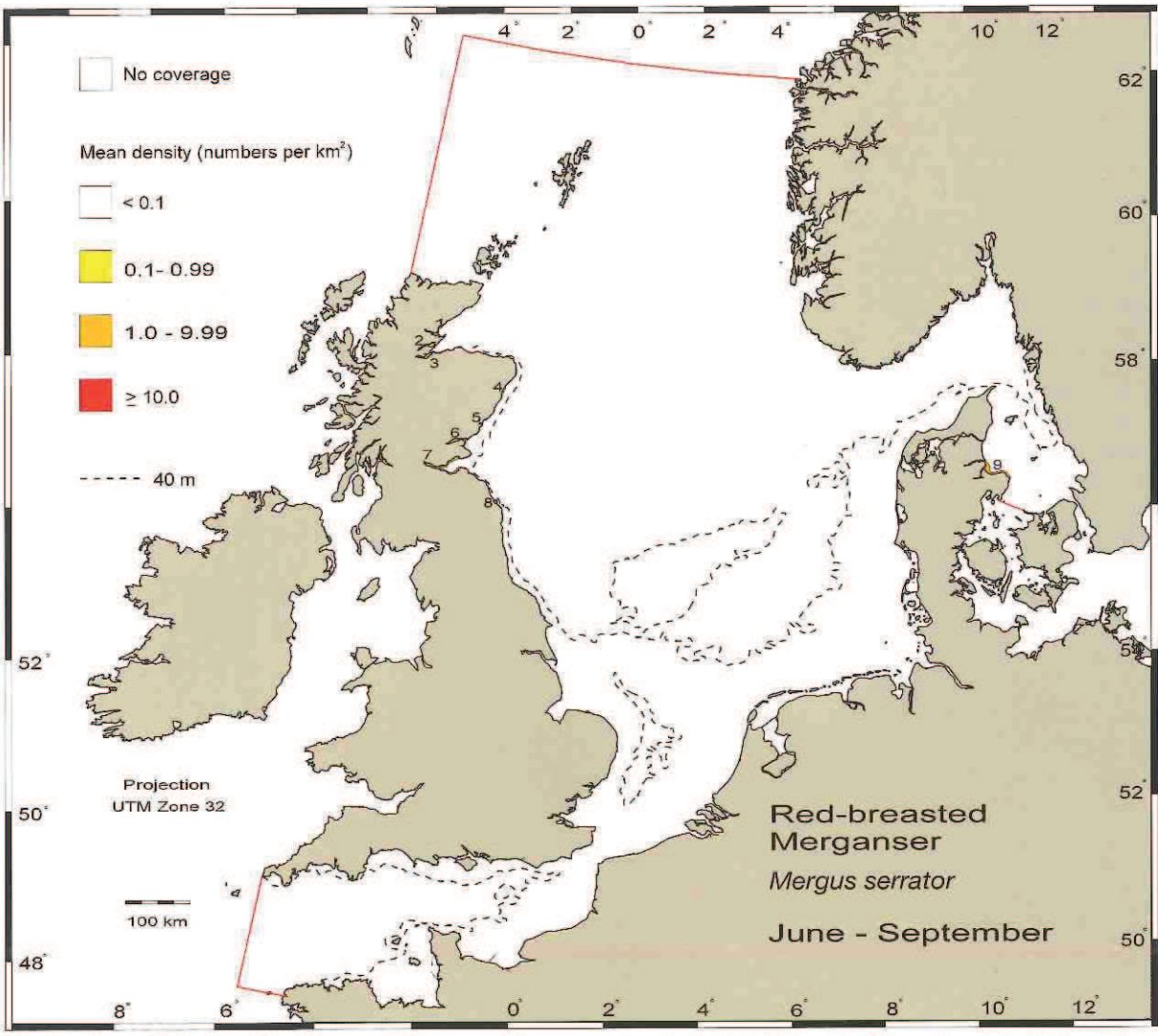
Locality	Density	Km²	Estimate	%	Locality	Density	Km²	Estimate	%
1 Scapa Flow	0.79	210	165	1.67	23 Portland Harbour	9.00	10	90	0.91
2 Dornoch Firth & Embo-Brora	0.83	60	50	0.51	24 Exe Estuary	4.00	20	80	0.81
3 Cromarty Firth	4.60	75	345	3.50	25 Cote du Pays de Caux	0.61	90	55	0.56
4 Moray Firth	**12.94**	**85**	**1100**	**11.16**	26 Courseulles – Arromanches	15.63	8	125	1.27
5 Ythan Estuary	6.00	5	30	0.30	27 Rade de Caen	10.00	16	160	1.62
6 Montrose Bay	**66.67**	**15**	**1000**	**10.15**	28 Baie de Veys	2.40	25	60	0.61
7 Firth of Tay mouth	**73.33**	**15**	**1100**	**11.16**	29 Cote Ouest Cotenti	1.52	23	35	0.36
8 Firth of Forth	3.64	140	510	5.18	30 Pointe de Saire-Aumeville-lestre	16.25	8	130	1.32
9 Lindisfarne	0.71	35	25	0.25	31 St. Jacut de la Me	0.73	41	30	0.30
10 Craster	6.00	5	30	0.30	32 Cote du Trego	0.85	65	55	0.56
11 Durham coast	0.67	30	20	0.20	33 Baie de Morlaix & Penze	1.71	35	60	0.61
12 Tees Estuary	10.00	10	100	1.01	34 Læsø	3.36	110	370	3.75
13 Wash	1.04	125	130	1.32	35 Ålborg Bugt	1.27	150	190	1.93
14 Thames Estuary	1.05	210	220	2.23	36 Northwestern Hesselø Bay	0.25	260	65	0.66
15 Ferring – Goring	1.67	15	25	0.25	37 Northeast Hesselø Bay	0.95	185	175	1.78
16 Pagham Harbour	5.00	6	30	0.30	38 North Bohuslän	4.40	50	220	2.23
17 Langstone & Chichester Harbours	5.34	44	235	2.38	39 Grebbestad – Göteborg	0.49	800	390	3.96
18 Newton Estuary	5.00	5	25	0.25	40 Göteborg – Varberg	2.10	400	840	8.52
19 Needs Oar Point & Northwest Solent	2.67	15	40	0.41	41 Varberg – Laholmsbugten	1.37	95	130	1.32
20 Southampton Water	1.00	25	25	0.25	42 Skälderviken	3.00	55	165	1.67
21 Portsmouth Harbour	4.00	15	60	0.61	Residual			1030	10.45
22 Poole Harbour	7.50	40	300	3.04	**Total**			**9855**	**100.00**



Distribution and density of Red-breasted Merganser Mergus serrator *in the North Sea, the Channel and the Kattegat from March to May 1980-1994.*

The average numbers of Red-breasted Merganser *Mergus serrator* in key areas from March to May 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Cromarty Firth	0.80	75	60	2.64
2 Moray Firth	1.65	85	140	6.15
3 Ythan Estuary	6.00	5	30	1.32
4 Firth of Tay – Eden Estuary	0.92	65	60	2.64
5 Firth of Forth	2.54	140	355	15.60
6 Lindisfarne	0.86	35	30	1.32
7 Wash	0.64	125	80	3.52
8 Orwell Estuary	2.50	10	25	1.10
9 Thames Estuary	0.81	210	170	7.47
10 Pagham Harbour	5.00	6	30	1.32
11 Langstone & Chichester harbours	3.41	44	150	6.59
12 Needs Oar Point & Northwest Solent	2.00	15	30	1.32
13 Southampton Wate	1.00	25	25	1.10
14 Portsmouth Harbour	2.00	15	30	1.32
15 Poole Harbour	4.25	40	170	7.47
16 Portland Harbour	5.50	10	55	2.42
17 Exe Estuary	2.75	20	55	2.42
18 Hirsholmene	1.33	30	40	1.76
19 Læsø	0.18	110	20	0.88
20 Northern Ålborg Bugt	0.71	85	60	2.64
21 Southern Ålborg Bugt	2.15	65	140	6.15
Residual			520	22.86
Total			**2275**	**100.00**



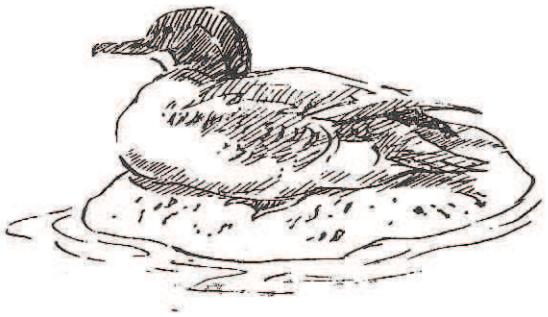
Distribution and density of Red-breasted Merganser Mergus serrator *in the North Sea, the Channel and the Kattegat from June to September 1980-1994.*

The average numbers of Red-breasted Merganser *Mergus serrator* in key areas from June to September 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Dornoch Firth & Embo – Brora	2.00	60	120	7.87
2 Cromarty Firth	0.53	75	40	2.62
3 Moray Firth	0.53	85	45	2.95
4 Blackdog – Ythan	6.67	12	80	5.25
5 Montrose Basin	2.50	8	20	1.31
6 Firth of Tay – Eden Estuary	2.23	65	145	9.51
7 Firth of Forth	3.71	140	520	34.10
8 Lindisfarne	3.29	35	115	7.54
9 Southern Ålborg Bugt	3.15	65	205	13.44
Residual			235	15.41
Total			**1525**	**100.00**

Goosander *Mergus merganser*

Goosanders breed in Iceland, Britain, Fennoscandia and Russia and in North America. In Northwest Europe the species mainly winters along the Norwegian coast and in fresh water and estuarine habitats of the Baltic and the North Sea. In the study region, most Goosanders winter in fresh water. It marine areas they feed almost exclusively on small fish (Madsen 1957).



Importance of the North Sea

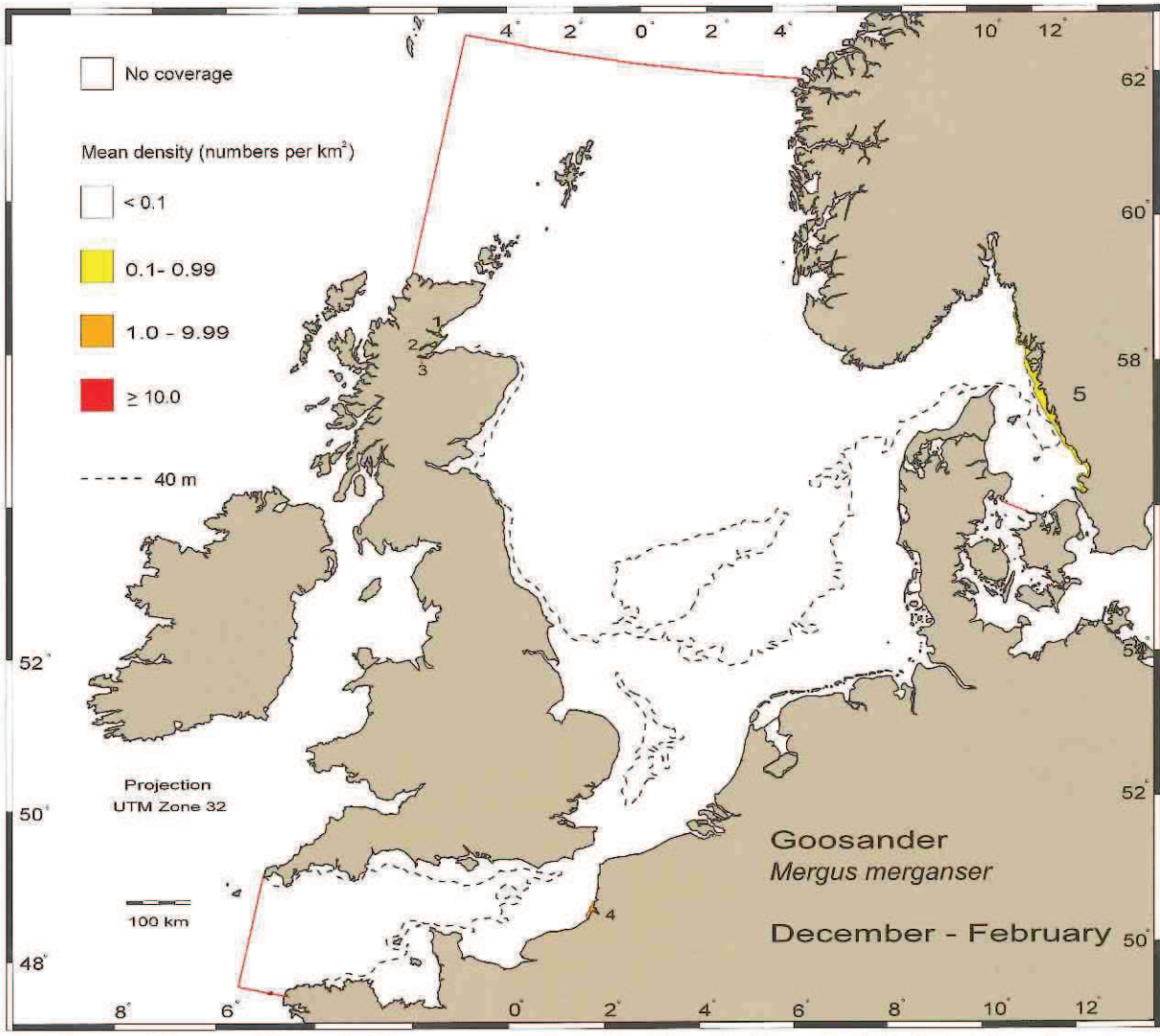
The total number of 3,000 goosanders estimated to winter in marine sites in the North Sea represents 2% of the total Northwest European winter population. A similar number of birds winters along the Norwegian coasts of the region (Nygård *et al.* 1988). More than 90% of the Northwest European winter population occur in the Baltic (Pihl *et al.* 1995). The IJsselmeer/ western Wadden Sea forms another important wintering area adjacent to the study region with 10-15,000 birds (Platteeuw 1987b).

Main areas

Significant numbers of Goosanders only occur in the Moray Firth and along the Swedish west coast. However, only the innner Moray Firth is of international importance.

Distribution

In the North Sea the Goosander is a regular visitor only to sheltered, inshore waters of the British and Swedish coasts, and it clearly avoids the exposed coasts of the continent.



Distribution and density of Goosander Mergus merganser *in the North Sea, the Channel and the Kattegat from December to February 1980-1994.*

The average numbers of Goosander *Mergus merganser* in key areas from December to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Cromarty Firth	0.69	75	50	1.55
2 Dornoch Firth	0.40	50	20	0.62
3 Beauly Firth	**63.33**	**30**	**1900**	**58.82**
4 Baie de la Somme (cold winters)	2.56	45	115	3.56
5 Sweden west coast	0.66	1400	930	28.79
Residual			215	6.66
Total			**3230**	**100.00**

Great Skua *Catharacta skua*

Great Skuas breed solely in Europe, being confined to Iceland (5400 pairs), Scotland (7900 pairs) and Faroes-Scandinavia (400 pairs) Lloyd *et al.* (1991). Their breeding range is expanding northward, as birds have colonized Svalbard, Bear Island and Jan Mayen in recent years. The species winters in the Atlantic, generally south of the study region, but individuals may wander greatly to the west as well, sometimes reaching North America (Furness 1987). The species is long-lived and the proportion of non-adults in the study region is on average 55%, but this figure is likely to have decreased in recent years (Tasker *et al.* 1985b, Klomp & Furness 1992). The list of food species is long, ranging from birds, eggs, fish and carrion to invertebrates and offal. Small, shoaling fish are probably most important. Food is either taken directly by the birds or by kleptoparasition of other birds (Furness 1979, Tasker *et al.* 1985b, Hudson & Furness 1988).

Importance of the North Sea

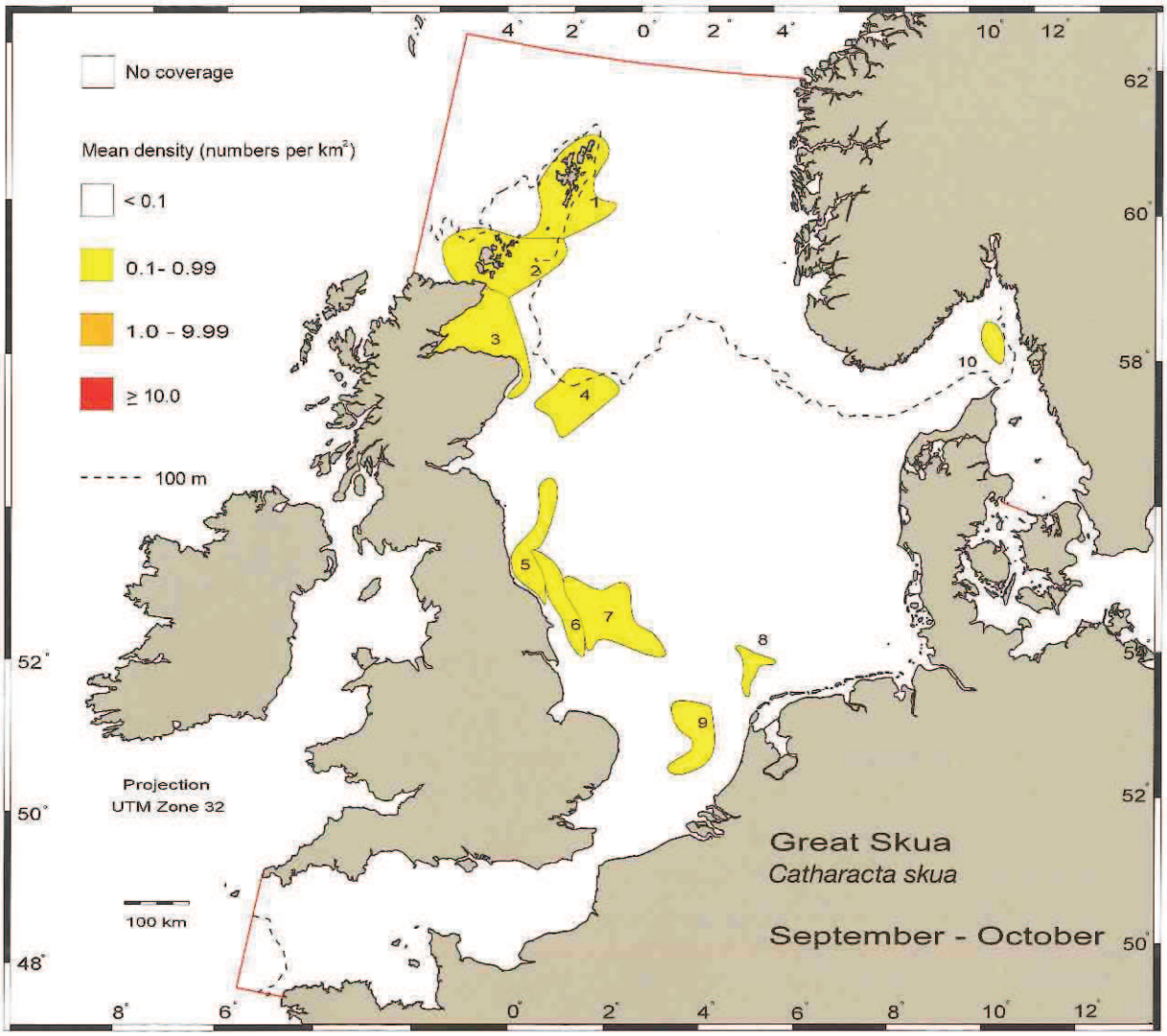
With nearly 60% of the world population of 14,000 pairs breeding in Orkney-Shetland, the North Sea is of great importance to the species. Numbers in the North Sea are highest shortly after the breeding season,when most young have fledged, but have not yet dispersed out of the study region. In this period, the total number of birds found in the North Sea exceeds the total number of breeders in the Northeast Atlantic. The best areas in the study region are also of global importance to this species.

Main areas

In the early breeding season (April-June) the waters around Shetland and Foula, and off western Orkney are internationally important. Half of the European breeding population occurs in these areas (20% of the total European population); the rest are presumably at the colonies. Very few birds were found outside these colony areas. In the later part of the breeding season the adults range further offshore, subadults leave their clubsites at the colonies and the young fledge, leading to maximum numbers at sea in the study region in July-August. Shetland and Orkney waters remain important, but internationally important numbers now also occur in more distant areas: the Moray Firth, off Flamborough Head and in the Skagerrak. In autumn (September-October) important numbers still occur off Northwest Scotland and off Flamborough; the Skagerrak is largely deserted (although still over 1% of the breeding population remains here), and numbers rise to above the 1% level near the Brown Ridge in the Southern North Sea. In winter (November-March) the birds live outside the North Sea (Stone *et al.* 1995), but in the southwest of the study region, in the Western Channel, several hundreds remain.

Distribution patterns

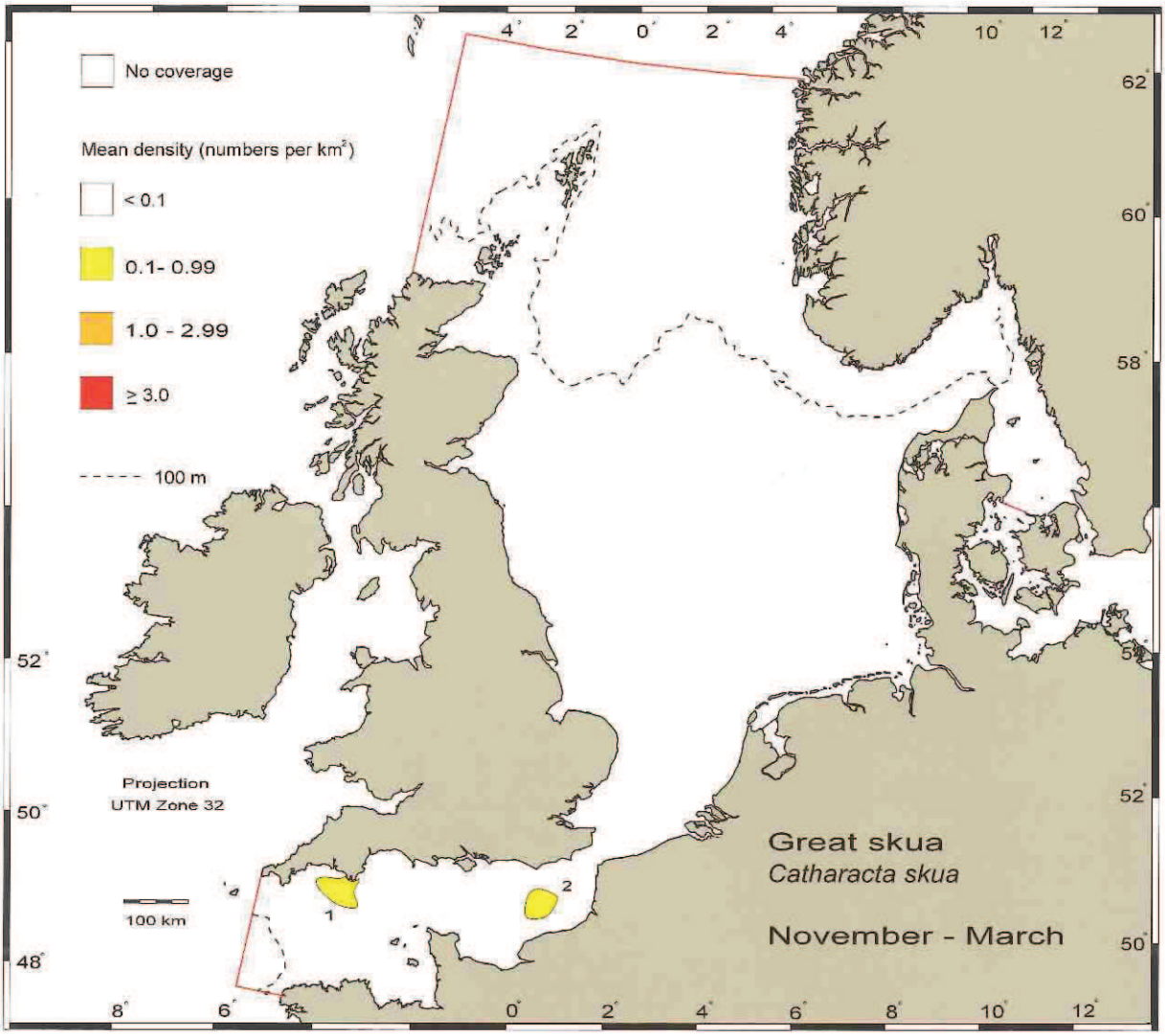
Great Skuas are highly concentrated around their colonies in summer, and dispersed in the Atlantic in winter. The onset of migration is as early as July, with immatures leaving first. In August failed breeders and juveniles follow, and by October all birds have left the colonies. During autumn migration, the birds range through most of the study region, but densities are always low in the central North Sea and in the Kattegat south of Læsø. Most birds remain off Scotland in autumn, but high numbers also build up in the Skagerrak. Both of these areas are deserted in August-September and large numbers pass through the Southern Bight and Channel. In winter some birds remain only in the western approaches to the Channel. Great Skuas return to their breeding colonies from the end of March.



Distribution and density of Great Skua Catharacta skua *in the North Sea, the Channel and the Kattegat from September to October 1980-1994.*

The average numbers of Great Skua *Catharacta skua* from September to October 1980-1994. Areas marked with bold are of international importance (MCC criteria).

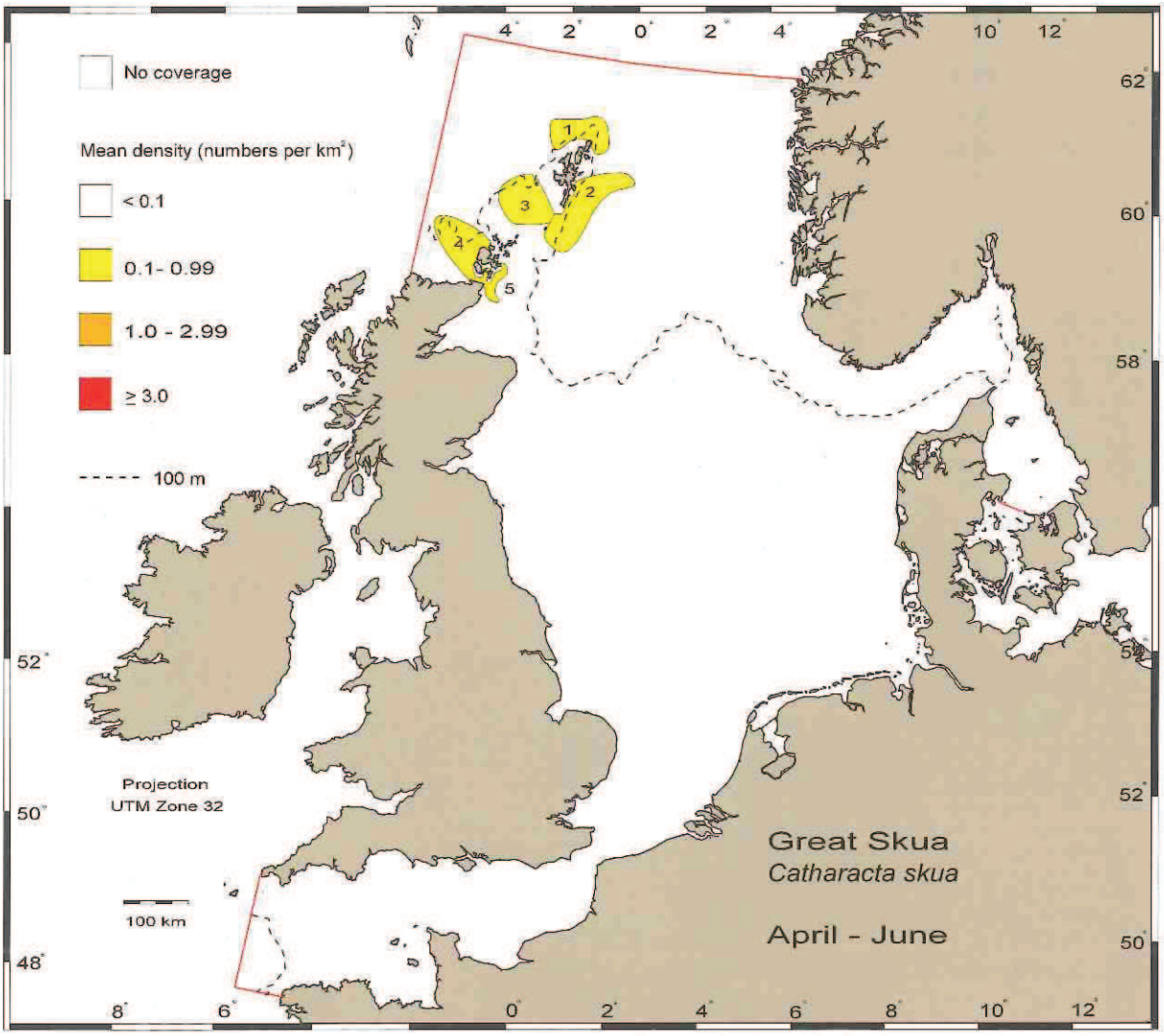
Locality	Density	Km²	Estimate	%
1 Shetland	**0.23**	**13000**	**3000**	**24.60**
2 Orkney	**0.11**	**14000**	**1500**	**12.30**
3 Moray Firth	**0.10**	**9600**	**1000**	**8.20**
4 Turbot Bank	**0.13**	**7700**	**1000**	**8.20**
5 Farms Deeps	0.12	5500	650	5.32
6 Flamborough Head	**0.60**	**4200**	**2500**	**24.50**
7 Outer Dowsing Shoal	**0.11**	**9800**	**1100**	**9.00**
8 Terschelling Bank	**0.17**	**1750**	**300**	**2.50**
9 Brown Ridge	**0.14**	**5500**	**750**	**6.15**
10 Eastern Skagerak	**0.23**	**1650**	**400**	**3.28**
Total			**12200**	**100.00**



Distribution and density of Great Skua Catharacta skua *in the North Sea, the Channel and the Kattegat from November to March 1980-1994.*

The average numbers of Great Skua *Catharacta skua* from November to March 1980-1994. Areas marked with bold are of international importance (MCC criteria).

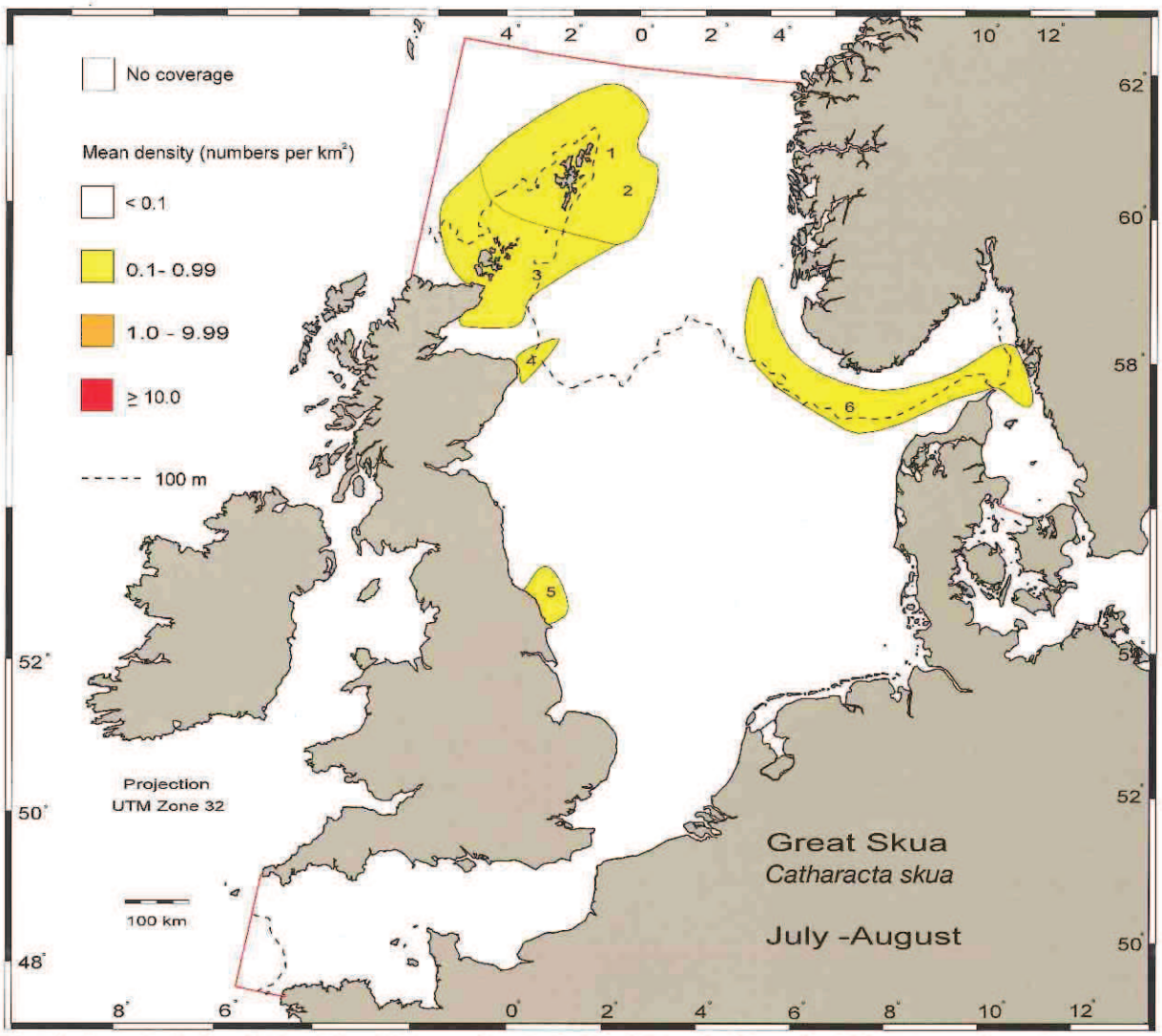
Locality	Density	Km²	Estimate	%
1 Start Point	**0.34**	**2200**	**750**	**75.00**
2 The Eastern Channel	0.11	1800	200	20.00
Residual			50	5.00
Total			**1000**	**100.00**



Distribution and density of Great Skua Catharacta skua *in the North Sea, the Channel and the Kattegat from April to June 1980-1994.*

The average numbers of Great Skua *Catharacta skua* from April to June 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 North Shetland	**0.52**	**3800**	**1975**	**31.47**
2 East Shetland	**0.18**	**6900**	**1250**	**19.92**
3 Foula	**0.25**	**5000**	**1250**	**19.92**
4 West Orkney	**0.22**	**4800**	**1050**	**16.73**
5 East Orkney	0.19	1250	250	3.98
Residual			500	7.97
Total			**6275**	**100.00**



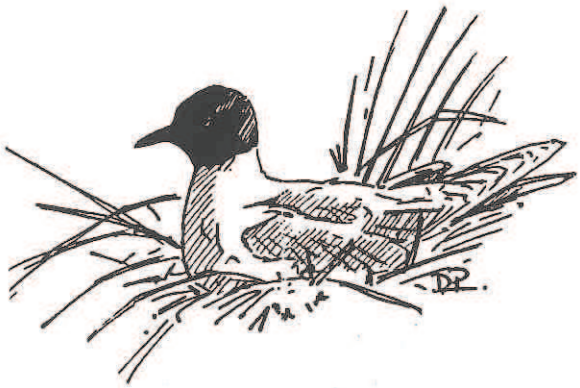
Distribution and density of Great Skua Catharacta skua *in the North Sea, the Channel and the Kattegat from July to August 1980-1994.*

The average numbers of Great Skua *Catharacta skua* from July to August 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 North Shetland	**0.47**	**6700**	**3100**	**10.33**
2 Shetland	**0.23**	**38000**	**8700**	**29.00**
3 Orkney	**0.20**	**25000**	**5000**	**16.67**
4 Eastern Moray Firth	**0.26**	**2000**	**500**	**1.67**
5 Flamborough Head	**0.12**	**3400**	**400**	**1.33**
6 Skagerrak	**0.11**	**30000**	**3300**	**11.00**
Residual			9000	30.00
Total			**30000**	**100.00**

Little Gull *Larus minutus*

Little Gulls breed mainly inland in wetlands from the eastern Baltic into Belorussiya and Russia and again further eastward in western and eastern Siberia (Cramp 1985). Little Gulls winter from the Baltic and North Seas south to the Mediterranean, Black and Caspian Seas (Bruun 1968, Meininger & Sørensen 1993, Durinck *et al.* 1994b, Stone *et al.* 1995).



Importance of the North Sea

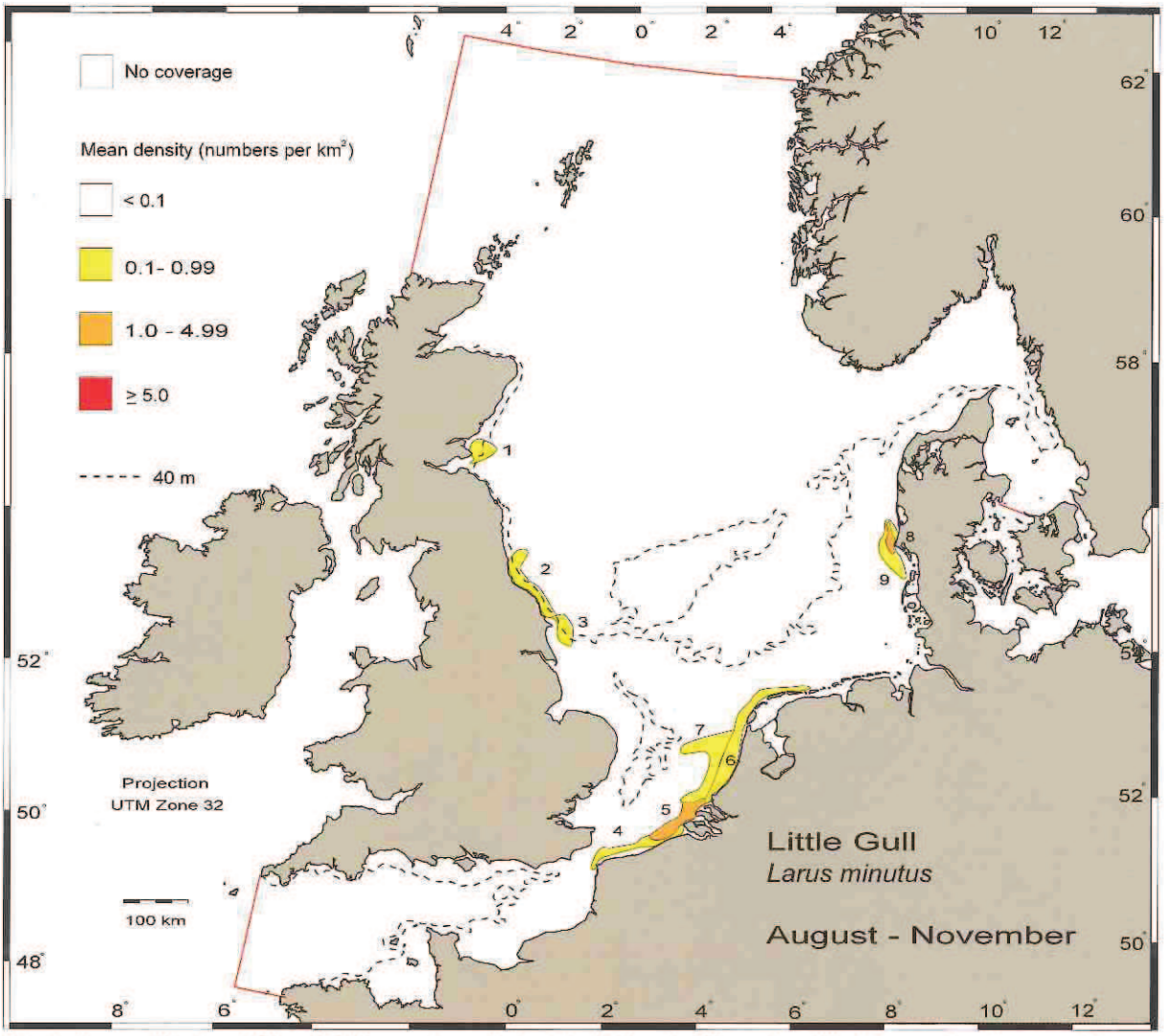
The European population is currently estimated at 30,000-45,000 pairs, of which some 80% occur in Russia and Finland (Rose & Scott 1994, Tucker & Heath 1994). The North Sea is important mainly during spring and autumn migration. Up to 30,000 birds (around 65% of the population) may migrate along the Continental coast south of Blåvandshuk in spring (den Ouden & Stougie 1990). The numbers that remain in the study region during winter represent about 0.7% of the population.

Main areas

In spring (March-May) migrating Little Gulls are found off the whole continental seaboard of the North Sea south of Blåvandshuk. The waters off Belgium, The Voordelta and the Dutch mainland coast are of international importance. During autumn migration the Dutch coast is also internationally important, as are the waters off Blåvandshuk. Relatively large numbers cross the North Sea in autumn, and internationally important numbers occur near the River Tees. Winter distribution is mainly along the continental seaboard and concentrations of international importance are present off the Northern Wadden Sea and in the Baie de la Seine.

Distribution patterns

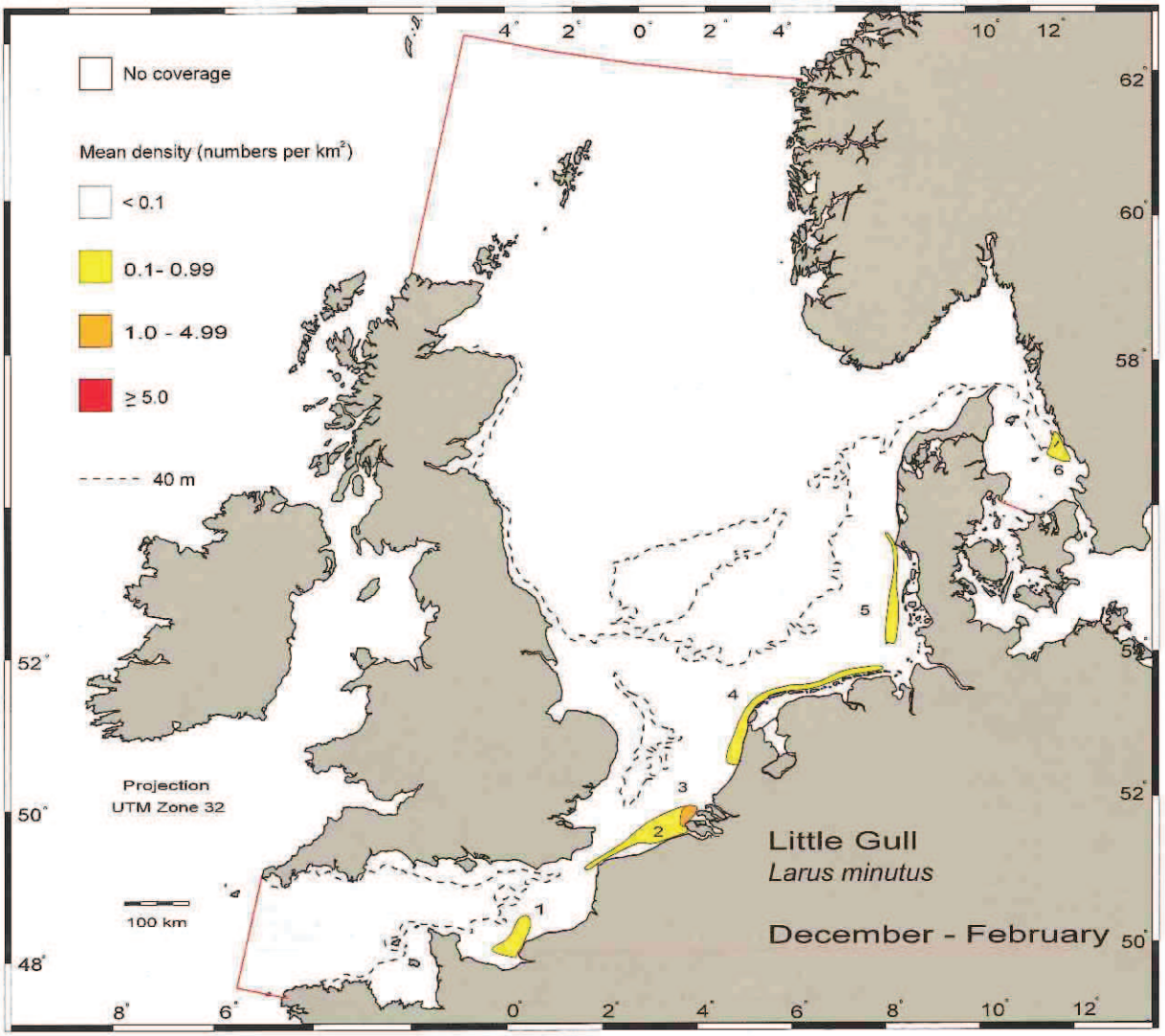
Little Gulls are typically found in estuarine inshore waters characterised by tidal and plume fronts. Passage during migration along the Continent is usually rapid (Meltofte & Faldborg 1987, den Ouden & Stougie 1990, Garthe 1993) and judging from observations at sea, most gulls remain closely inshore. Winter distribution in the North Sea seems connected to the presence of relatively large (up to 4500) wintering numbers in IJsselmeer (Voslamber 1991).



Distribution and density of Litte Gull Larus minutus *in the North Sea, the Channel and the Kattegat from August to November 1980-1994.*

The average numbers of Litte Gull *Larus minutus* in key areas from August to November 1980-1994. Areas marked with bold are of international importance (MCC criteria).

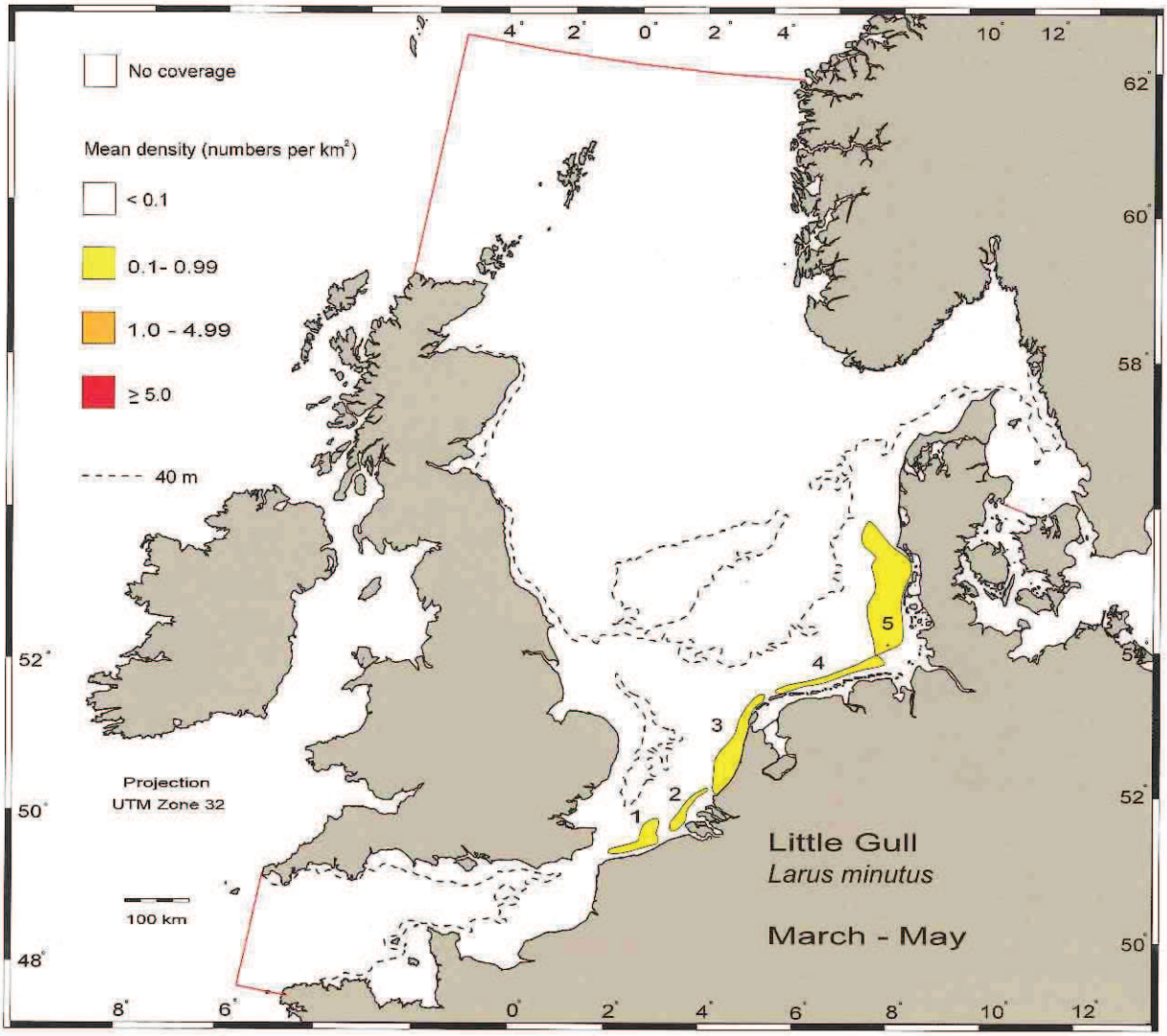
Locality	Density	Km²	Estimate	%
1 Tay Bay	0.44	1000	450	5.00
2 Tyne to north Yorkshire	**0.80**	**2100**	**1700**	**18.89**
3 Flamborough Head	0.29	1000	300	3.33
4 French – Belgian Coast	0.20	1500	300	3.33
5 Voordelta	**1.50**	**1700**	**2600**	**28.89**
6 Dutch coast	**0.41**	**3700**	**1700**	**18.89**
7 Broad Fourteens	0.10	3300	300	3.33
8 Blåvandshuk	**2.45**	**400**	**1000**	**11.11**
9 Horns Rev	0.35	1500	500	5.56
Residual			100	1.11
Total			**9000**	**100.00**



Distribution and density of Litte Gull Larus minutus *in the North Sea, the Channel and the Kattegat from December to February 1980-1994.*

The average numbers of Litte Gull *Larus minutus* in key areas from December to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 North Seine	**0.92**	**1800**	**1700**	**31.66**
2 French – Belgian Coast	0.13	3400	440	8.19
3 Voordelta	1.28	550	700	13.04
4 Dutch Frisian Coast	0.14	3400	480	8.94
5 Eastern North Sea	**0.57**	**3300**	**1900**	**35.38**
6 Middelgrundene	0.16	900	150	2.79
Residual			0	0.00
Total			**5370**	**100.00**



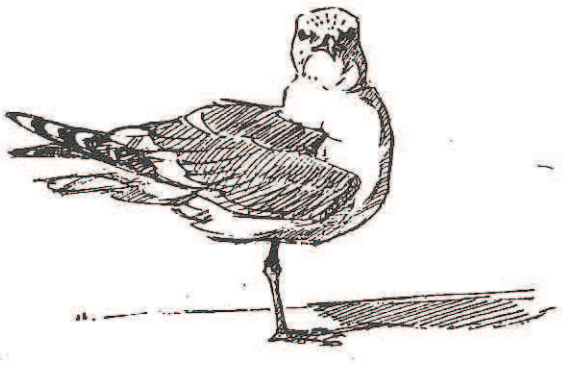
Distribution and density of Litte Gull Larus minutus *in the North Sea, the Channel and the Kattegat from March to May 1980-1994.*

The average numbers of Litte Gull *Larus minutus* in key areas from March to May 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Belgian – French Border	**0.57**	**1600**	**900**	**15.13**
2 Voordelta	**0.90**	**900**	**800**	**13.45**
3 Dutch Coast	**0.72**	**3300**	**2400**	**40.34**
4 Frisian Islands	0.33	1700	550	9.24
5 Eastern German Bight	0.14	9200	1300	21.85
Residual			0	0.00
Total			**6000**	**100.00**

Common Gull *Larus canus*

Common Gulls breed in a broad band in boreal Eurasia eastward to central North America (Glutz & Bauer 1982). The Northwest European breeding population is 800,000 pairs (Rose & Scott 1994). The centre of the breeding distribution is around the Baltic (Lloyd *et al.* 1991). Common Gulls use inland habitats to a great extent, but large numbers occur in the Baltic and North Seas in winter. This includes birds from further east (Durinck *et al.* 1994b). Terrestrial food is important to Common Gulls but at sea the diet is comprised mainly of marine invertebrates and fish, though it may also include offal and discards from fisheries (Bauer & Glutz 1982).



Importance of the North Sea

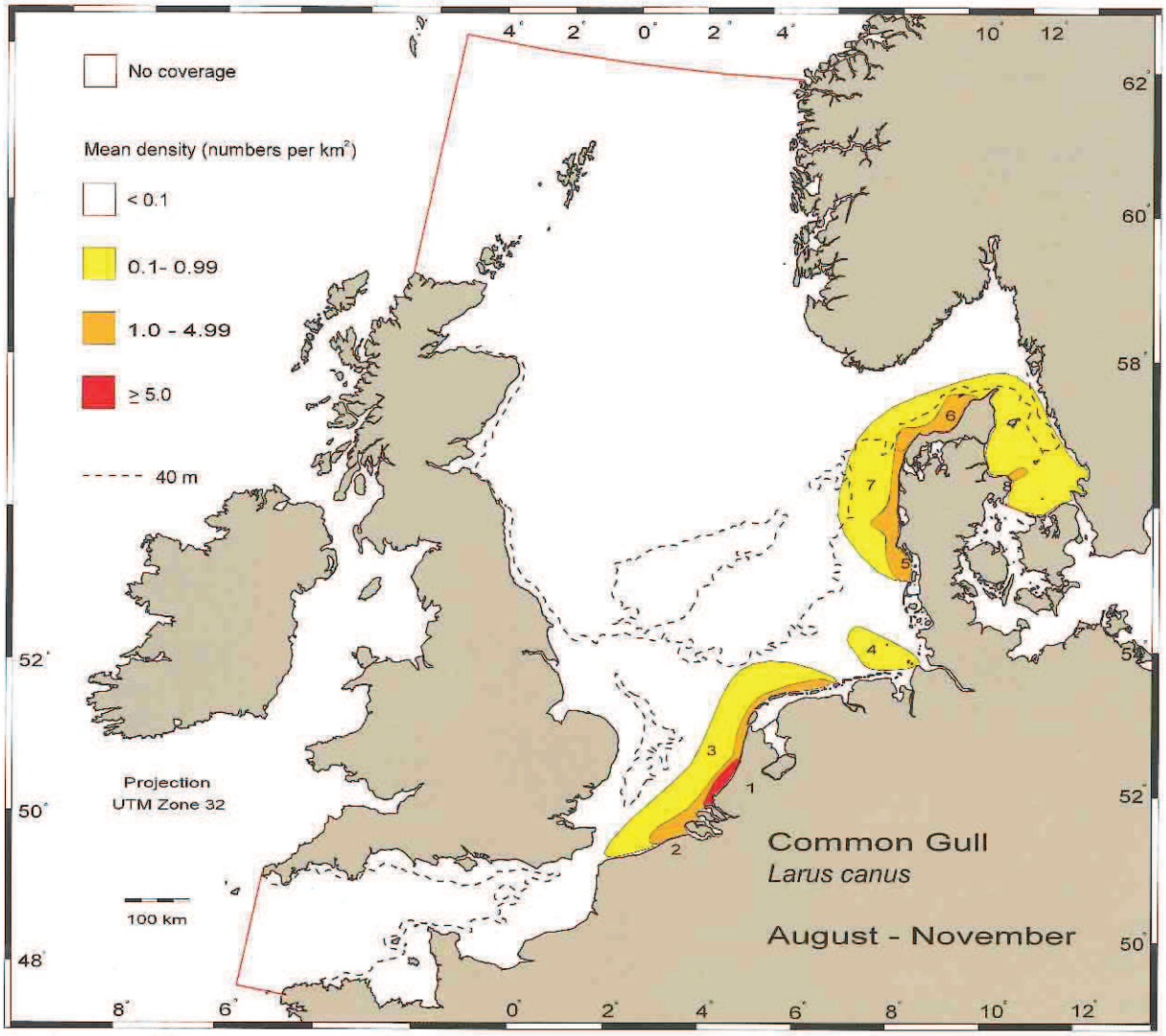
Around the North Sea, some 70,000 pairs of Common Gulls breed in coastal colonies. Inland colonies support another 40,000 pairs in Denmark, 53,000 in Britain and 300,000 in Norway and Sweden (Tasker *et al.* 1987, Lloyd *et al.* 1991). Highest numbers of Common Gulls are found in the North Sea in winter: 175,000 or 11% of the Northwest European population. Closely connected with these are up to 58,000 Common Gulls wintering in the Wadden Sea and 47,000 wintering in the western Baltic (Leopold *et al.* 1993, Meltofte *et al.* 1994, Durinck *et al.* 1994b).

Main areas

From spring to autumn (March to November) numbers in the North Sea do not exceed 50,000 birds, most of which are found off the continental coasts. There are no areas of international importance in these months. In winter large numbers occur in the eastern North Sea. An internationally important concentration is found at the Amrum Bank, while similar densities are found in the Elbe Estuary, suggesting a link with the Wadden Sea.

Distribution patterns

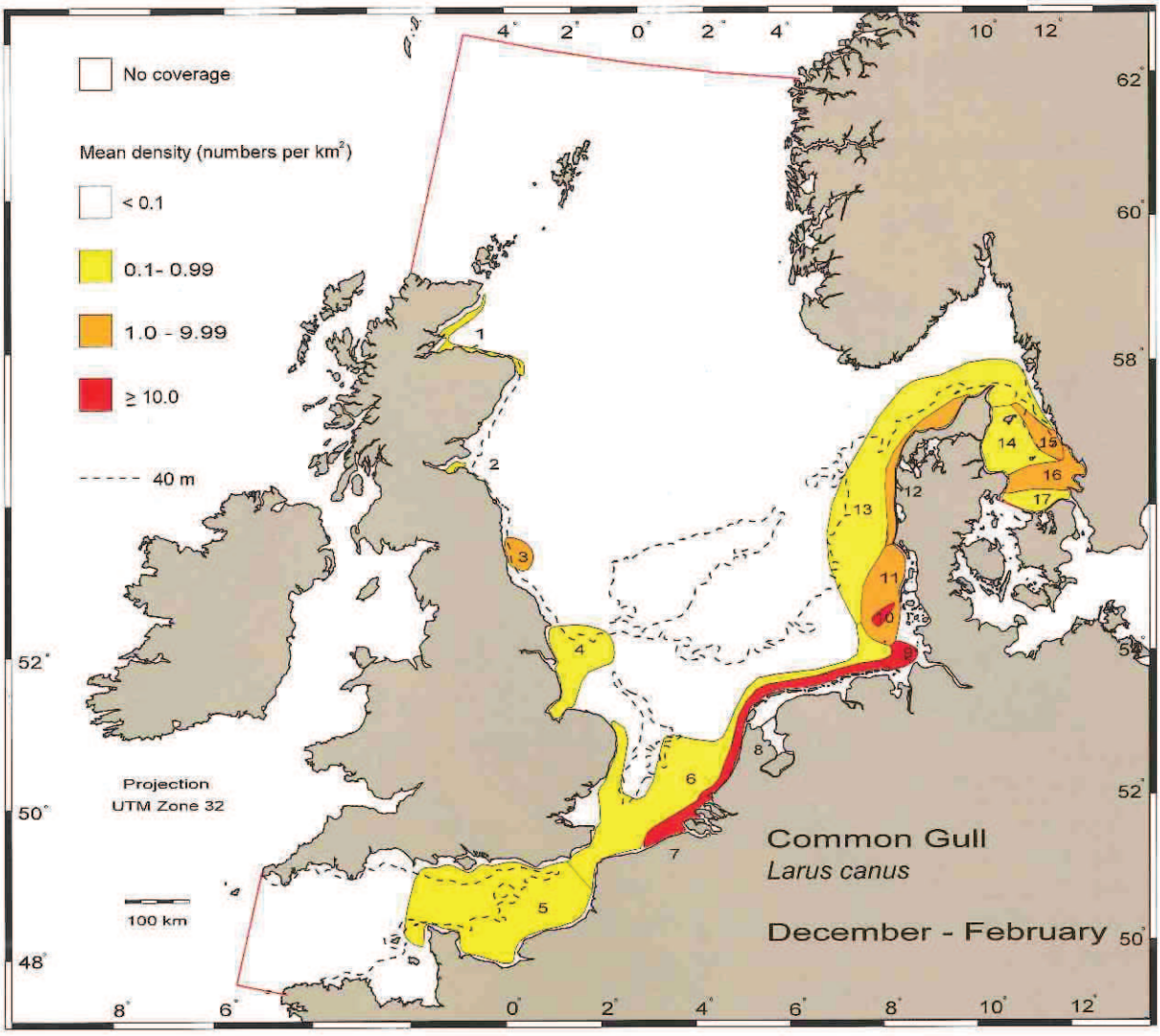
In the study region the Common Gull occurs off continental coasts at sea, despite the large numbers breeding inland in Britain. Many of these go westward to the Irish sea (Stone *et al.* 1995). In winter the species is found off all continental coasts, and the Channel supports a good many birds. Numbers off the British east coast remain low. Common Gulls are found only in small numbers offshore during migration, which takes place in April-July and again in October/November (Platteeuw *et al.* 1994, Meltofte & Faldborg 1987). Adults in Dutch colonies change from terrestrial to marine prey when eggs hatch in June, and densities at sea may then increase locally (Camphuysen & Leopold 1994).



Distribution and density of Common Gull Larus canus *in the North Sea, the Channel and the Kattegat from August to November 1980-1994.*

The average numbers of Common Gull *Larus canus* in key areas from August to November 1980-1994. Areas marked with bold are of international importance (MCC criteria).

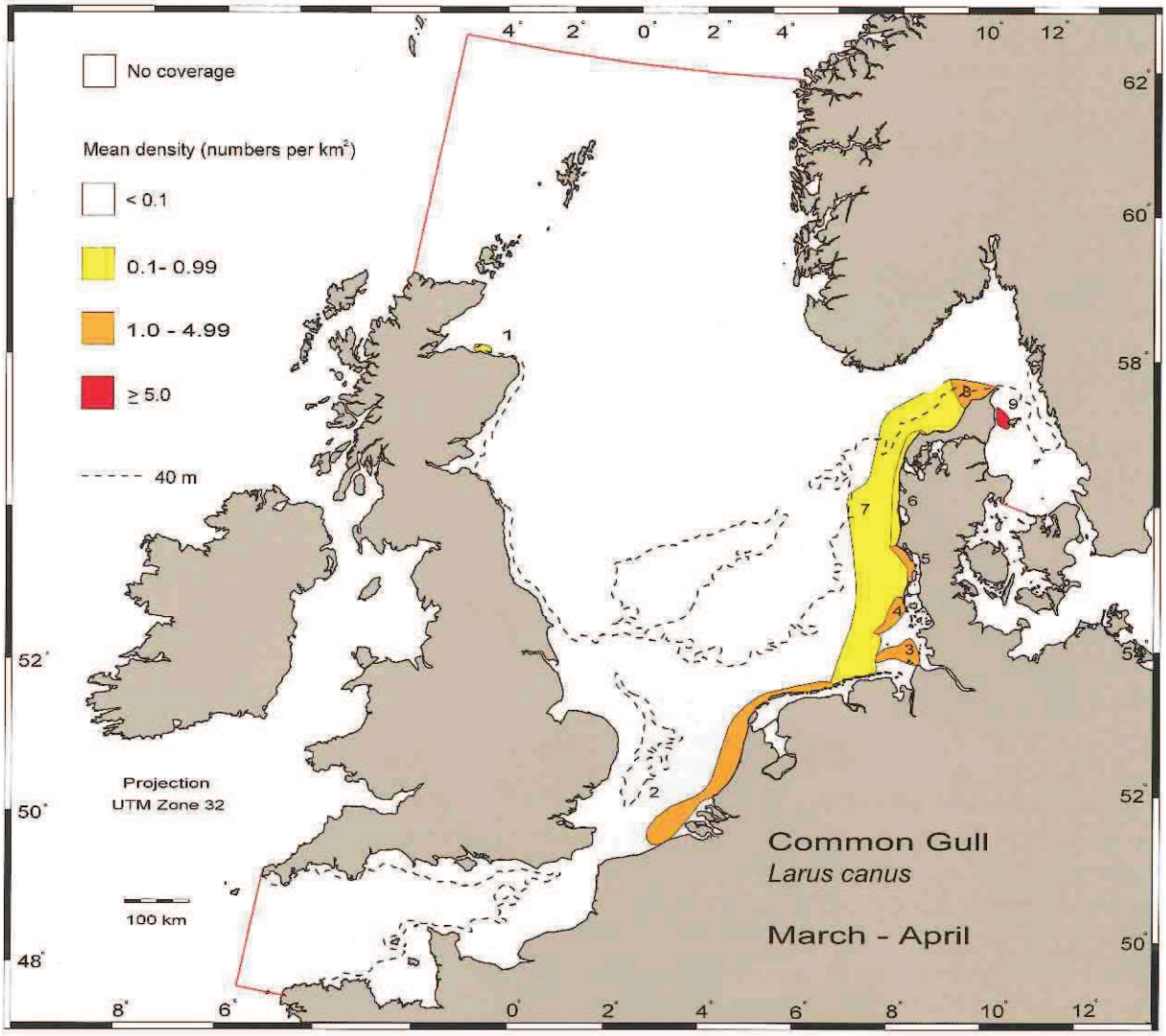
Locality	Density	Km²	Estimate	%
1 Westhoofd – Ijmuiden	5.32	1000	5300	10.84
2 Voordelta	1.25	5200	6500	13.30
3 Belgian/Dutch offshore	0.19	19000	3600	7.36
4 Elbe Mouth	0.61	4600	2800	5.73
5 Danish west coast	1.20	4400	5300	10.84
6 Jammer Bugt	2.04	3300	6700	13.70
7 Eastern North Sea-Kattegat	0.25	39000	9800	20.04
8 Fornæs	1.09	360	390	0.80
Residual			8500	17.39
Total			**48890**	**100.00**



Distribution and density of Common Gull Larus canus *in the North Sea, the Channel and the Kattegat from December to February 1980-1994.*

The average numbers of Common Gull *Larus canus* in key areas from December to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

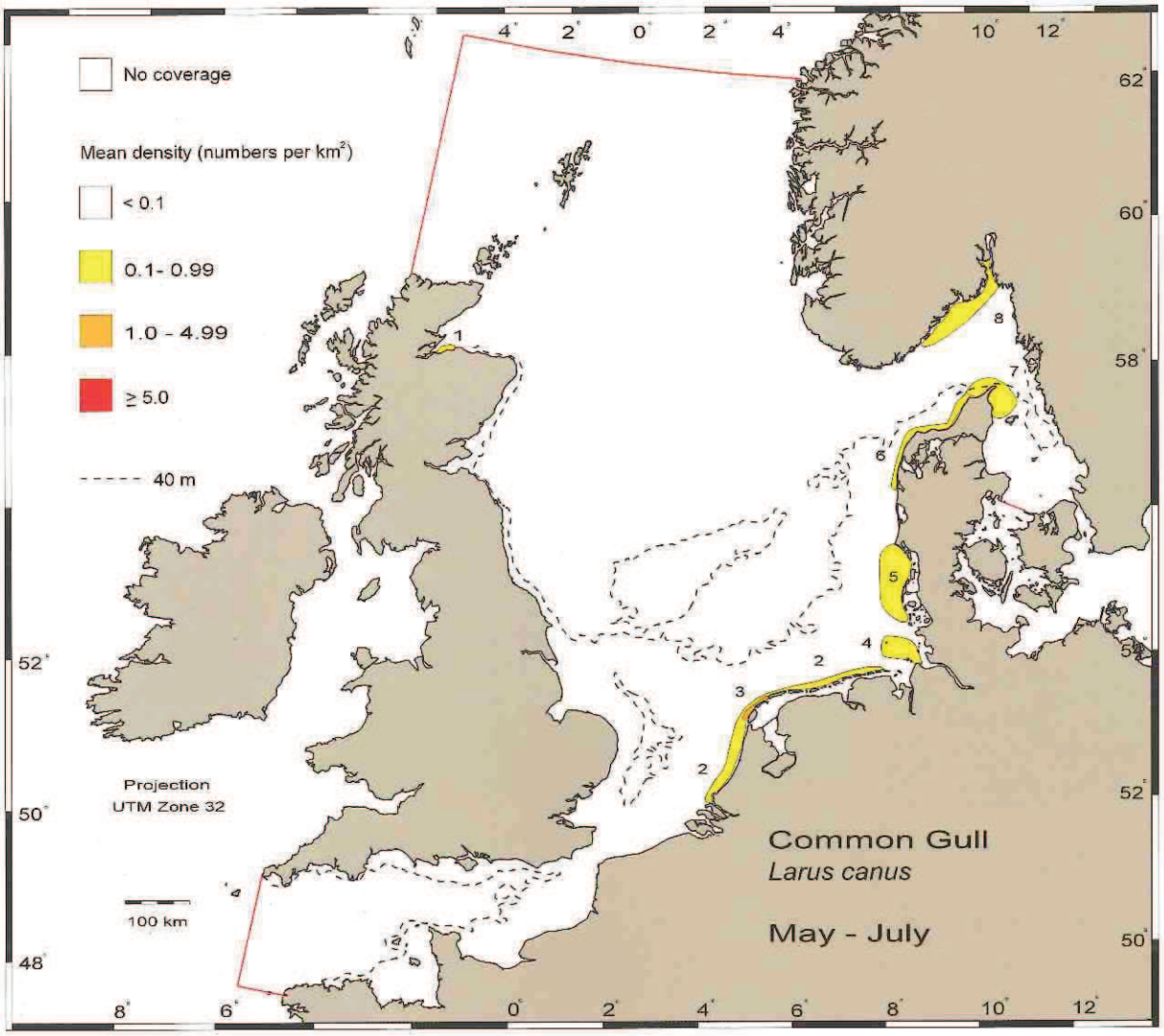
Locality	Density	Km²	Estimate	%
1 Moray Firth coasts	0.23	2400	550	0.31
2 Firth of Forth	0.45	400	180	0.10
3 Tynemouth	1.47	1700	2500	1.42
4 Flamborough Head – Wash	0.82	8200	6700	3.82
5 Channel	0.35	31000	11000	6.27
6 Southern North Sea	0.83	27000	22500	12.82
7 Voordelta	5.02	2400	12000	6.84
8 Frisian Coast	5.14	5100	26000	14.81
9 Elbe Mouth	8.42	1600	13500	7.69
10 Amrum Banke	**35.88**	**600**	**21500**	**12.25**
11 Eastern German Bight	2.27	7200	16000	9.12
12 Danish west coast	2.36	4100	10000	5.70
13 Eastern North Sea-Skagerrak	0.45	33000	15000	8.55
14 Ålborg Bugt	0.27	7000	2000	1.14
15 Middelgrundene	2.14	2500	5400	3.08
16 Central Kattegat	1.02	4500	4600	2.62
17 Southern Kattegat	0.46	2400	1100	0.63
Residual			5000	2.85
Total			**175530**	**100.00**



Distribution and density of Common Gull Larus canus *in the North Sea, the Channel and the Kattegat from March to April 1980-1994.*

The average numbers of Common Gull *Larus canus* in key areas from March to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Buckie	0.57	300	170	0.38
2 Belgian – Dutch coast	1.78	8800	16000	35.54
3 Elbe Mouth	1.53	1650	2500	5.55
4 Amrum Bank	2.40	1150	2750	6.11
5 North Waddensea	2.49	730	1800	4.00
6 Danish West coast	0.85	2150	1800	4.00
7 Eastern North Sea	0.10	29000	2900	6.44
8 Tannis Bugt	4.21	1800	7600	16.88
9 Læsø Rende	9.61	470	4500	10.00
Residual			5000	11.11
Total			**45020**	**100.00**



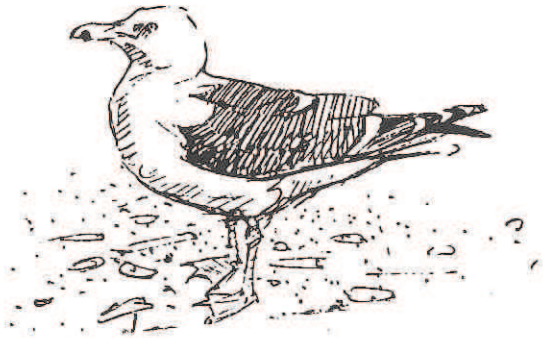
Distribution and density of Common Gull Larus canus *in the North Sea, the Channel and the Kattegat from May to July 1980-1994.*

The average numbers of Common Gull *Larus canus* in key areas from May to July 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Inner Moray Firth	0.71	450	320	1.47
2 Frisian – Dutch Coast	0.29	3630	1050	4.82
3 Texel	1.52	285	430	1.97
4 Elbe Mouth	0.49	1850	900	4.13
5 Eastern German Bight	0.33	4300	1400	6.42
6 Danish west coast	0.84	1622	1350	6.19
7 Skagen	0.31	2500	7750	35.55
8 Oslo Fjord – Torungen	0.34	3300	1100	5.05
Residual			7500	34.40
Total			**21800**	**100.00**

Lesser Black-backed Gull *Larus fuscus*

Lesser Black-backed Gulls breed on most of Europe's Atlantic seaboard and inland, from Siberia to Iceland and south to Portugal. Three subspecies are involved. The subspecies *L.f. graellsii* and *L.f. intermedius* in west Europe and the subspecies *L.f. fuscus* in north and northeast Europe. Most of these gulls winter further south in African waters. In the North Sea their food is mainly of marine origin, consisting of fish, invertebrates and fishery waste (Glutz & Bauer 1982).



Importance of the North Sea

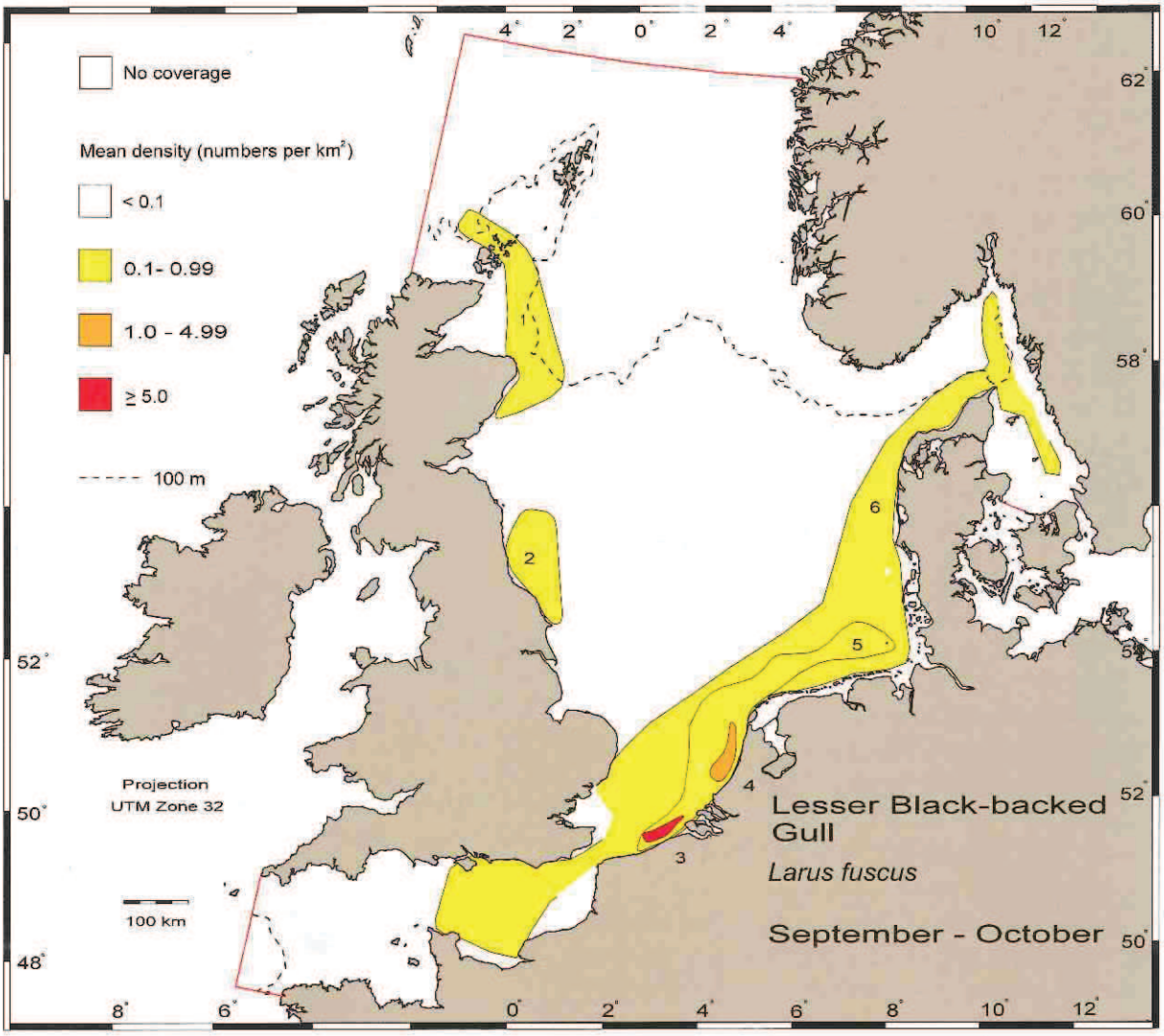
The approximate breeding population for Northwest Europe is 700,000 birds, 450,000 *L.f. graellsii* and *L.f. intermedius* and 250,000 *L.f. fuscus* (Lloyd *et al.* 1991, Rose & Scott 1994). In the study region, some 88,000 pairs breed (25% of Northeast Atlantic population). The largest numbers are found in The Netherlands, France and around the Skagerrak/Norwegian Trench (around 24,000 pairs each) and in the United Kingdom (86,000 pairs) (Tasker *et al.* 1987, Lloyd *et al.* 1991, Yésou 1991, Tucker & Heath 1994). All these belong to the *L.f. graellsii/ intermedius* complex. The *L.f. fuscus* subspecies migrates through the Baltic and is believed to be less common in the North Sea. Birds from Southwest Norway (Kvinnesland & Munkejord 1984) and possibly from Iceland migrate through the study region. Numbers in the study region are highest in spring and summer (March-August) when around 130,000 birds are present at sea (18.6% of Northeast Atlantic breeding population).

Main areas

In all seasons the majority of birds are dispersed outside areas of international importance. During spring migration (March-April) 95% of all Lesser Black-backed Gulls are found in the eastern half of the study region, and after the breeding season the vast majority remains in the eastern half. In this period birds are also present in the Channel. An area of international importance is found between Vlieland and IJmuiden from May to October. In spring, the Skagerrak (March-April) and Helgoland Bight (May-June) are of international importance. In winter, the North Sea is largely abandoned, but some 15,000 birds winter in the Channel.

Distribution patterns

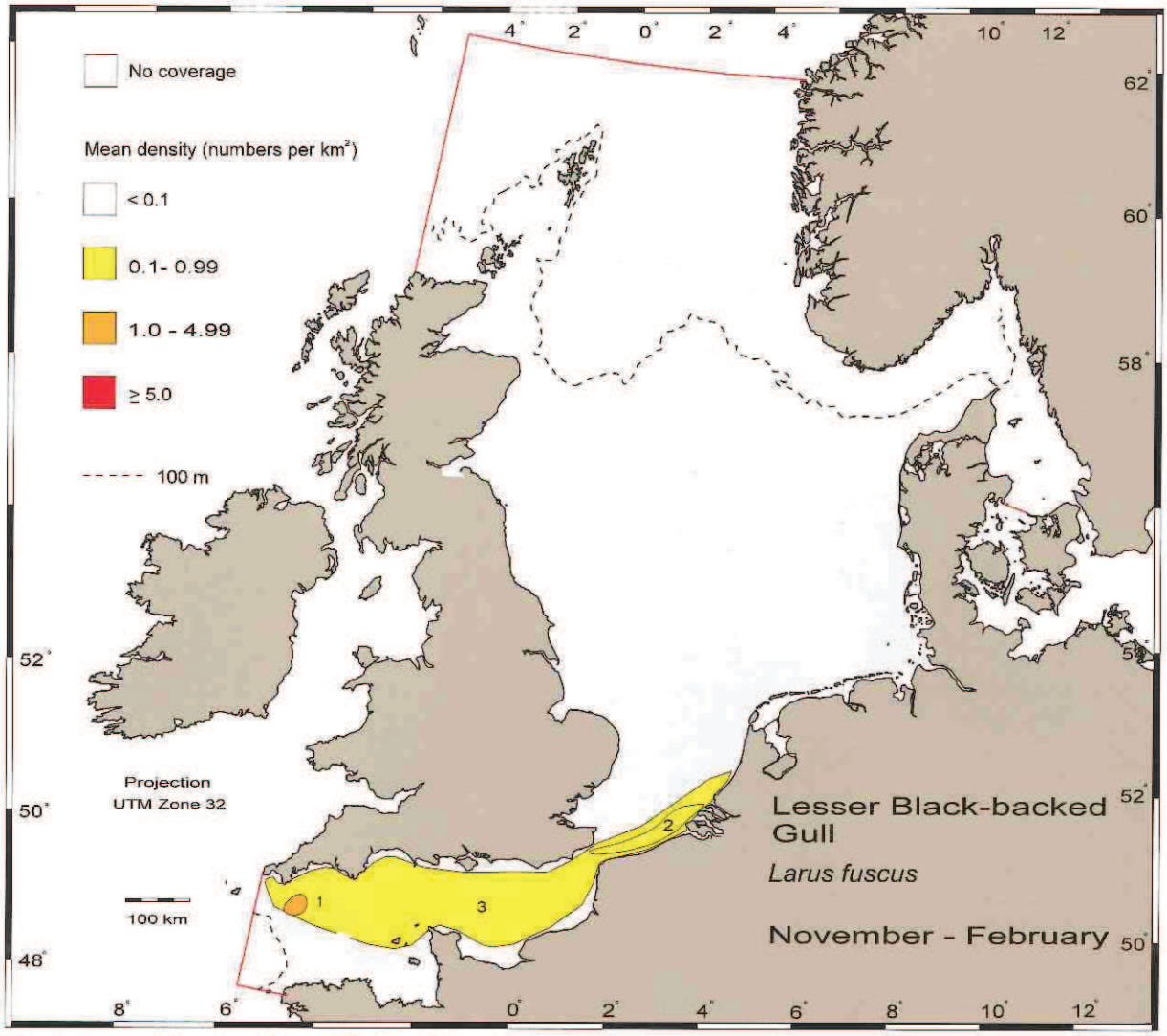
Lesser Black-backed gulls generally disperse off the European Continental coasts within the study region, while areas along the British coast are less heavily used. They use the Channel to enter and exit the North Sea. In the breeding season, adults can make relatively long feeding flights, compared to other gull species (Camphuysen *in press*). Trawlers have an effect on distribution as many birds eat offal and discards from fisheries (Camphuysen *et al.* 1995).



Distribution and density of Lesser Black-backed Gull Larus fuscus *in the North Sea, the Channel and the Kattegat from September to October 1980-1994.*

The average numbers of Lesser Black-backed Gull *Larus fuscus* in key areas from September to October 1980-1994. Areas marked with bold are of international importance (MCC criteria).

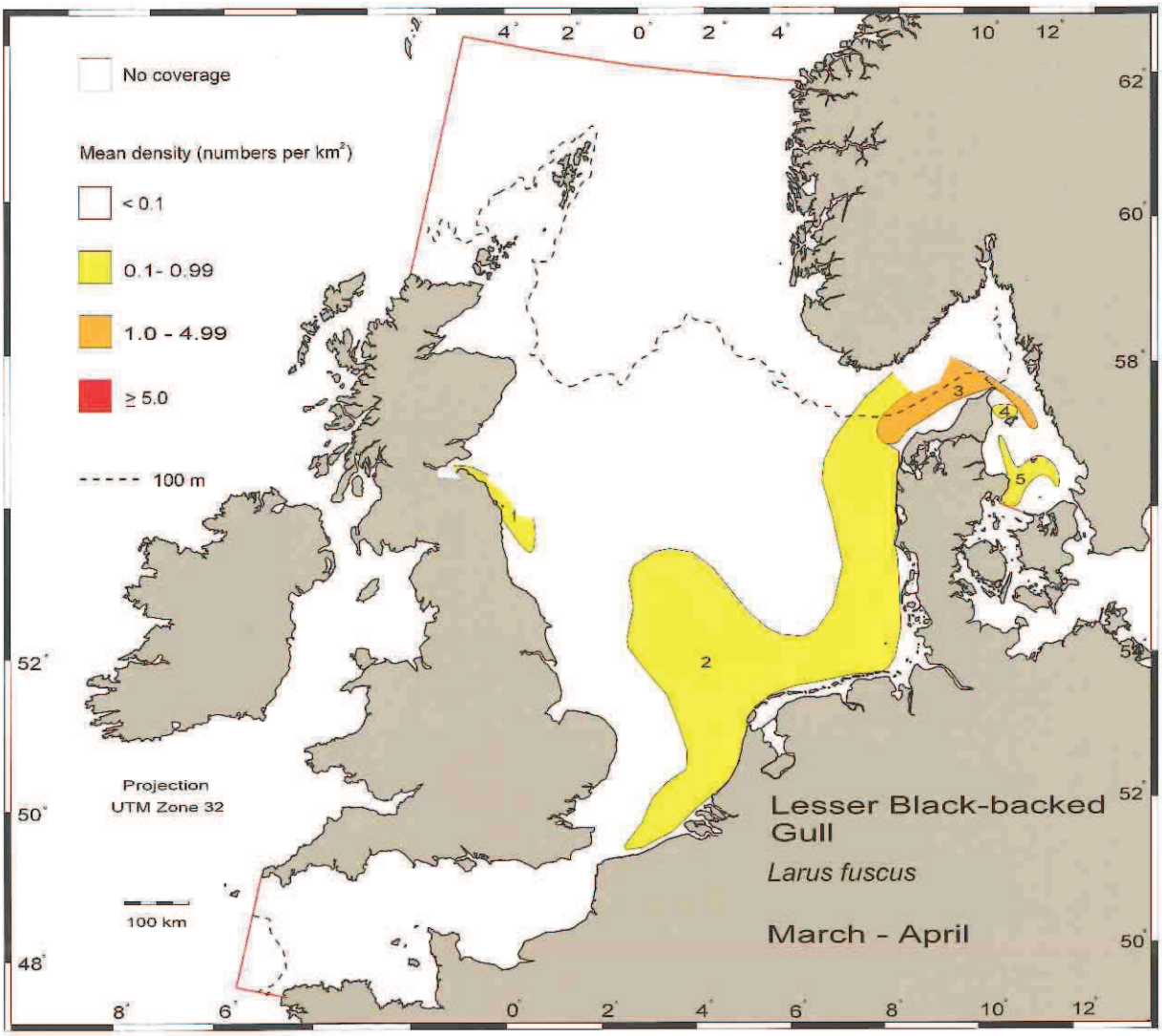
Locality	Density	Km²	Estimate	%
1 Orkney-Aberdeen Bank	0.18	17800	3200	4.98
2 North East Bank – Barmade Bank	0.18	14000	2520	3.92
3 Kwinte Bank – Middelbank	6.13	1080	6620	10.29
4 Egmond Ground – Ijmuiden Ground	**3.23**	**2400**	**7750**	**12.05**
5 Southeast North Sea	0.91	25500	23205	36.08
6 North Sea, low	0.19	98500	18715	29.10
Residual			2300	3.58
Total			**64310**	**100.00**



Distribution and density of Lesser Black-backed Gull Larus fuscus *in the North Sea, the Channel and the Kattegat from November to February 1980-1994.*

The average numbers of Lesser Black-backed Gull *Larus fuscus* in key areas from November to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

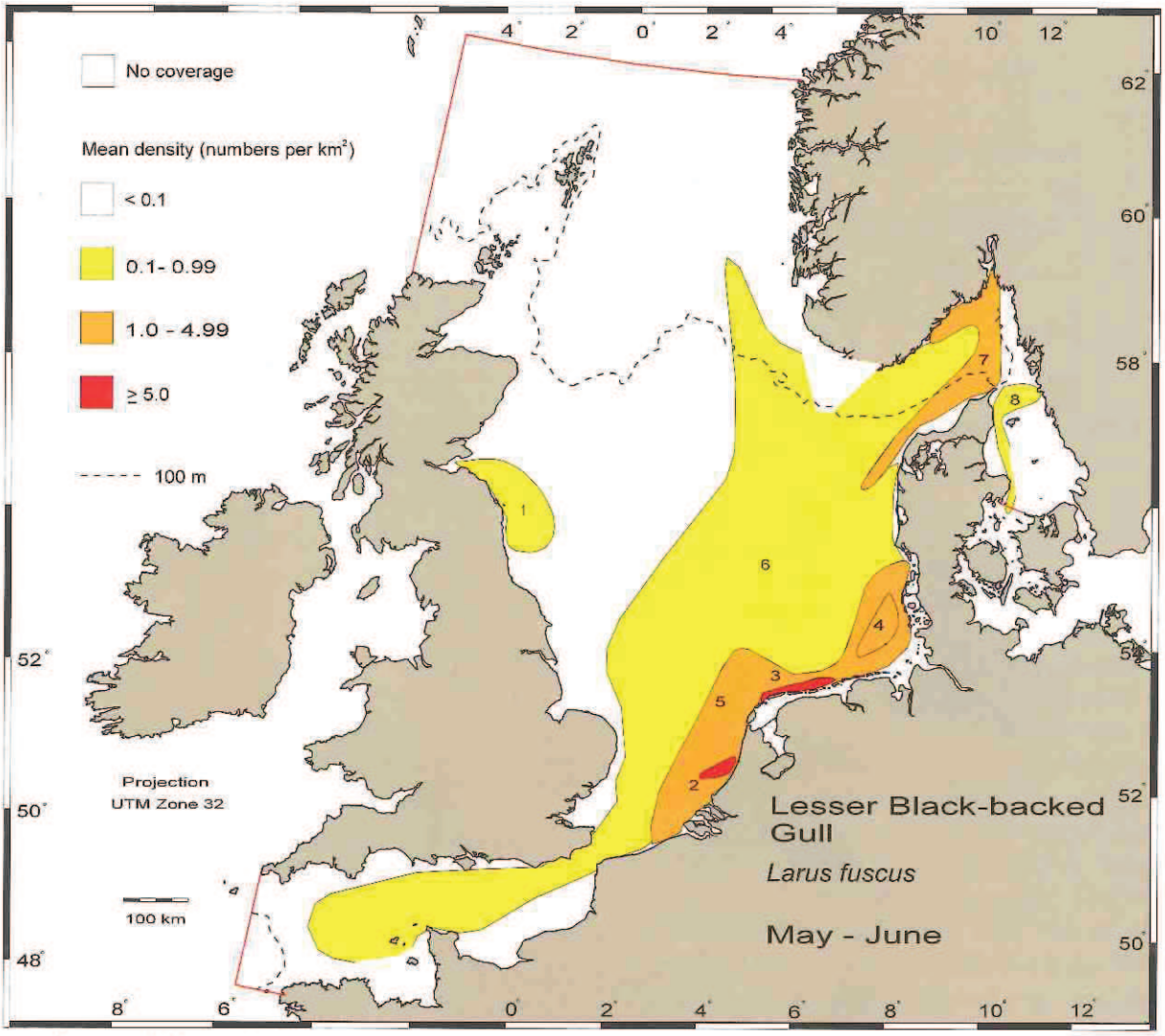
Locality	Density	Km²	Estimate	%
1 West Channel	4.30	1200	5160	33.69
2 Dover Strait – Voordelta	0.79	3500	2765	18.05
3 Channel	0.10	55000	5500	35.91
Residual			1890	12.34
Total			**15315**	**100.00**



Distribution and density of Lesser Black-backed Gull Larus fuscus *in the North Sea, the Channel and the Kattegat from March to April 1980-1994.*

The average numbers of Lesser Black-backed Gull *Larus fuscus* in key areas from March to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

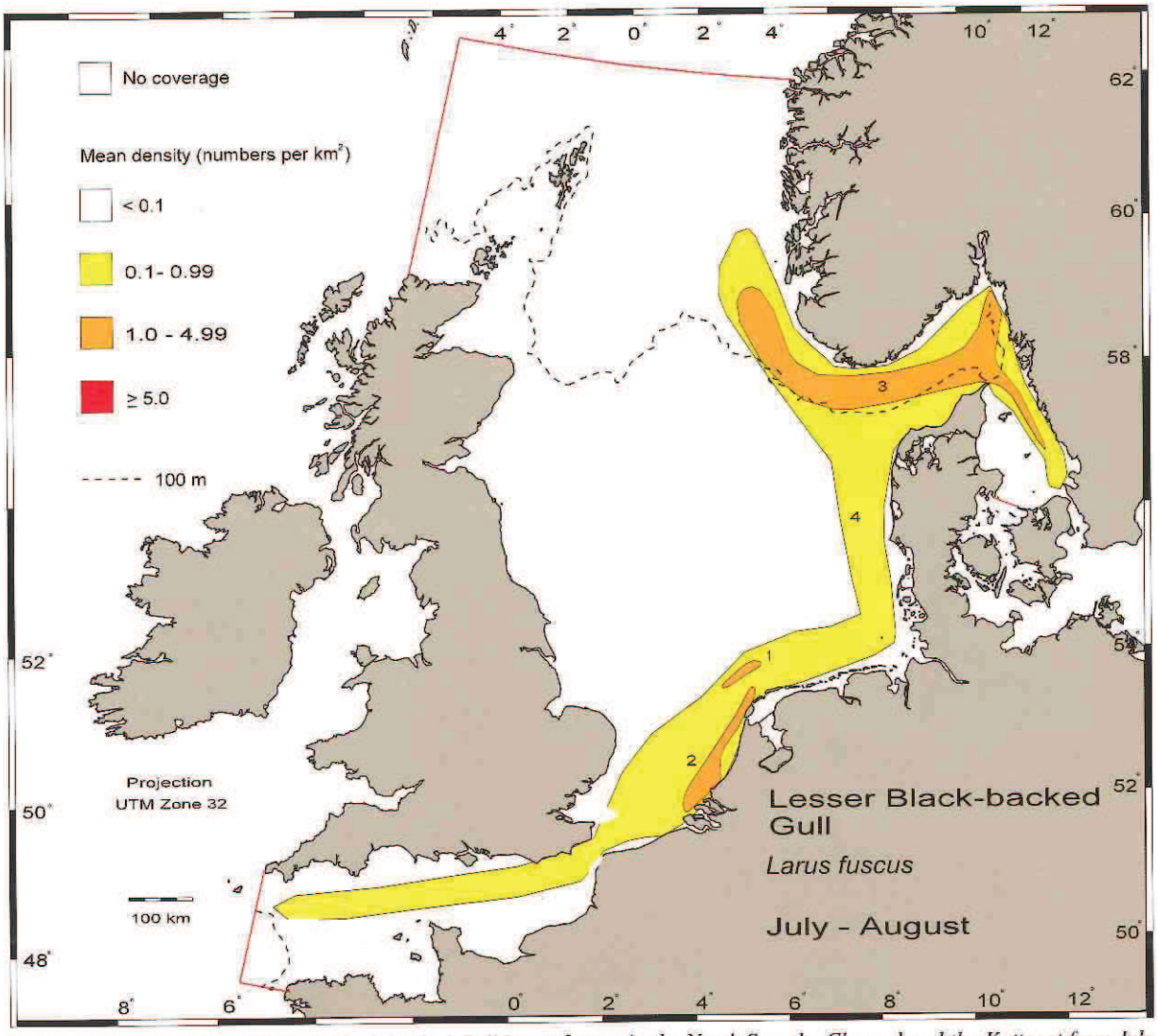
Locality	Density	Km²	Estimate	%
1 Firth of Forth – Farn Deeps	0.17	7740	1315	1.02
2 Eastern North Sea	0.75	110000	82500	64.06
3 Skagerrak	**3.35**	**12000**	**40200**	**31.21**
4 Kummel Bank	0.95	570	540	0.42
5 Kattegat	0.47	3600	1690	1.31
Residual			2540	1.97
Total			**128785**	**100.00**



Distribution and density of Lesser Black-backed Gull Larus fuscus *in the North Sea, the Channel and the Kattegat from May to June 1980-1994.*

The average numbers of Lesser Black-backed Gull *Larus fuscus* in key areas from May to June 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Firth of Forth – Farn Deeps	0.10	16000	1600	1.31
2 Ijmuiden Ground	**14.61**	**1180**	**17240**	**14.16**
3 East Frisian Islands	**7.28**	**1500**	**10920**	**8.97**
4 Helgoland Bight	**4.14**	**2500**	**10350**	**8.50**
5 Southeast North Sea	1.42	35320	50155	41.21
6 Channel – Eastern North Sea	0.11	207500	22825	18.75
7 Eastern Skagerrak	1.22	17700	21595	17.74
8 Kattegat	0.68	5700	3875	3.18
Residual			2000	1.64
Total			**121720**	**100.00**



Distribution and density of Lesser Black-backed Gull Larus fuscus *in the North Sea, the Channel and the Kattegat from July to August 1980-1994.*

The average numbers of Lesser Black-backed Gull *Larus fuscus* in key areas from July to August 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Terschelling Bank	4.64	980	4545	3.42
2 Ijmuiden Ground – Vlieland Ground	**2.46**	**5270**	**12965**	**9.76**
3 Norwegian Trench – Kattegat	1.37	35500	48635	36.62
4 North Sea, low	0.45	133220	59950	45.14
Residual			6700	5.05
Total			**132795**	**100.00**

Herring Gull *Larus argentatus*

Herring Gull is the most widespread species of large gull in the northern hemisphere, breeding on many coasts, often inland as well although not in such large numbers. Two subspecies, *L.a. argentatus* and *L.a. argenteus*, are common in the study region and a third *L.a. cachinnans*, (which may be a separate species) breeds in small numbers on French coasts. A total of 1.35 million pairs of *L.a. argentatus* and *L.a. argeteus* breed in West and Northwest Europe (Rose & Scott 1994). Herring Gulls from western Europe are more or less sedentary, while birds from further north migrate into the North Sea after breeding. Most of the diet within the study region consists of fish and invertebrates, of which a considerable amount is obtained as fishery waste. Although often outcompeted by more aggressive and more numerous scavengers in the Northwest North Sea, Herring Gulls often dominate in feeding flocks associated with trawlers in the Southern and Eastern North Sea (Glutz & Bauer 1982, Tasker *et al.* 1987, Camphuysen *et al.* 1995).

Importance of the North Sea

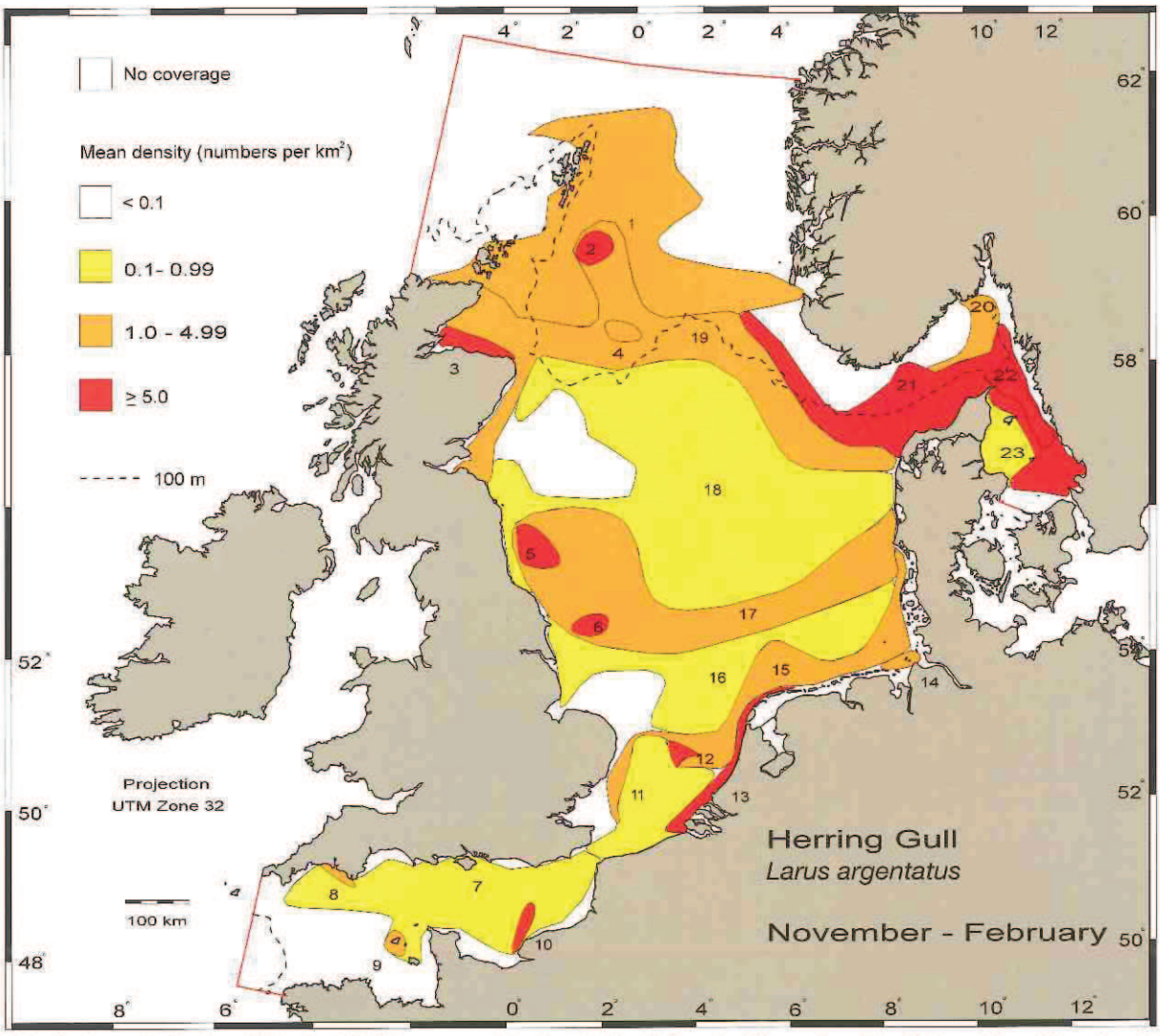
About 300,000 pairs breed on the coasts of the study region (Tasker *et al.* 1987, Lloyd *et al.* 1991). Herring Gulls prefer shelf seas and coastal habitats, often taking advantage of human activities. The abundance of refuse dumps along the North Sea coasts, the numerous fishing vessels at sea and the fish and shellfish riches in the sea make most of the North Sea a prime habitat for this species. In spring (March-April) nearly 300,000 birds are estimated at sea in the study region, dropping in summer to 130,000 – 150,000 birds. In winter (November-February) nearly 1 million Herring Gulls are found dispersed throughout the study region, while another 157,000 have been found in the Wadden Sea during winter (Meltofte *et al.* 1994) and 30,000 in the Dutch Delta area (Meininger *et al.* 1994). The numbers wintering in other coastal areas have not yet been assessed.

Main areas

In spring (March-April) most Herring Gulls are dispersed in coastal waters of the Southern and German Bights, Skagerrak/Kattegat, and in the northwest from Northeast Scotland to Shetland. Herring Gulls are concentrated in important numbers near Fair Isle in spring, possibly due to local presence of fishing fleets. In summer and autumn (May-October) the distribution pattern is very similar, but numbers at sea drop and no area is of particular importance. In winter, large numbers invade the study region, and Herring Gulls are found throughout the area. Part of the eastern Kattegat-Skagerrak, the Brown Ridge, the Northeast Bank off the British east coast and the Dutch Bank in the central northern North Sea are all of international importance in this season. Note however, that the majority (80%) spend the winter outside these areas of concentration.

Distribution patterns

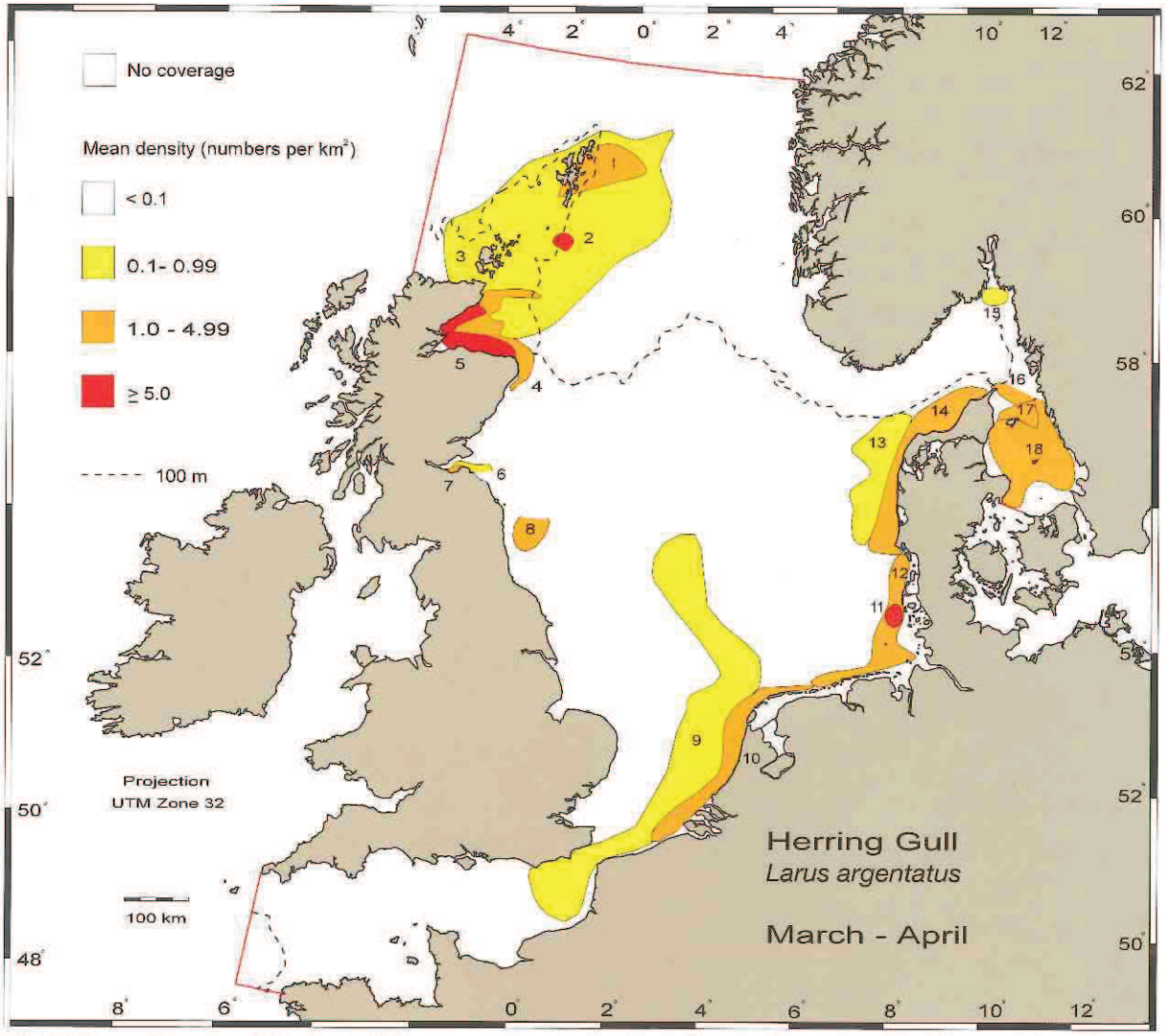
Fishing vessels attract tens of thousands, resulting in numerous temporary and geographically changing concentrations of Herring Gulls throughout the region (Camphuysen *et al.* 1995). The summer and winter distribution patterns are strikingly different in this species. From spring to autumn, Herring Gulls are found mainly in inshore waters from the Eastern Channel up to the Kattegat. This large coastal stretch holds about 70% of all Herring Gulls at sea in the study region in these months. Most of the remainder are found off Cornwall and off the Northeast coasts of Britain. In autumn the gulls are moving offshore in the east, and at the same time there is an increase in the Wadden Sea (Meltofte *et al.* 1994). In winter Herring Gulls may be found anywhere in the study region, both inshore and offshore. Many birds that breed further north winter in the North Sea region (Meltofte & Faldborg 1987).



Distribution and density of Herring Gull Larus argentatus *in the North Sea, the Channel and the Kattegat from November to February 1980-1994.*

The average numbers of Herring Gull *Larus argentatus* in key areas from November to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

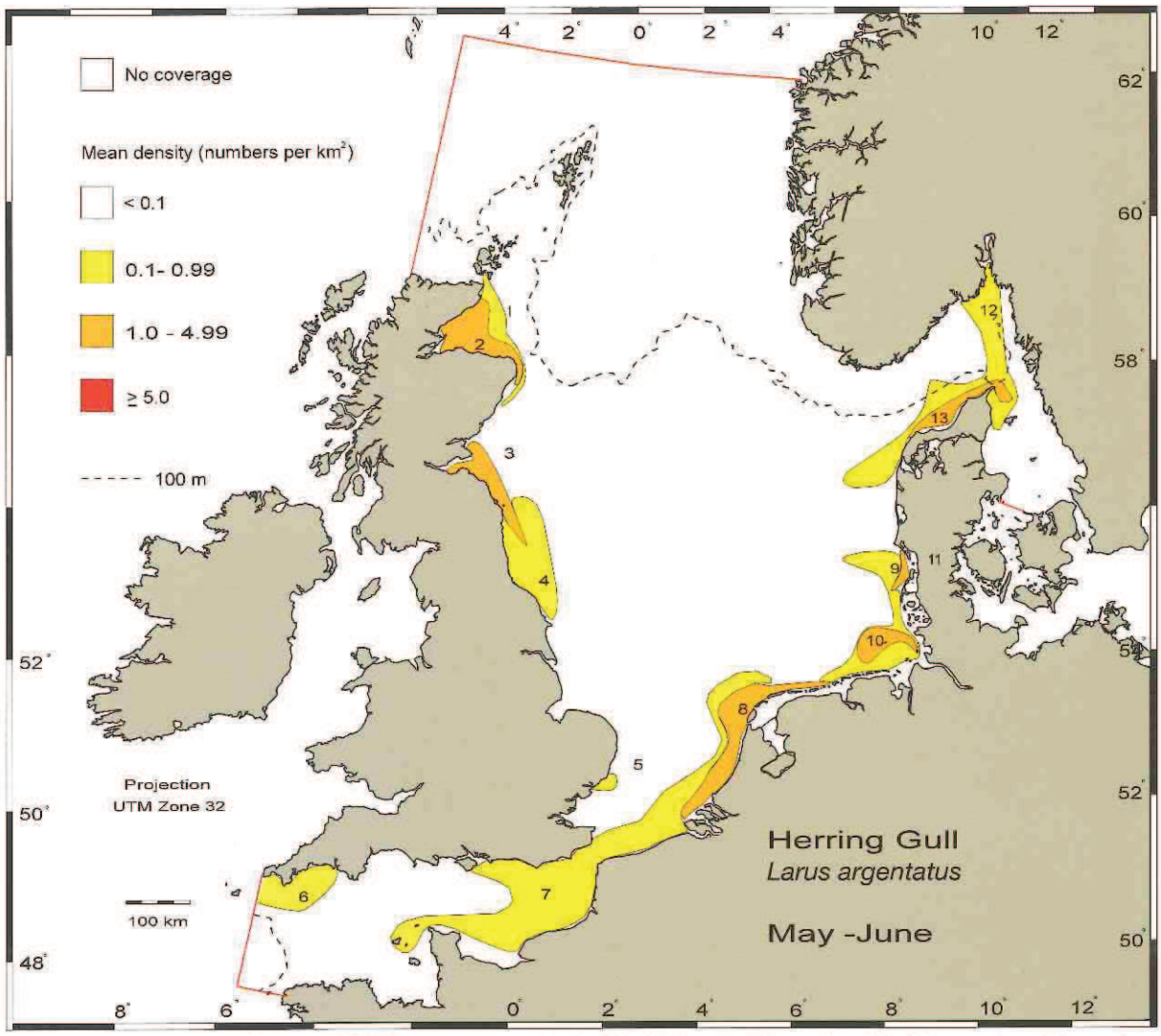
Locality	Density	Km²	Estimate	%
1 Northern North Sea, low	0.35	69300	24000	2.47
2 Dutch Bank	**12.91**	**2400**	**31000**	**3.19**
3 Southern Moray Firth	11.54	2075	24000	2.47
4 Fladen Ground	4.14	1980	8200	0.84
5 North East Bank	**12.8**	**4700**	**60000**	**6.17**
6 Hills	8.69	2080	18000	1.85
7 The Channel, low	0.31	41925	13000	1.34
8 Bigbury Bay	3.25	1010	3300	0.34
9 Guernsey	2.25	1440	3200	0.33
10 Cap D'antifer	8.05	2125	17000	1.75
11 Dover Strait – Lemon Ground	0.76	14050	11000	1.13
12 Brown Ridge	**28.29**	**1385**	**39000**	**4.01**
13 Dutch Coast	**10.49**	**5050**	**53000**	**5.45**
14 Elbe – Weser Estuary	3.00	2530	7600	0.78
15 Southern North Sea, medium	1.86	19250	36000	3.70
16 Southern North Sea, low	0.31	26000	8100	0.83
17 Central North Sea, medium	1.65	59720	99000	10.19
18 Central North Sea, low	0.57	110000	63000	6.48
19 Northern North Sea, medium	1.90	57170	109000	11.22
20 Northeastern Skagerrak	1.37	4700	6500	0.67
21 Norwegian Trench – Kattegat	5.87	47500	280000	28.82
22 Eastern Kattegat – Skagerrak	**12.84**	**4120**	**53000**	**5.45**
23 Northwestern Kattegat	0.82	5900	4800	0.49
Residual			0	0.00
Total			**971700**	**100.00**



Distribution and density of Herring Gull Larus argentatus *in the North Sea. the Channel and the Kattegat from March to April 1980-1994.*

The average numbers of Herring Gull *Larus argentatus* in key areas from March to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

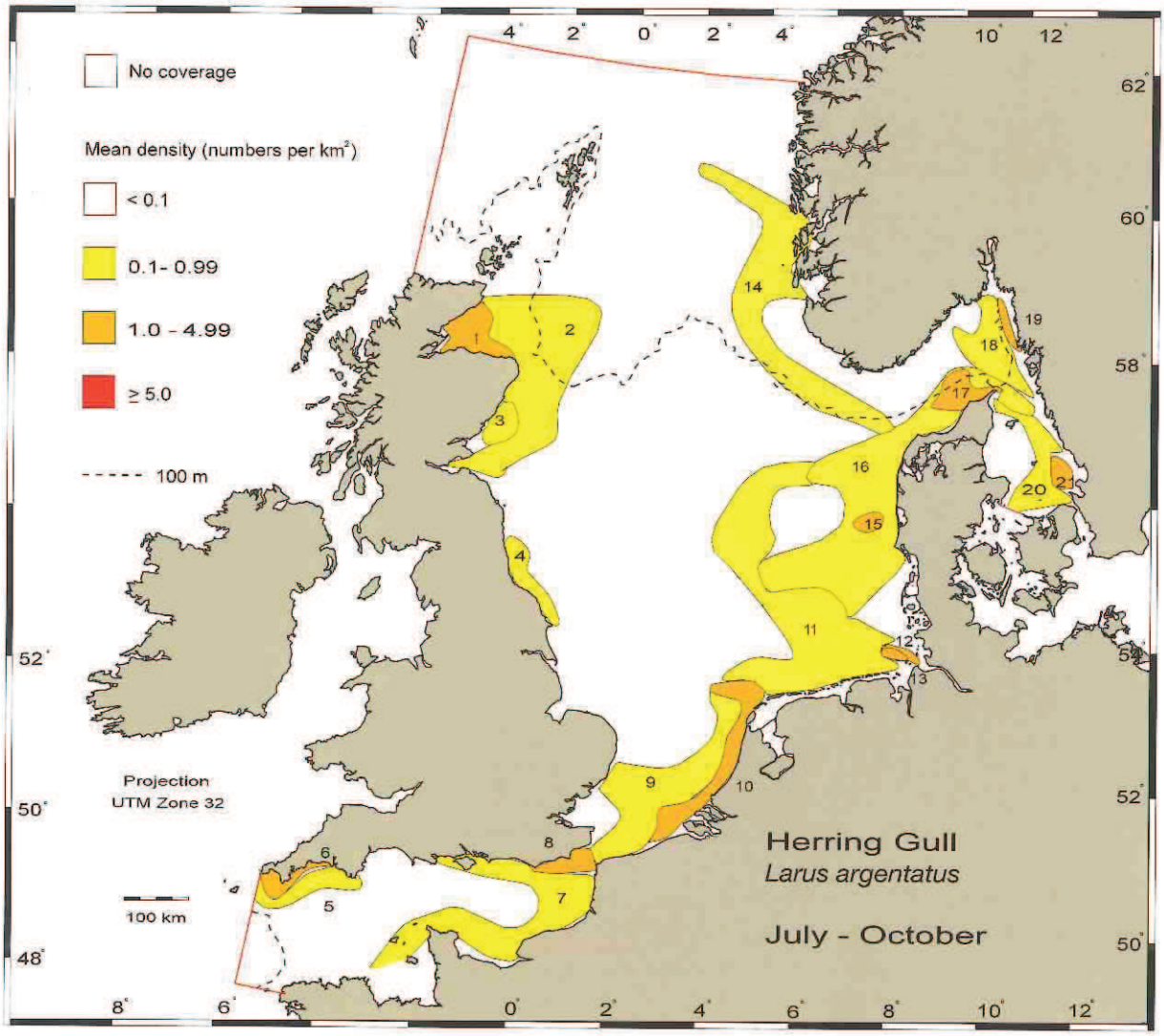
Locality	Density	Km²	Estimate	%
1 Shetland East	4.73	8200	39000	13.90
2 Fair Isle	**39.49**	**765**	**30000**	**10.69**
3 Shetland – Orkney. low	0.14	62535	8700	3.10
4 Outer Moray Firth	1.88	4650	8700	3.10
5 Inner Moray Firth	5.78	5140	29700	10.58
6 Outer Firth of Forth	0.61	1400	850	0.30
7 Inner Firth of Forth	3.98	250	1000	0.36
8 North East Bank	1.39	3140	4400	1.57
9 Channel – Dogger Bank	0.45	46000	21000	7.48
10 Dutch Coast	4.00	10100	40000	14.25
11 Amrum Bank	8.00	750	6000	2.14
12 Southeastern German Bight	1.24	8250	10000	3.56
13 Jutland Reef – Horns Rev	0.85	8650	7400	2.64
14 Danish West coast	3.60	11000	40000	14.25
15 Oslo Fjord	0.39	450	200	0.07
16 Skagen East	1.12	1350	1500	0.53
18 North Læsø	2.93	1230	3600	1.28
19 Kattegat	1.54	13500	21000	7.48
Residual			7600	2.71
Total			**280650**	**100.00**



Distribution and density of Herring Gull Larus argentatus *in the North Sea. the Channel and the Kattegat from May to June 1980-1994.*

The average numbers of Herring Gull *Larus argentatus* in key areas from May to June 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Outer Moray Firth	0.15	2565	400	0.32
2 Inner Moray Firth	2.83	6000	17000	13.52
3 Firth of Forth – North East Bank	1.63	7415	12000	9.55
4 Barmade Bank	0.51	9000	4600	3.66
5 Harwich	0.41	1100	500	0.40
6 Western Channel	0.35	6450	2255	1.80
7 The Channel – Brown Ridge	0.37	38600	14500	11.54
8 Netherlands Coast	3.49	9920	35000	27.84
9 German Bight, low	0.58	8465	4900	3.90
10 Helgoland Bight	1.61	3160	5100	4.06
11 Northeastern German Bight	2.06	845	1700	1.35
12 Jutland Reef – Skagerrak	0.83	16800	14000	11.14
13 Jammer Bugt – Ålbæk Bugt	3.66	4290	16000	12.73
Residual			0	0.00
Total			**125700**	**100.00**



Distribution and density of Herring Gull Larus argentatus *in the North Sea. the Channel and the Kattegat from July to October 1980-1994.*

The average numbers of Herring Gull *Larus argentatus* in key areas from July to October 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Moray Firth	3.16	6500	20500	13.83
2 Firth of Forth – Fladen Ground	0.17	29750	5000	3.37
3 Scalp Bank	0.96	2410	1200	0.81
4 Flamborough Head – Coquet Island	0.56	4450	2500	1.69
5 Northwestern Channel	0.65	4300	2800	1.89
6 Mounts Bay, medium	1.59	2860	4600	3.10
7 Eastern Channel	0.34	27870	9500	6.41
8 Dover Strait	1.73	3650	6300	4.25
9 Brown Ridge	0.10	18500	1900	1.28
10 Netherlands coast	1.32	11250	15000	10.12
11 Weisse Bank – Great Fisher Bank	0.13	28750	3700	2.50
12 Elbe Estuary, low	1.52	720	1100	0.74
13 Elbe Estuary, medium	4.04	640	2600	1.75
14 Norwegian Trench	0.16	33500	5400	3.64
15 Ringkøbing Grund	4.20	1580	6600	4.45
16 Weisse Bank – Skagen	0.67	34600	23000	15.52
17 Eastern Skagerrak, medium	3.01	3920	12000	8.10
18 Eastern Skagerrak, low	0.23	6850	1600	1.08
19 Bohuslän Coast	3.80	1860	7100	4.79
20 Kattegat, low	0.95	7200	6800	4.59
21 Southeastern Kattegat	4.27	1400	6000	4.05
Residual			3000	2.02
Total			**148200**	**100.00**

Great Black-backed Gull *Larus marinus*

Great Black-backed Gulls breed on temperate, boreal and arctic coasts on both sides of the Atlantic. This species has expanded its breeding range since the beginning of this century, colonizing Svalbard, Denmark, Germany, The Netherlands and France (Lloyd *et al.* 1991, Vercruijsse & Spaans 1994). Breeders from North Sea, Irish and Baltic coasts are largely sedentary, while birds from higher latitudes migrate south in autumn into the study region (Coulson *et al.* 1984). The species takes a wide variety of foods, ranging from birds, eggs, rubbish and invertebrates to fish, including discards and offal (Glutz & Bauer 1982, Camphuysen *et al.* 1995).

Importance of the North Sea

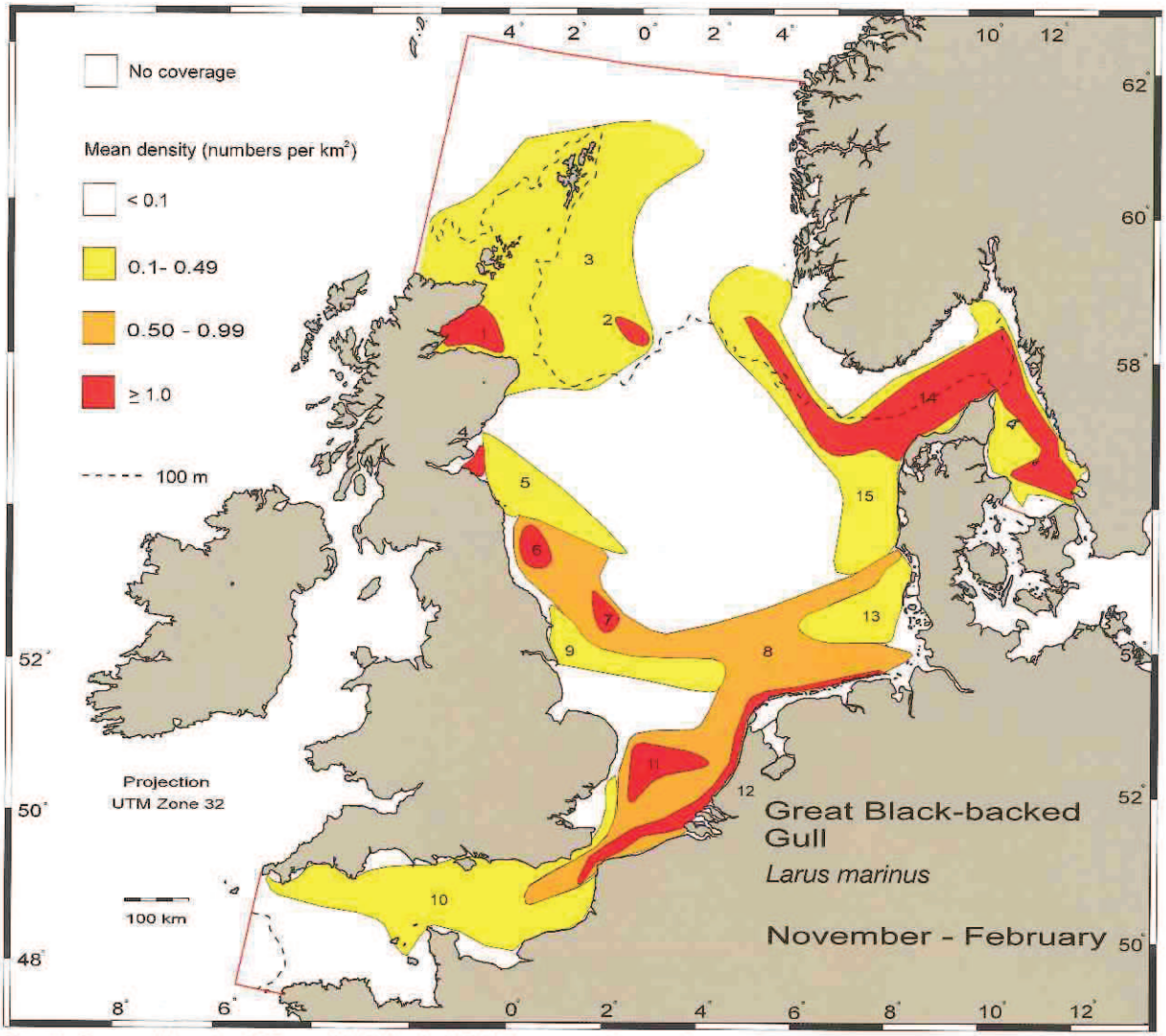
Roughly 75% of the world population of Great Black-backed Gull breeds in Europe, with the largest numbers in Russia (>10,000 pairs), Norway (40,000-50,000) and the United Kingdom (18,900). The current Northeast Atlantic population is estimated at 240,000 pairs (Rose & Scott 1994). Relatively few, about 25,000 pairs, breed in the study region (10% of the Northeast Atlantic population). The highest numbers occur in Shetland/Orkney (4000 pairs), the Southwest Norway (8600) and in the Channel (3000 pairs) (Lloyd *et al.* 1991). The North Sea is an important region in winter, when it supports 300,000 Great Black-backed Gulls (62% of the Northeast Atlantic population). As this is roughly 45% of the world population, the North Sea is of global importance in winter.

Main areas

The majority of Great Black-backed Gulls are dispersed outside areas of international importance throughout the year. In spring and summer (March through July) most Great Black-backed Gulls in the region are found near the breeding grounds, off Northeast Scotland, in the Skagerrak and in the Channel. Several thousand sub-adults are present in summer in the German Bight and adjacent Wadden Sea (Meltofte *et al.* 1994). In autumn large numbers move into the study region, resulting in a total estimate of over 150,000 for the study region in August-October (33 % of Northeast Atlantic population). The birds occur over large areas of sea, but are concentrated in the Moray Firth and over the outer Pit in internationally important numbers. Large numbers also use the southern and eastern North Sea. Numbers peak in winter (November-February). The Moray Firth and the Hills are internationally important. The eastern and southern North Sea, including Skagerrak/Kattegat and Channel support 190,000 birds, or nearly 40% of the Northeast Atlantic population. As the birds are spread out over large areas, only the core area – the Brown Ridge – is of international importance.

Distribution patterns

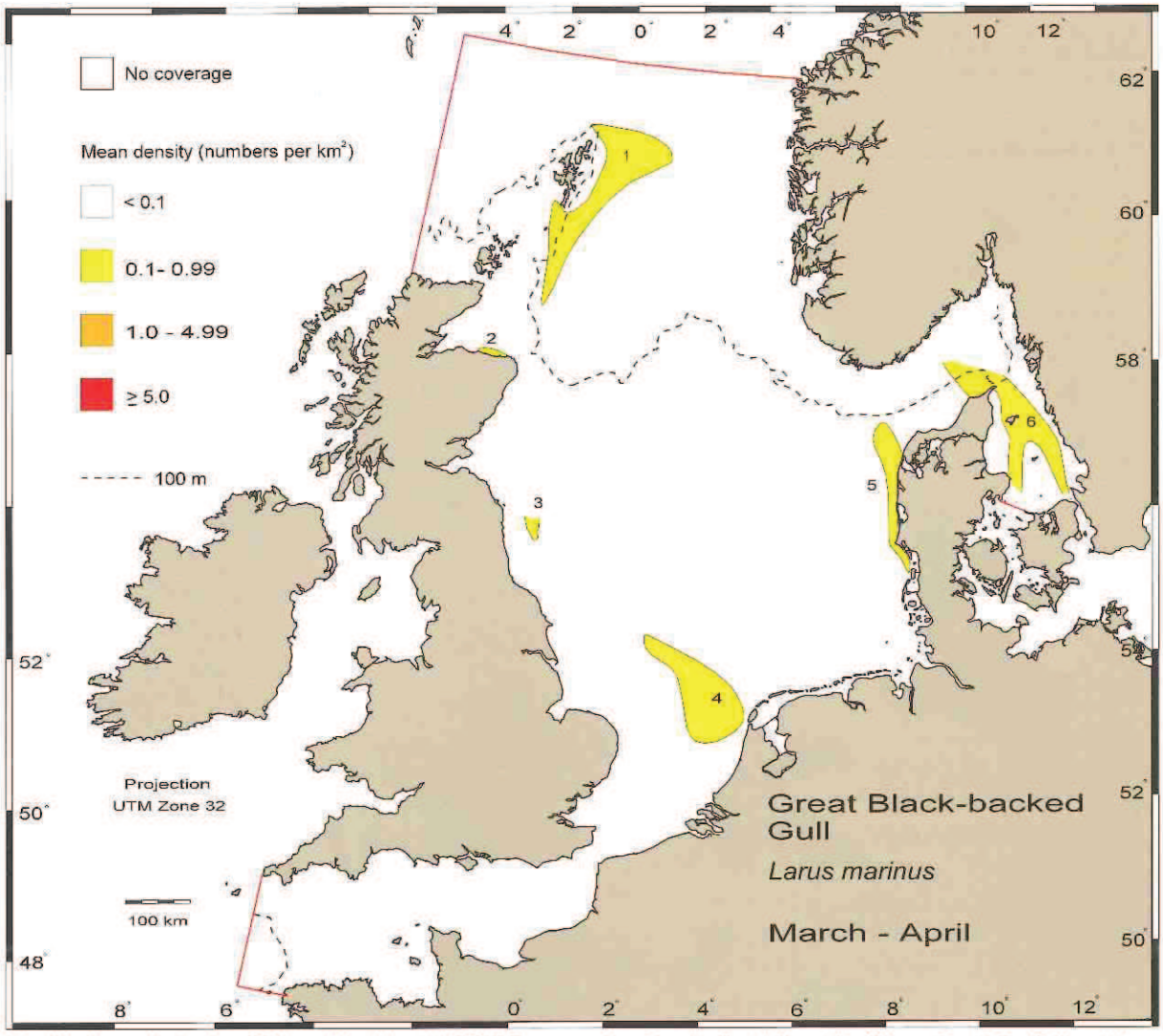
Great Black-backed gulls are generally dispersed, both in the breeding season and in winter. Colonies of over 1000 pairs are very rare. These gulls may concentrate at good feeding sites, such as fishing vessels, but not usually in the large numbers seen in other scavenging seabirds. Concentrations of over 1000 birds near fishing vessels are rare (Camphuysen 1993b, Camphuysen *et al.* 1993, 1995). Although widely dispersed, Great Black-backed Gulls are not present in the central and northern North Sea except during autumn migration. The birds start to return to their breeding colonies in March.



Distribution and density of Great Black-backed Gull Larus marinus *in the North Sea, the Channel and the Kattegat from November to February 1980-1994.*

The average numbers of Great Black-backed Gull *Larus marinus* in key areas from November to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

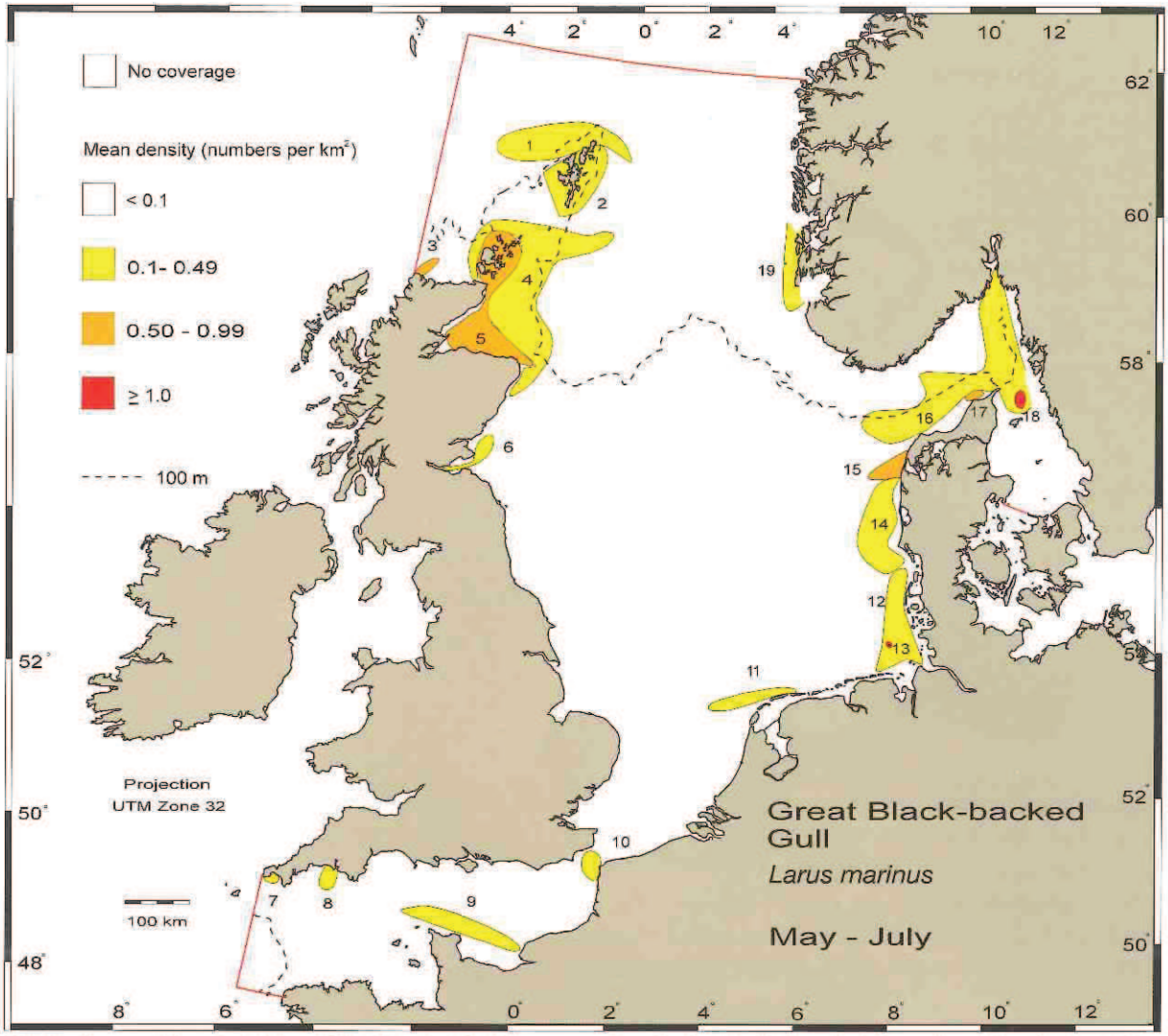
Locality	Density	Km²	Estimate	%
1 Moray Firth	**2.30**	**3600**	**8000**	**2.67**
2 Fladen Ground	1.63	1750	2900	0.97
3 Northwestern North Sea	0.46	108000	50000	16.67
4 Firth of Forth	1.13	1440	1600	0.53
5 Wee Bankie - East Bank	0.42	11670	5000	1.67
6 North East Bank	**5.19**	**2800**	**15000**	**5.00**
7 Hills	**7.82**	**2300**	**18000**	**6.00**
8 Southern North Sea, medium	0.86	74150	64000	21.34
9 Lemon Bank	0.26	12170	3200	1.07
10 Channel	0.32	47260	15000	5.00
11 Brown Ridge	**2.36**	**7700**	**18200**	**6.07**
12 Belgian – Dutch Coast	1.56	10200	16000	5.34
13 German Bight	0.20	10500	2000	0.67
14 Eastern Kattegat – Skagerrak	1.18	45500	54000	18.01
15 Northeast North Sea, low	0.33	48500	16000	5.34
Residual			11000	3.67
Total			**299900**	**100.00**



Distribution and density of Great Black-backed Gull Larus marinus *in the North Sea, the Channel and the Kattegat from March to April 1980-1994.*

The average numbers of Great Black-backed Gull *Larus marinus* in key areas from March to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

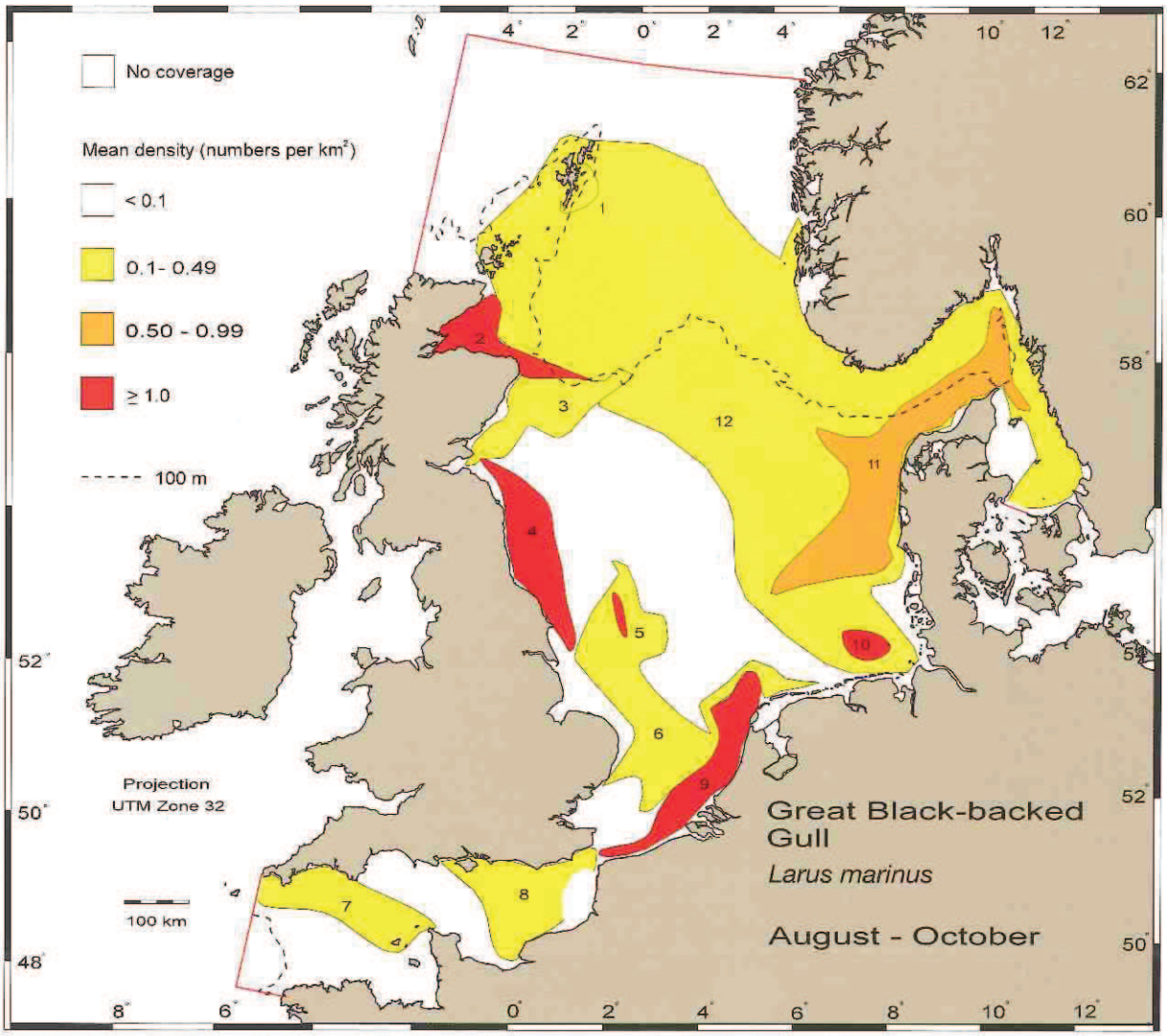
Locality	Density	Km²	Estimate	%
1 Shetland	0.34	18000	6000	33.52
2 Moray Firth	0.10	1165	100	0.56
3 Farn Deeps	0.14	2435	300	1.68
4 Brown Ridge – Dogger Bank	0.10	25750	2600	14.53
5 Eastern North Sea	0.26	8600	2200	12.29
6 Skagerrak – Kattegat	0.10	20000	2000	11.17
Residual			4700	26.26
Total			**17900**	**100.00**



Distribution and density of Great Black-backed Gull Larus marinus *in the North Sea, the Channel and the Kattegat from May to July 1980-1994.*

The average numbers of Great Black-backed Gull *Larus marinus* in key areas from May to July 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 North Shetland	0.12	7850	900	3.69
2 Shetland	0.27	7330	2000	8.20
3 Cape Wrath	0.73	350	250	1.02
4 Moray Firth – Orkney. low	0.10	18550	1900	7.79
5 Moray Firth – Orkney	0.53	12600	6700	27.46
6 Firth of Forth	0.14	1200	200	0.82
7 Mounts Bay	0.10	520	50	0.20
8 Plymouth	0.21	1100	200	0.82
9 Southern Channel	0.13	3500	450	1.84
10 Strait of Dove	0.12	250	30	0.12
11 Terschelling Bank	0.18	3075	560	2.30
12 Helgoland Bight	0.24	6770	1600	6.56
13 Helgoland	1.36	60	80	0.33
14 Jutland Westcoast	0.14	6760	950	3.89
15 Agger Tange	0.68	1550	1100	4.51
16 Læsø North	1.97	425	800	3.28
17 Skagerrak	0.15	20300	3000	12.30
18 Hirtshals	0.86	360	300	1.23
19 Boknafjord – Hardangerfjord	0.15	4500	700	2.87
Residual			2600	10.66
Total			**24395**	**100.00**



Distribution and density of Great Black-backed Gull Larus marinus *in the North Sea, the Channel and the Kattegat from August to October 1980-1994.*

The average numbers of Great Black-backed Gull *Larus marinus* in key areas from August to October 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Eastern Shetland	0.30	4000	1200	0.76
2 Moray Firth	**2.16**	**9950**	**22000**	**14.01**
3 Aberdeen Bank	0.20	14550	2900	1.85
4 Barmade Bank – North East Bank	1.50	15500	23000	14.65
5 Outer Silver Pit	**4.66**	**1450**	**6750**	**4.30**
6 Lemon Bank – Brown Ridge	0.18	37280	6700	4.27
7 Western Channel	0.25	21350	5350	3.41
8 Eastern Channel	0.21	19840	4200	2.68
9 Dutch – Belgium coast	1.21	15435	20000	12.74
10 Helgoland	1.37	3725	5000	3.18
11 Skagerrak – Danish Westcoast	0.54	48800	26400	16.82
12 Northeast North Sea, low	0.12	265725	32000	20.38
Residual			1500	0.96
Total			**157000**	**100.00**

Kittiwake *Rissa tridactyla*

Kittiwakes breed on cliffs and islands from the temperate to the arctic zones in the Atlantic, Arctic and Pacific Oceans. The total population is estimated at some 6-8 million pairs, of which 4.2 million pairs breed in the Northeast Atlantic. During this century the species has extended its range southward in Europe, colonizing Sweden, Denmark, France, Spain, Portugal and recolonized Helgoland. After the breeding season the birds disperse widely and those from the North Sea are found from the Bay of Biscay to Newfoundland (Lloyd *et al.* 1991, Rose & Scott 1994). Small shoaling fish are the major food, supplemented by waste from fisheries, particularly in winter. This small gull is easily outcompeted at trawlers by the larger species, and the species relies more than most of the other potential scavengers on natural foods in the North Sea (Vauk & Jokele 1975, Galbraith 1983, Harris & Wanless 1990, Maul 1994, Camphuysen *et al.* 1995).

Importance of the North Sea

A total of 415,000 pairs breed in the North Sea, and another 10,000 pairs in the Channel (overall 10% of Northeast Atlantic population). Most breed on the British east coasts, from Flamborough (Yorkshire) to Shetland. Although most Kittiwakes in the study region breed in Scotland, the largest colony (83,700 pairs in 1986) is at Flamborough. Much larger numbers breed further north. Two million pairs breed in the zone from the Faroe Islands and Iceland to Northwest Russia (Lloyd *et al.* 1991). The offshore areas in the North Sea hold between 7% (breeding season) and 12% (non-breeding season) of the total Northeast Atlantic population.

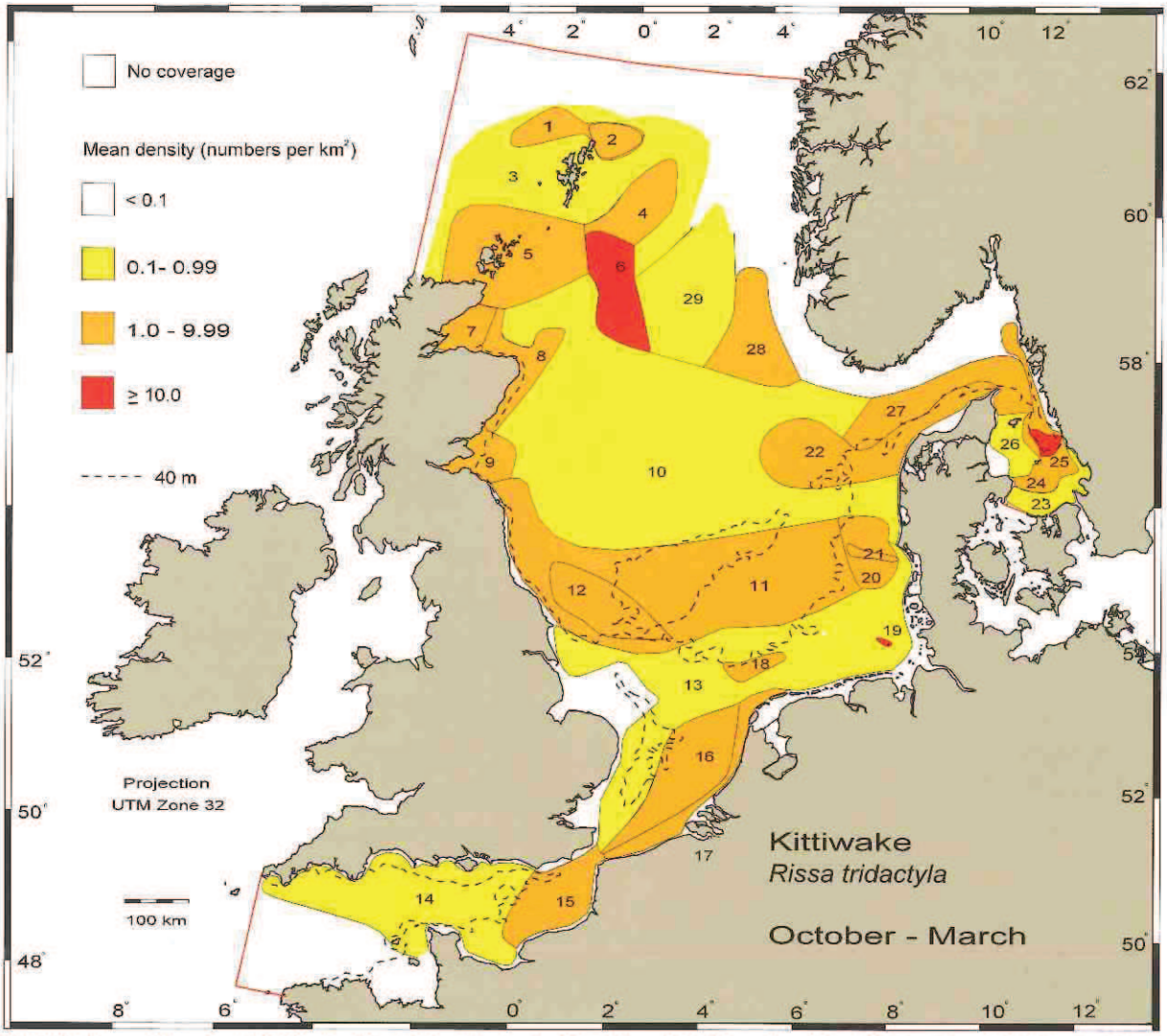
Main areas

During summer a total of nearly 600,000 occur at sea in the study region. The birds occur over large areas of sea with the result that no single area has a high enough concentration to be of international importance. In winter, the numbers at sea in the study region nearly double, to over 1 million birds or 17% of Northeast Atlantic breeding population.

Nevertheless, no single area is of international importance even allowing for an estimated 200,000 birds in the Skagerrak/Kattegat area. The most important areas are the Middelgrunde, the central Skagerrak and Reef areas, Fladen Ground, the Dogger Bank and the Silver Pit.

Distribution patterns

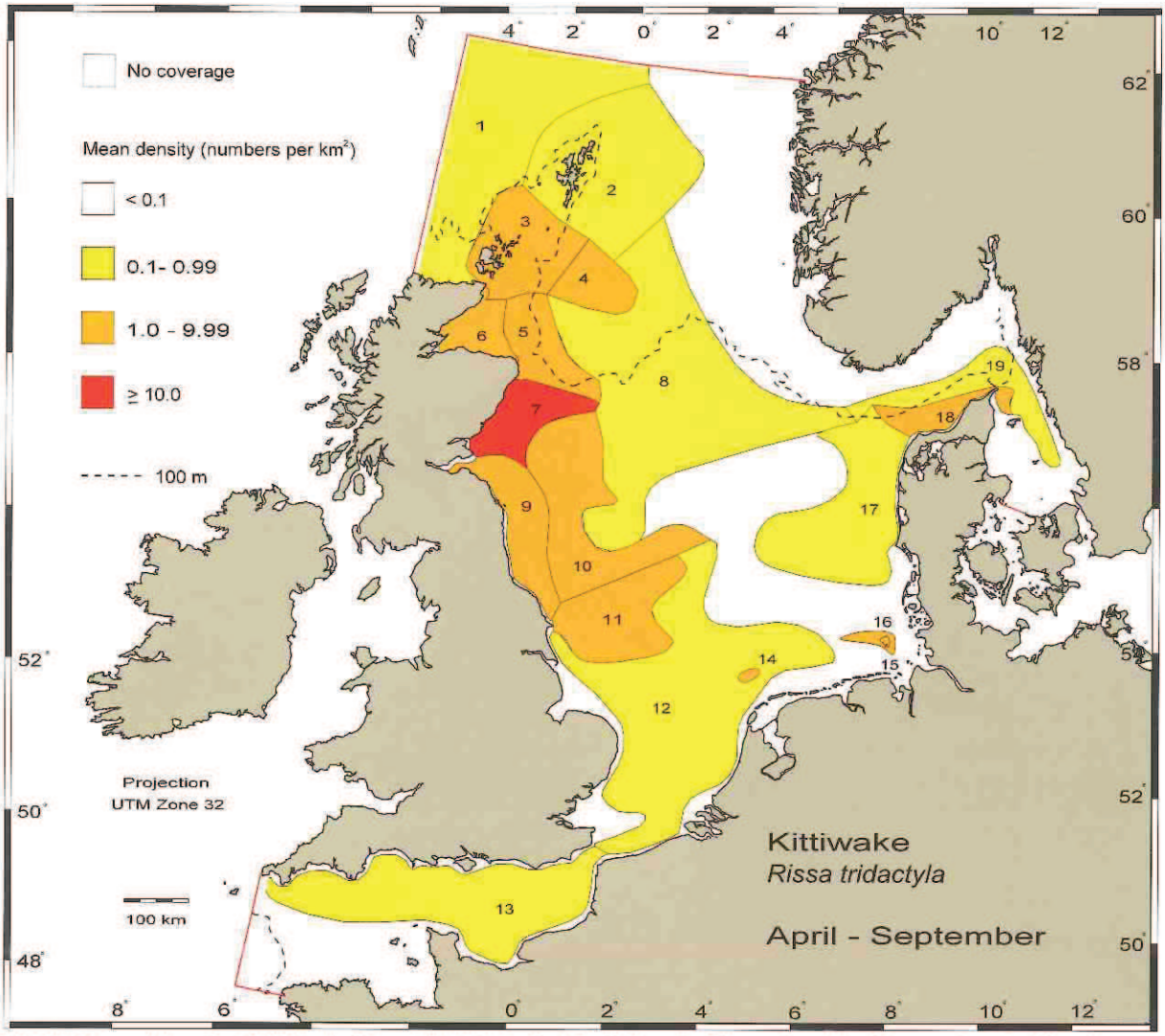
In summer there is a clear association with the main breeding areas in the Western North Sea; nearly 90% of the Kittiwakes within the study region are found at sea in these areas. Few Kittiwakes remain in the central North Sea, the Channel and, particularly on the eastern side, in low salinity waters influenced by riverine input (Durinck *et al.* 1993b). Only the Helgoland colony stands out in this area. In winter the distribution pattern remains more or less the same, with the exception of the Skagerrak/Kattegat area which now supports 24% of the birds within the study region. At all times, Kittiwakes generally avoid continental, inshore waters, such as in the German Bight (Skov *et al.* 1994b) and in the Baltic (Durinck *et al.* 1994b).



Distribution and density of Kittiwake Rissa tridactyla *in the North Sea, the Channel and the Kattegat from October to March 1980-1994.*

The average numbers of Kittiwake *Rissa tridactyla* from October to March 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%	Locality	Density	Km²	Estimate	%
1 Northwestern Shetland	1.18	5200	6100	0.59	17 Cap Gris Nez – Ameland	1.13	6600	7500	0.73
2 North Shetland	6.31	3300	21000	2.03	18 Terschelling Bank	2.38	2300	5500	0.53
3 Cape Wrath – Viking Bank	0.22	58000	12500	1.21	19 Helgoland	10.84	190	2100	0.20
4 Forty Mile Ground	1.06	9600	10000	0.97	20 Horns Rev	1.27	6900	8800	0.85
5 Orkney	1.62	27000	44000	4.26	21 Blåvandshuk	9.60	900	8700	0.84
6 Fladen Ground	10.86	12000	130000	12.59	22 Jutland Bank – Skagerrak	2.23	21500	48000	4.65
7 Moray Firth west	3.60	3800	13500	1.31	23 Kattegat, low	0.61	4300	2600	0.25
8 Northeast Scotland	1.15	7500	8500	0.82	24 Kattegat, medium	2.04	7600	15500	1.50
9 Firth of Forth	1.40	4600	6500	0.63	25 Middelgrundene	59.26	1300	77000	7.46
10 Central North Sea	0.50	138000	69000	6.68	26 Ålborg Bay	0.18	4400	790	0.08
11 Dogger Bank	1.60	66000	106000	10.26	27 Central Skagerrak	7.18	15000	108000	10.46
12 Barmade Bank – Silver Pit	8.00	12000	96000	9.30	28 The Reef	6.79	14400	98000	9.49
13 Southern North Sea	0.47	63000	30000	2.91	29 Bergen Bank	0.17	27000	4600	0.45
14 Channel	0.43	38000	16000	1.55	Residual			20000	1.94
15 Dover Strait	1.42	12500	17500	1.69	**Total**			**1032690**	**100.00**
16 Brown Ridge	2.24	17600	39000	3.78					



Distribution and density of Kittiwake Rissa tridactyla *in the North Sea, the Channel and the Kattegat from April to September 1980-1994.*

The average numbers of Kittiwake *Rissa tridactyla* from April to September 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Northwestern Continental Shelf	0.51	55000	28000	4.87
2 Shetland	0.54	46000	25000	4.27
3 Orkney	2.69	20000	54000	9.39
4 Fladen Ground	1.11	9500	10500	1.87
5 Bosies Bank	3.34	12800	43000	7.48
6 Moray Firth	7.33	6700	49000	8.52
7 Aberdeen Bank	12.12	11000	133000	23.13
8 Fladen Ground – East Bank	0.32	87000	28000	4.87
9 Farn Deeps – Barmade Bank	3.99	15700	63000	10.96
10 East Bank	1.08	31500	34000	5.91
11 Outer Silver Pit	2.28	20400	47000	8.17
12 Southern North Sea	0.27	76000	21000	3.65
13 Channel	0.14	46000	6500	1.13
14 Terschelling Bank	1.45	500	700	0.12
15 Helgoland, medium	6.50	160	1000	0.17
16 Helgoland, low	1.56	1430	2200	0.38
17 Monkey Bank – Horns Rev	0.28	35400	9900	1.72
18 Jammer Bugt	1.45	6500	9400	1.63
19 Skagerrak - Kattegat	0.10	14000	1400	0.24
Residual			10000	1.74
Total			**575000**	**100.00**

Sandwich Tern *Sterna sandvicensis*

In Europe, Sandwich Terns breed in two distinctly separated regions; in the northwest and southeast (Cramp 1985). The Northwestern European population which is increasing in numbers has its stronghold within the study region in the United Kingdom, The Netherlands, Germany, France and Denmark. The bulk of Sandwich Terns in the study region are found in large breeding colonies in undisturbed coastal and island habitats. During breeding as well as during migration, Sandwich Terns feed exclusively in relatively shallow marine areas. They mainly prey on small surface shoaling fish by plunge diving (Dunn 1972). The species winters off west Africa (Møller 1981).

Importance of the North Sea

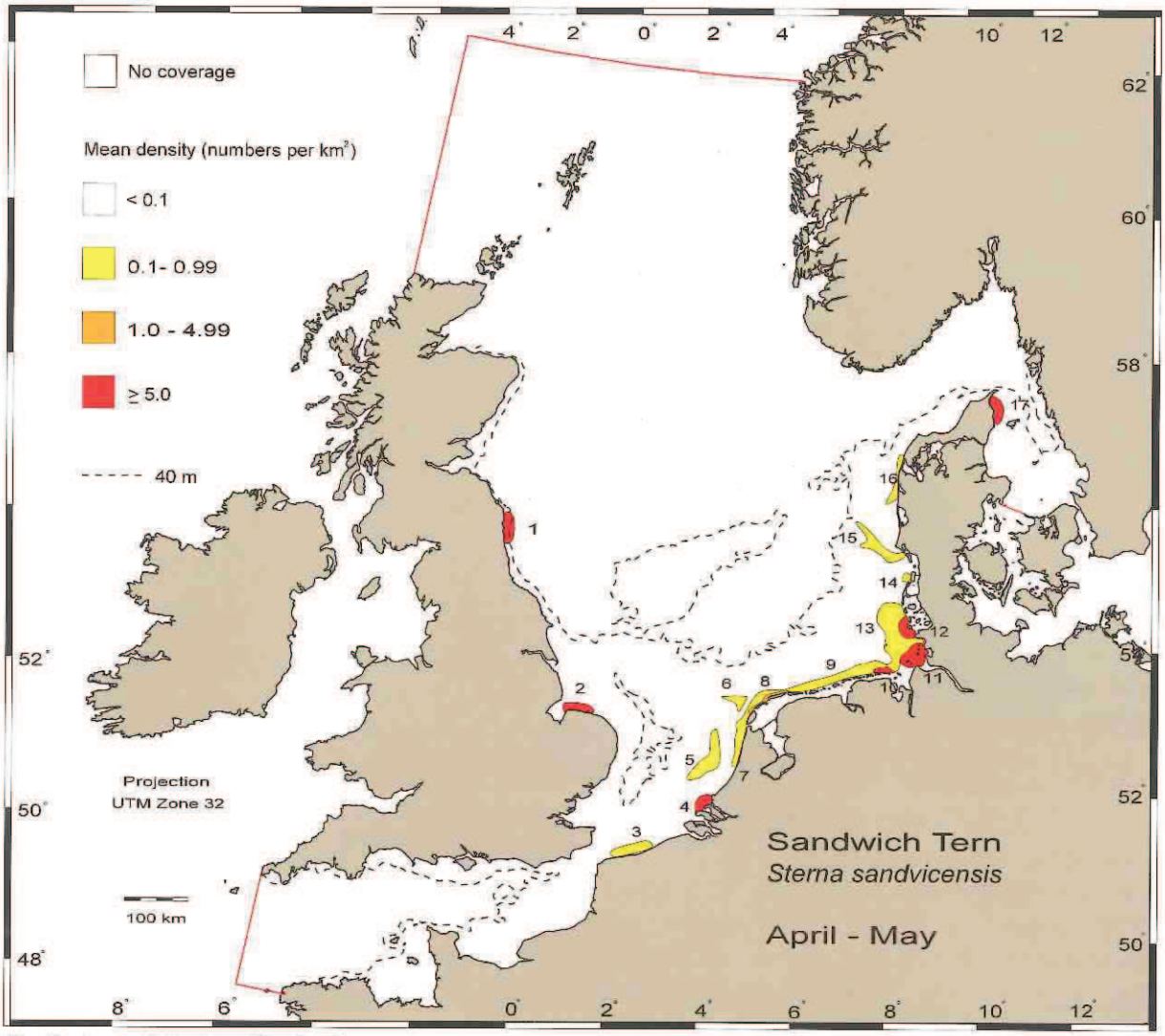
An estimated 75,000 pairs breed in western Europe (Rose & Scott 1994), of which at least 2/3 breed in the study region. Most birds occur at sea during the breeding season when a minimum of 34,000 birds are estimated for the region (22.7% of the Northwest European breeding population).

Main areas

During summer, large numbers feed around the colonies of international importance in the North Sea and the Kattegat: Coquet Island, Scolt Head, Scharhörn, Trischen, Wangerooge, Norderoog, the Voordelta and Hirsholmene. During autumn, large numbers remain in the zones off the colonies. The waters off the Elbe supports internationally important numbers during this period.

Distribution patterns

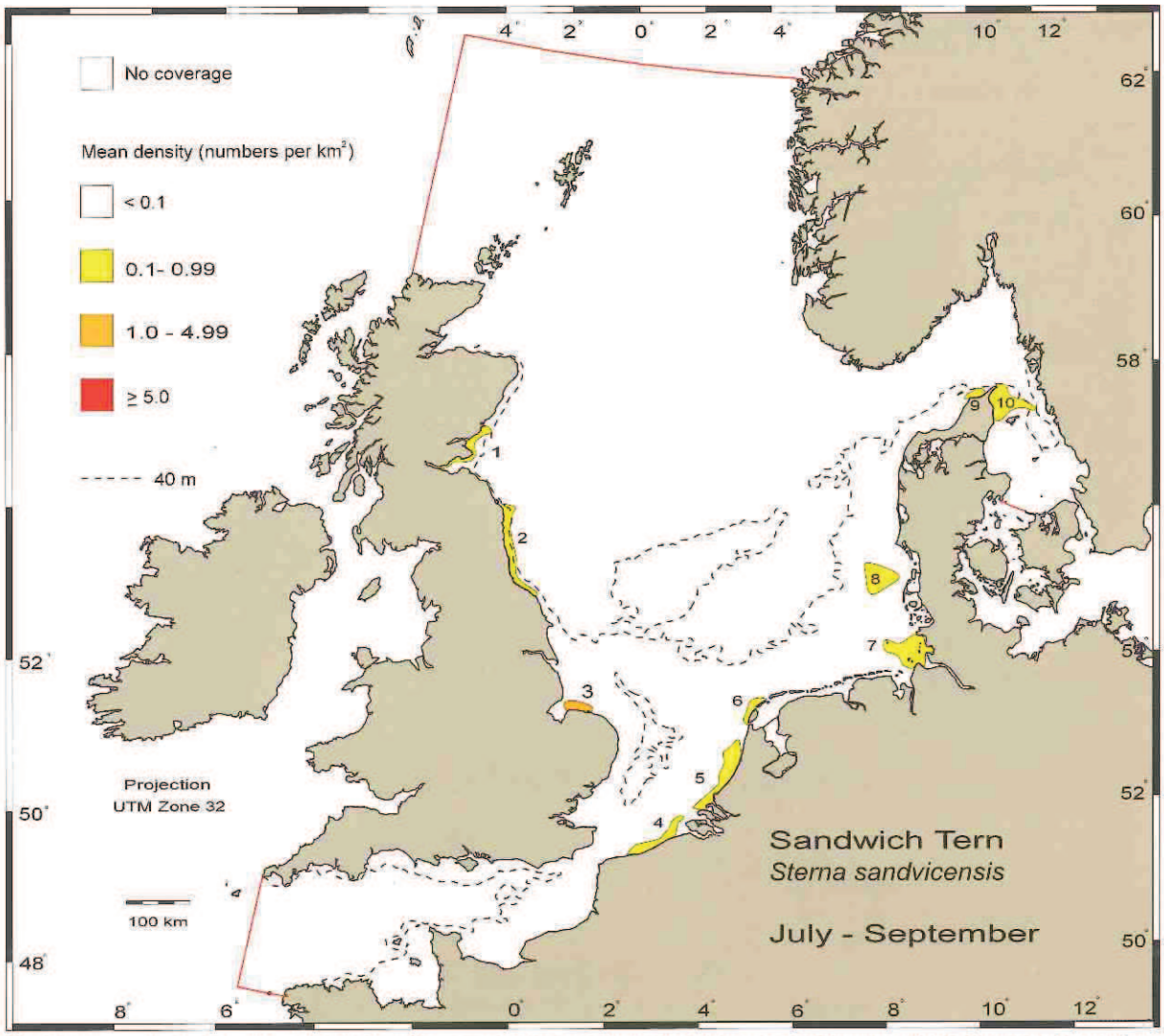
Sandwich Terns are found mainly in areas associated with breeding colonies, and the effects of migration on distribution patterns are small. Concentrations are coastal, although some birds feed offshore. Sandwich Terns are most widely distributed after the breeding season.



Distribution and density of Sandwich Tern Sterna sandvicensis *in the North Sea, the Channel and the Kattegat from April to May 1980-1994.*

The average numbers of Sandwich Tern *Sterna sandvicensis* in key areas from April to May 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Coquet Island	**9.70**	**720**	**7000**	**20.40**
2 Scolt Head	**11.70**	**530**	**6200**	**18.07**
3 Belgian coast	0.28	900	250	0.73
4 Voordelta	**6.40**	**490**	**3150**	**9.18**
5 Broad Fourteens	0.21	1600	350	1.02
6 Texel	0.29	400	120	0.35
7 Dutch west coast	0.66	1430	950	2.77
8 Texel – Terschelling coast	2.07	250	500	1.46
9 Ameland – Wangerooge	0.38	1980	750	2.19
10 Wangerooge – Jade	5.52	225	1200	3.50
11 Scharhörn – Trischen	**5.00**	**1100**	**5500**	**16.03**
12 Norderoog	**6.00**	**600**	**3600**	**10.49**
13 German Bight	0.38	3270	1200	3.50
14 Rømø	0.34	150	50	0.15
15 Horns Rev	0.17	1270	200	0.58
16 Nr. Lyngvig – Lodbjerg	0.40	530	200	0.58
17 Hirsholmene	**5.00**	**600**	**3000**	**8.74**
Residual			100	0.29
Total			**34320**	**100.00**



Distribution and density of Sandwich Tern Sterna sandvicensis *in the North Sea, the Channel and the Kattegat from July to September 1980-1994.*

The average numbers of Sandwich Tern *Sterna sandvicensis* in key areas from July to September 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Montrose – Firth of Firth	0.19	830	160	3.15
2 North Yorkshire	0.16	1480	240	4.73
3 Scolt Head	2.30	530	1220	24.00
4 Belgian coast	0.48	1075	500	9.84
5 Dutch Coast	0.20	1920	380	7.48
6 Texel – Vlieland	0.35	460	160	3.15
7 Elbe Mouth	**0.74**	**2270**	**1700**	**33.47**
8 Sylt – Rømø	0.14	1730	240	4.73
9 Tannis Bugt	0.19	300	60	1.18
10 Ålbæk Bugt	0.20	1840	370	7.28
Residual			50	0.98
Total			**5080**	**100**

Common Tern *Sterna hirundo*

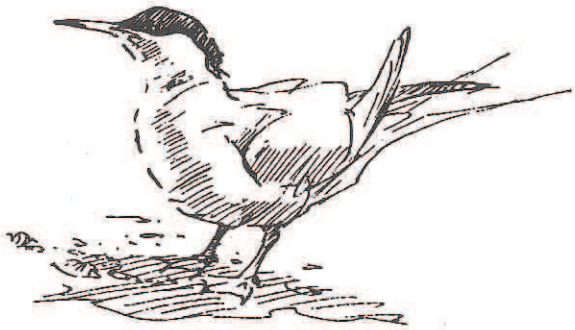
In Europe they breed on most coasts as well as in a great number of inland wetlands. They are conspicuously lacking from most of Iberia and the northern islands (Faroe, Iceland, Svalbard and east of the North Cape). As Common Terns may breed in wetlands that provides safe nesting and sufficient food, the distinction between marine and inland colonies is often difficult to make. In winter the species is essentially marine. European Common Terns winter along the coasts of Africa and none remain in the study region. The diet is principally small fish, in the North Sea mainly herring, sprat, sandeels and smelt, but the species is a versatile feeder, and flatfish, crustacans and even insects may also be taken (Becker *et al.* 1987, Stienen & Brenninkmeijer 1992, Hume 1993).

Importance of the North Sea

An estimated 390,000 pairs breed in Europe (Rose & Scott 1994). Bearing in mind the difficulties of distinguishing between inland marine colonies, and between closely related tern species, the population size in the study area has been estimated at some 65,000 pairs (Tasker *et al.* 1987, Webb *et al.* 1995), or 17% of the European population. At sea, it was often impossible to distinguish between Common and Arctic Terns and numbers of either species may thus have been underestimated. In summer, between 4,000 and 8,000 Common Terns are estimated at sea in the study area, or 0.5% of the European breeding population. Numbers actually passing along the Continental seaboard during spring and autumn migration are probably ten times this estimate (Platteeuw *et al.* 1994).

Main areas

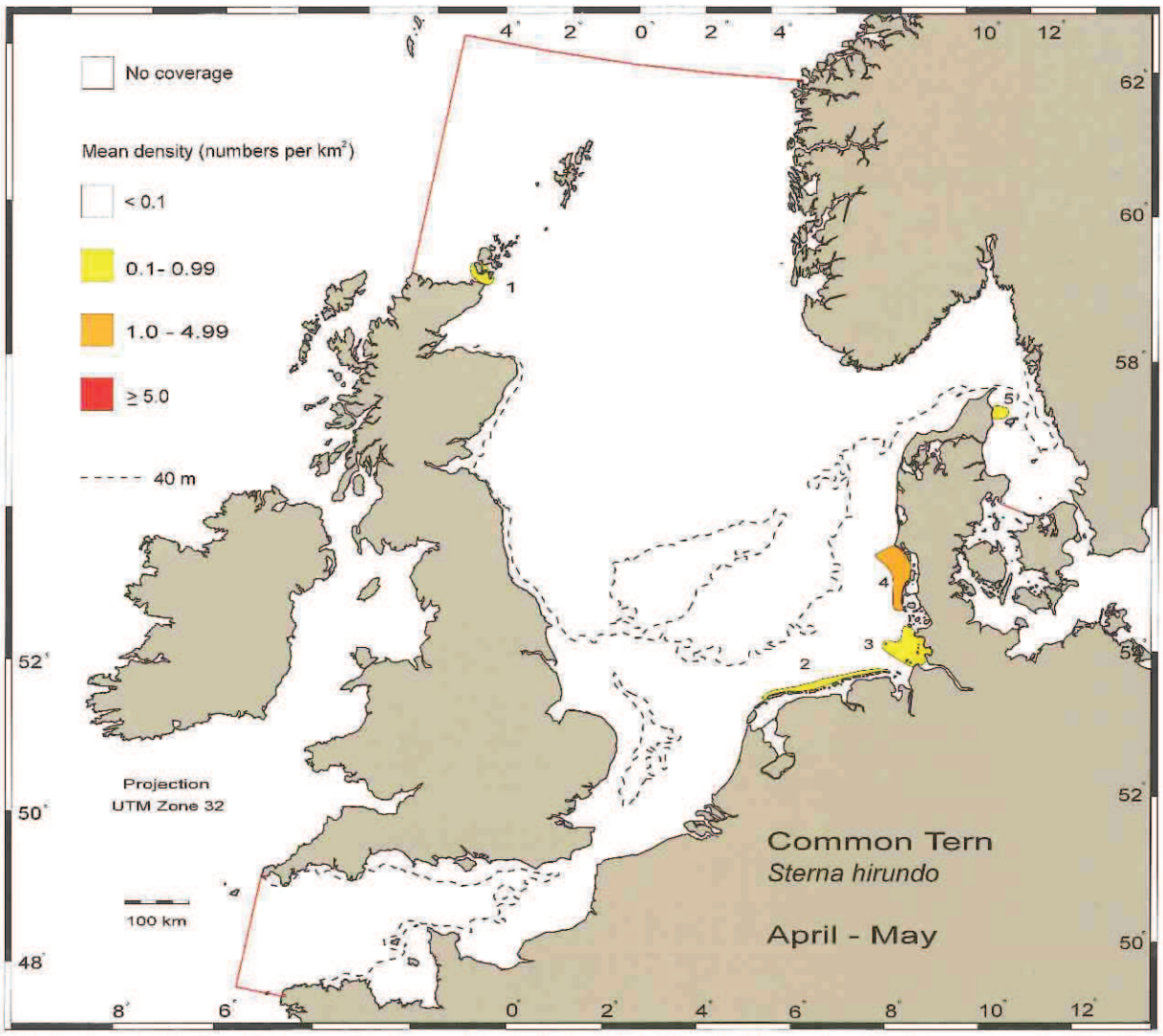
Although large numbers pass through the study region, no areas support numbers of international importance. The Wadden Sea is known to be of international importance from spring to autumn (Meltofte *et al.* 1994). During spring migration



(April-May) most Common Terns in the open sea were found closely inshore, off the Wadden Sea and in the German Bight. In autumn, the Elbe mouth (Germany) and the Voordelta (The Netherlands) were the most important areas.

Distribution patterns

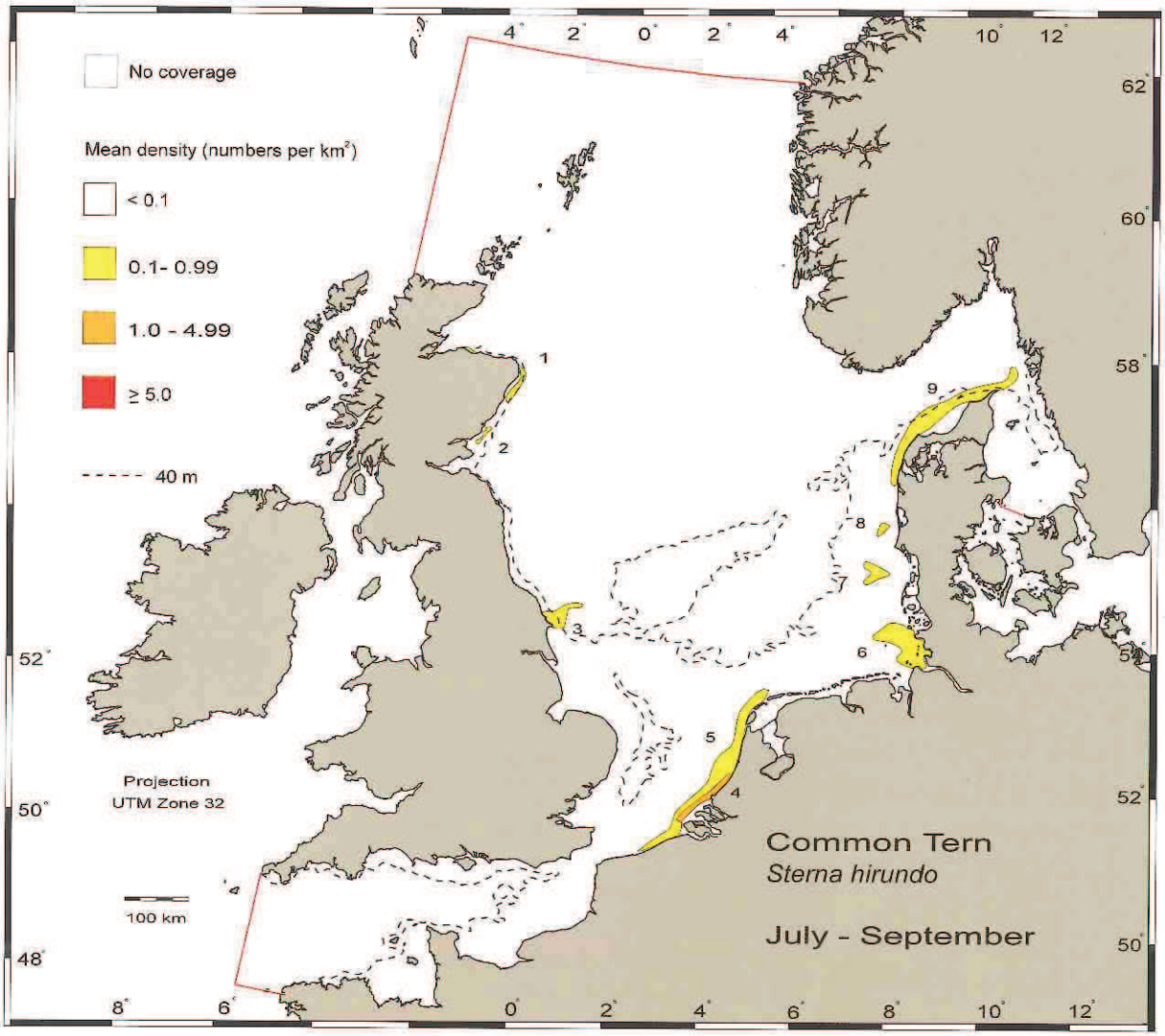
Common Terns are only found in larger numbers within sight of the coast, although they may feed far from the coast (Garthe & Hüppop 1994). There is an obvious link between concentrations offshore and some of the major breeding areas, for instance in the Dutch Delta, the Wadden Sea and northeast Scotland. With the majority of breeding colonies distributed along continental coasts, it is obvious that the most important maritime migration route follows the eastern North Sea seaboard. However, only the German and Southern Bight were intensively surveyed, as far as the nearshore (<2 km from the coast) waters are concerned and most birds that breed in Britain, Belgium and France, may have been overlooked.



Distribution and density of Common Tern Sterna hirundo *in the North Sea, the Channel and the Kattegat from April to May 1980-1994.*

The average numbers of Common Tern *Sterna hirundo* in key areas from April to May 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Orkney	0.37	870	320	7.53
2 Frisian coast	0.24	1400	340	8.00
3 Elbe Mouth	0.16	2500	400	9.41
4 Sylt – Blåvandshuk	1.15	2500	2900	68.24
5 Hirsholmene	0.42	440	190	4.47
Residual			100	2.35
Total			**4250**	**100.00**



Distribution and density of Common Tern Sterna hirundo *in the North Sea, the Channel and the Kattegat from July to September 1980-1994.*

The average numbers of Common Tern *Sterna hirundo* in key areas from July to September 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Peterhead	0.12	1250	150	2.00
2 Arbroath	0.38	160	60	0.80
3 Flamborough Head	0.21	1040	220	2.93
4 Voordelta	2.75	910	2500	33.33
5 Belgian – Dutch coast	0.19	4700	900	12.00
6 German Bight	0.74	3100	2300	30.67
7 Horns Rev south	0.41	750	300	4.00
8 Horns Rev north	0.53	230	120	1.60
9 North Jutland	0.10	4600	450	6.00
Residual			500	6.67
Total			**7500**	**100.00**

Guillemot *Uria aalge*

Guillemot colonies use cliffs and islands throughout the boreal and low arctic zones of the Atlantic and Pacific Oceans. In the Northeast Atlantic their breeding distribution extends from the Iberian Peninsula north to Svalbard and Novaya Zemlaya. The largest numbers are found in the British Isles and in Iceland, each holding over 1 million birds (Lloyd *et al.* 1991). Breeding Guillemots in Björnöya and northern Norway numbered hundreds of thousands of birds in the early 1980's, but declined to only tens of thousands in the late 1980's after a crash in capelin, their principal food species. In the North Sea, Guillemots mainly feed on sandeels and clupeids in summer, taking a wider selection of fish in winter (Blake 1983 & 1984, Camphuysen 1989, Durinck *et al.* 1991, Skov *et al.* 1992).

Importance of the North Sea

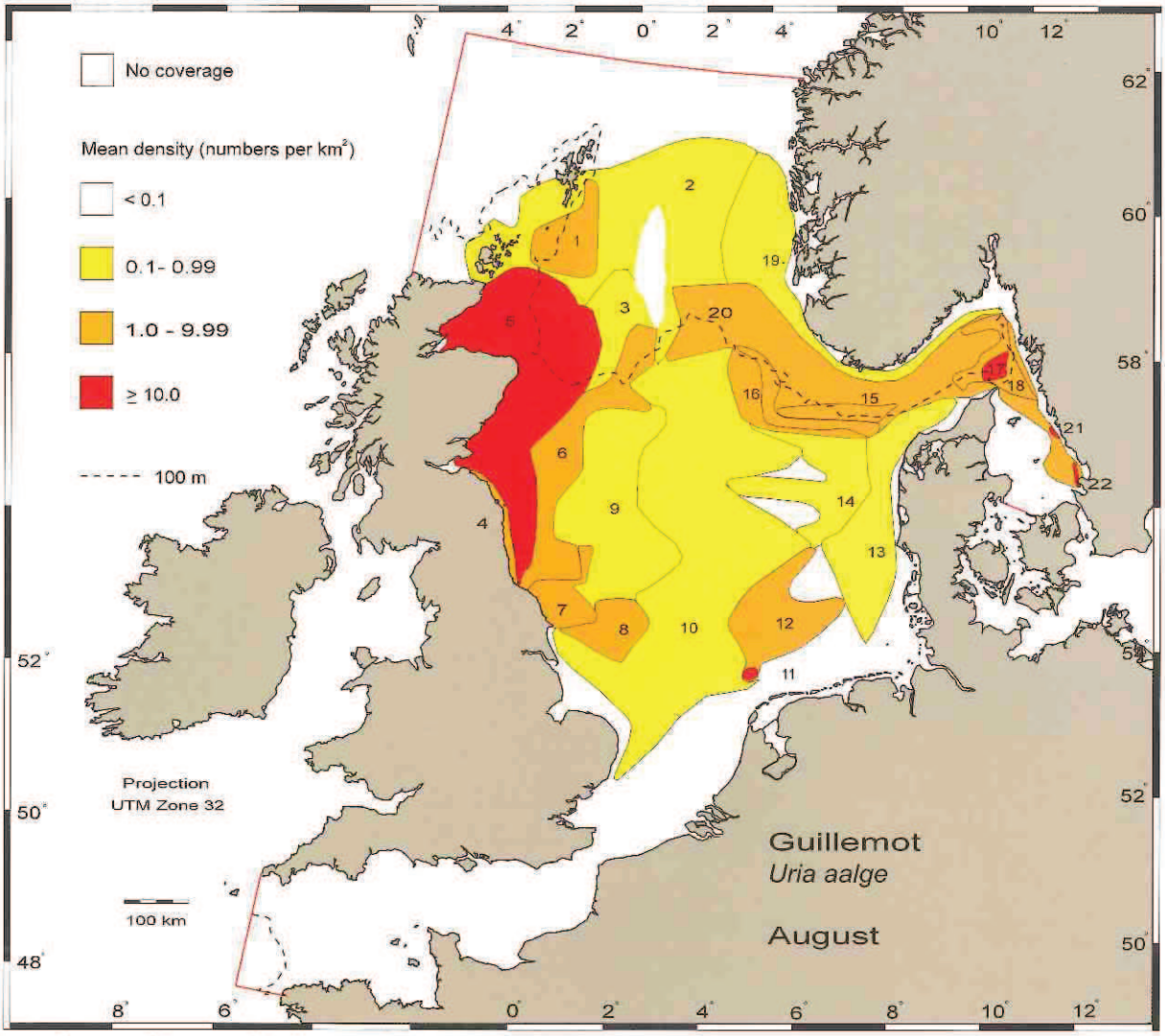
Together with Red-throated Diver, Common Scoter, Great Skua and Razorbill, the Guillemot is a species for which the study region represents a stronghold. Using a conversion factor of 1.5 between numbers of birds counted in a colony and numbers of birds associated with it, an estimated 1.7 million are associated with the colonies in the North Sea and Channel (Tasker *et al.* 1987, Lloyd *et al.* 1991, Webb *et al.* 1995). The vast majority of these breed in mainland Scotland and Orkney and Shetland. After breeding, an estimated 1.8 million Guillemots, (45 % of the Northeast Atlantic breeding population) are present at sea in the study region, including subadult non-breeders and newly fledged juveniles.

Main areas

During most of the year, between 65% and 87% of Guillemots are found outside areas of international importance. However, during moult they are concentrated and 70% occur within the important areas. In March/April most Guillemots are concentrated near the colonies in the northwest of the study area, although considerable numbers remain in the southeast and east. Internationally important colonies are found in Shetland, Orkney, the Moray Firth and at Fowlsheugh south of Aberdeen and Flamborough. In the breeding season (May-June), the western North Sea holds 95% of all Guillemots at sea. Besides the sea-areas near the colonies mentioned above, the waters between Flamborough and the Outer Silver Pit are of international importance. Young Guillemots fledge in July and are associated with moulting adults, the greatest concentrations occurring in Scottish waters. These waters are of great importance. Others swim across the North Sea, leading to increasing numbers in Skagerrak and its approaches. From August to October the sea off the Scottish and Northeast English coasts between the Moray Firth and the Barmade Bank is of great international importance. A second concentration of international importance is found in the Eastern Skagerrak. During winter the important concentration area off Scotland and Northeast England extends southeastward to the edge of the Dogger Bank. The West Bank is of international importance in winter.

Distribution patterns

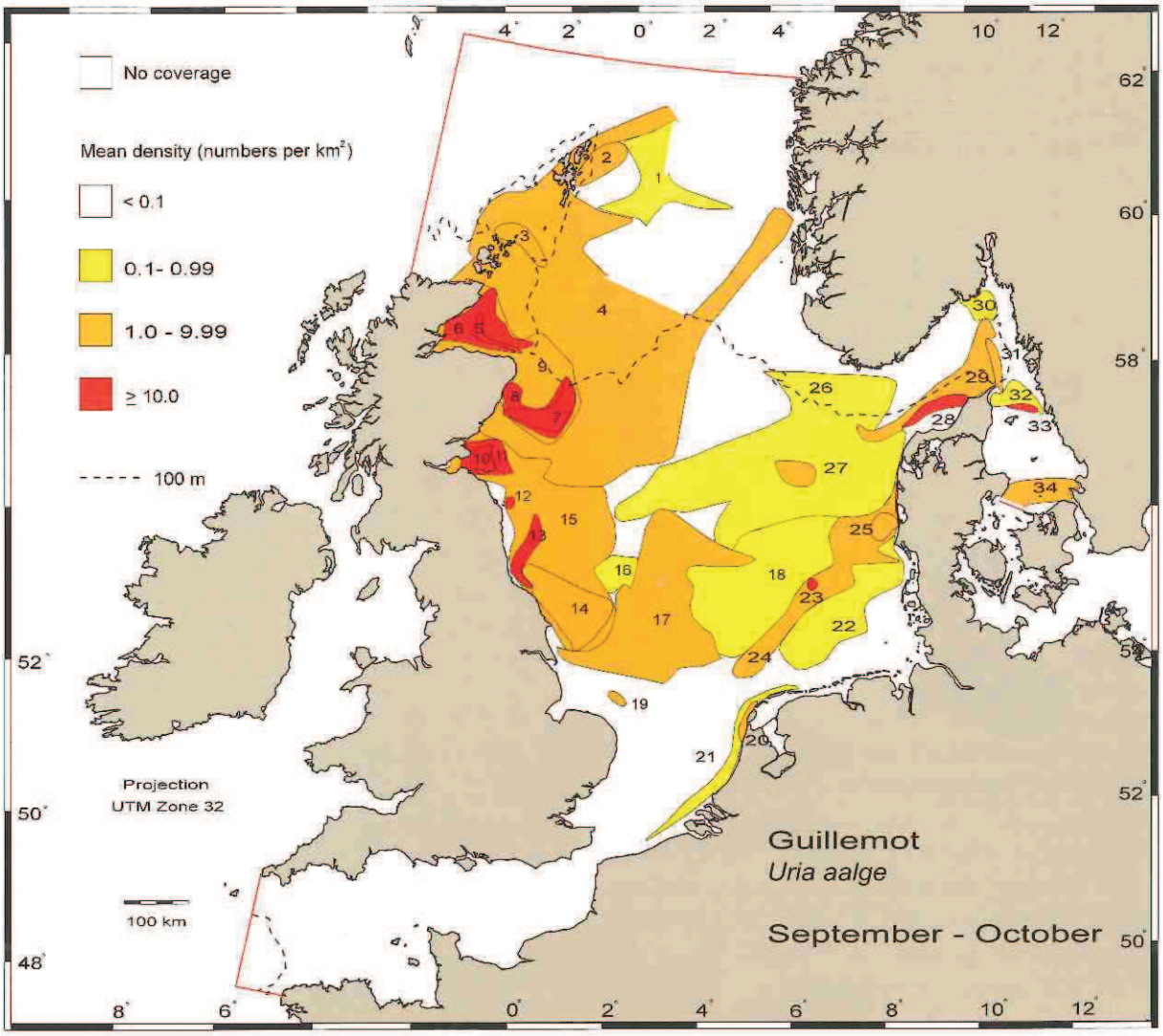
Guillemots are concentrated in the waters off Scotland and Northeast England throughout the year, but large numbers from the colonies in that area raise their young and winter in areas along the southern parts of the Norwegian Trench. Although widespread in winter, densities in the central North Sea and in the southern North Sea, inner German Bight and Channel are generally much lower than in the main areas of concentration. Considering that many Guillemots reach the Skagerrak by swimming, the crossing is fast, and no long-lasting concentrations form in the central northern North Sea.



Distribution and density of Guillemot Uria aalge *in the North Sea, the Channel and the Kattegat in August 1980-1994.*

The average numbers of Guillemot *Uria aalge* in key areas in August 1980-1994. Areas marked with bold are of international importance (MCC criteria).

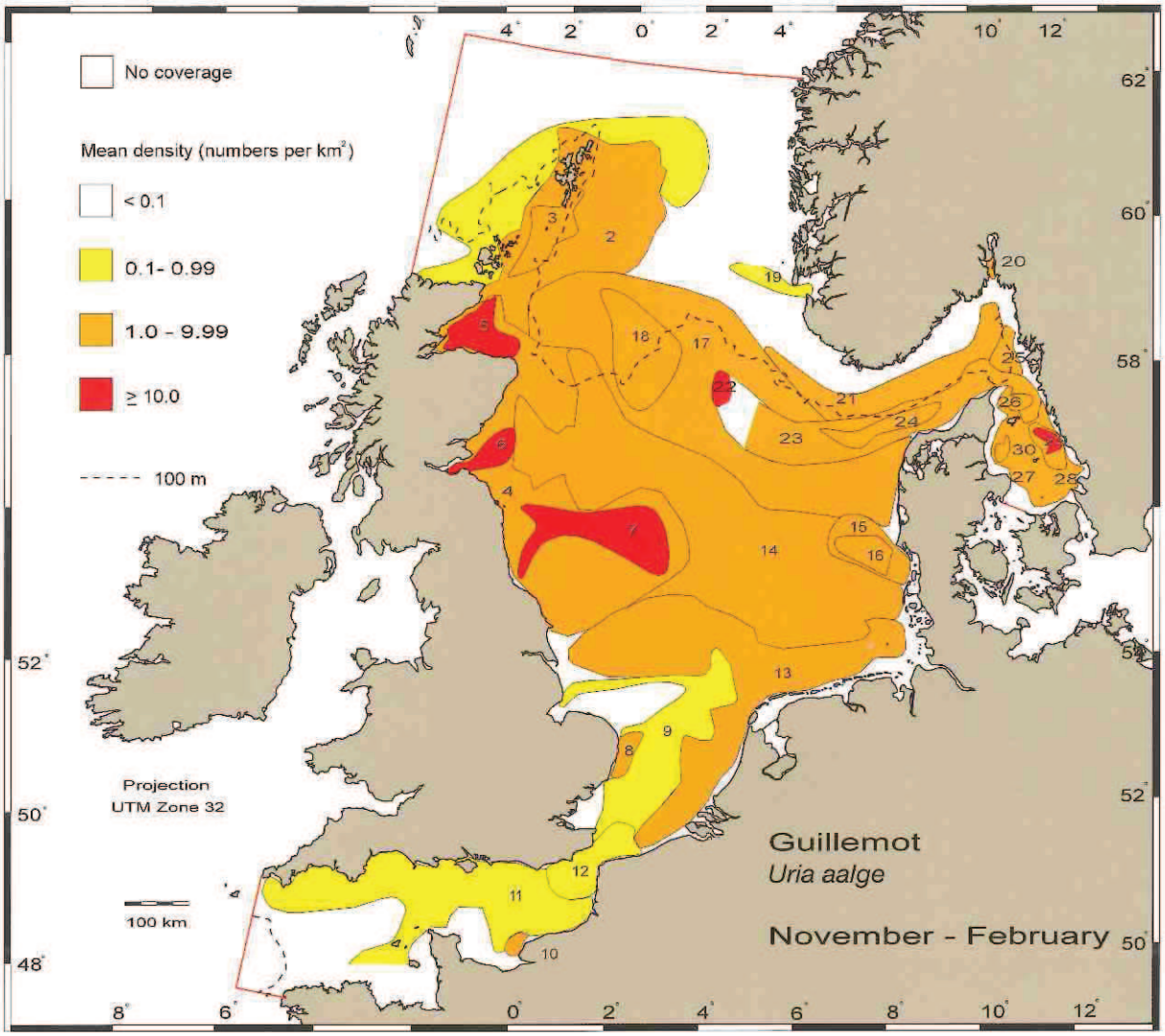
Locality	Density	Km²	Estimate	%
1 Dutch Bank	1.71	11300	19000	1.03
2 Viking Bank	0.86	44000	38000	2.06
3 Fladen Ground	0.52	7800	4000	0.22
4 Firth of Forth – Tyne	5.09	1785	9000	0.49
5 Moray Firth – Aberdeen Bank – Tees	**23.45**	**52000**	**1200000**	**64.92**
6 Fladen Ground – North Yorkshire	4.75	22450	106500	5.76
7 Flamborough Head – Castle Ground	8.52	6100	52000	2.81
8 Outer Silver Pit	3.40	7270	25000	1.35
9 East Bank – Central North Sea	0.91	33300	30000	1.62
10 Dogger Bank – Central North Sea	0.36	91000	33000	1.79
11 Frisian Front	**11.17**	**400**	**45000**	**2.43**
12 Oyster Bank	1.69	16700	28000	1.51
13 Eastern North Sea	0.25	21000	5000	0.27
14 Monkey Bank	0.76	17250	13000	0.70
15 Klondyke – West Bank, medium	3.41	3900	13000	0.70
16 Klondyke – West Bank, high	7.84	6000	47000	2.54
17 Eastern Skagerrak, high	**35.61**	**1300**	**46000**	**2.49**
18 Eastern Skagerrak, medium	5.05	6260	31600	1.71
19 Northern Norwegian Trench	0.47	23000	10800	0.58
20 Southern Norwegian Trench	1.62	52000	84000	4.54
21 Middelgrundene	23.61	150	3500	0.19
22 Skälderviken – Laholmsbugten	10.31	200	2000	0.11
Residual			3000	0.16
Total			**1848400**	**100.00**



Distribution and density of Guillemot Uria aalge *in the North Sea, the Channel and the Kattegat from September to Oktober 1980-1994.*

The average numbers of Guillemot *Uria aalge* in key areas from September to Oktober 1980-1994. Areas marked with bold are of international importance (MCC criteria).

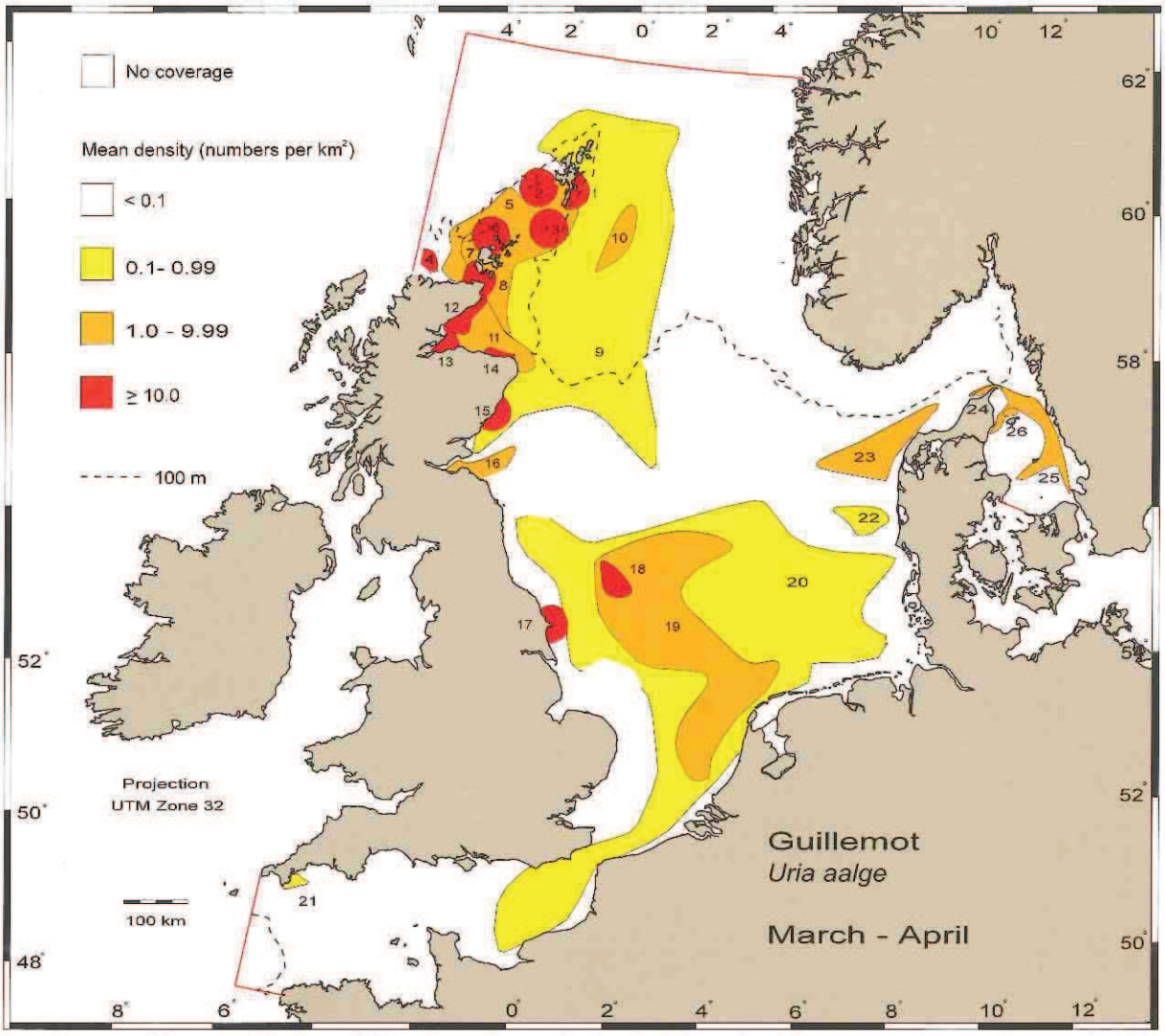
Locality	Density	Km²	Estimate	%
1 Northern North Sea, low	0.80	10430	8000	0.56
2 Shetland, east	3.18	3040	10000	0.70
3 North Orkney	6.77	2690	18000	1.26
4 Northern North Sea	2.77	112335	311000	21.81
5 Moray Firth, central	31.16	1025	32000	2.24
6 Moray Firth	**15.91**	**5250**	**84000**	**5.89**
7 Aberdeen Bank, core	**28.17**	**3475**	**98000**	**6.87**
8 Aberdeen Bank, periphery	13.04	3045	40000	2.80
9 Northeast Scotland, high	7.97	11430	91000	6.38
10 Inner Firth of Forth	**42.18**	**1370**	**58000**	**4.07**
11 Wee Bankie	11.95	1960	23000	1.61
12 Farne Deeps	18.29	250	5000	0.35
13 Tees Bay – Barmade Bank	**34.71**	**2300**	**80000**	**5.61**
14 Flamborough Head – Barmade Bank	7.04	8820	62000	4.35
15 North East Bank	5.60	28340	160000	11.22
16 Dogger North Ground	0.40	2000	800	0.06
17 Dogger Bank	3.89	33300	130000	9.12
18 Kvitbanken	0.97	23500	23000	1.61
19 Leman Bank	6.42	450	3000	0.21
20 Texel coast	2.53	650	1500	0.11
21 Dutch – Belgian coast	0.41	4250	2000	0.14
22 German Bight	0.61	12550	8000	0.56
23 Weisse Bank	18.02	150	2800	0.20
24 Horns Rev – Weisse Bank, medium	2.18	12950	28200	1.98
25 Northern Horns Rev	8.26	1380	11400	0.80
26 Great Fisher Bank – Klondyke	0.60	56550	34000	2.38
27 Little Fisher Bank	7.31	1950	14000	0.98
28 Western Skagerrak, high	11.50	1760	20000	1.40
29 Skagerrak. medium	2.46	6950	17000	1.19
30 Eastern Skagerrak, low	0.56	1175	700	0.05
31 Eastern Skagerrak, high	9.73	1050	10000	0.70
32 Northern Kattegat	0.70	1720	1200	0.08
33 Kummel Banke	8.94	500	9500	0.67
34 Southern Kattegat	4.71	4200	20000	1.40
Residual			9000	0.63
Total			**1426100**	**100.00**



Distribution and density of Guillemot Uria aalge *in the North Sea. the Channel and the Kattegat from November to February 1980-1994.*

The average numbers of Guillemot *Uria aalge* in key areas from November to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

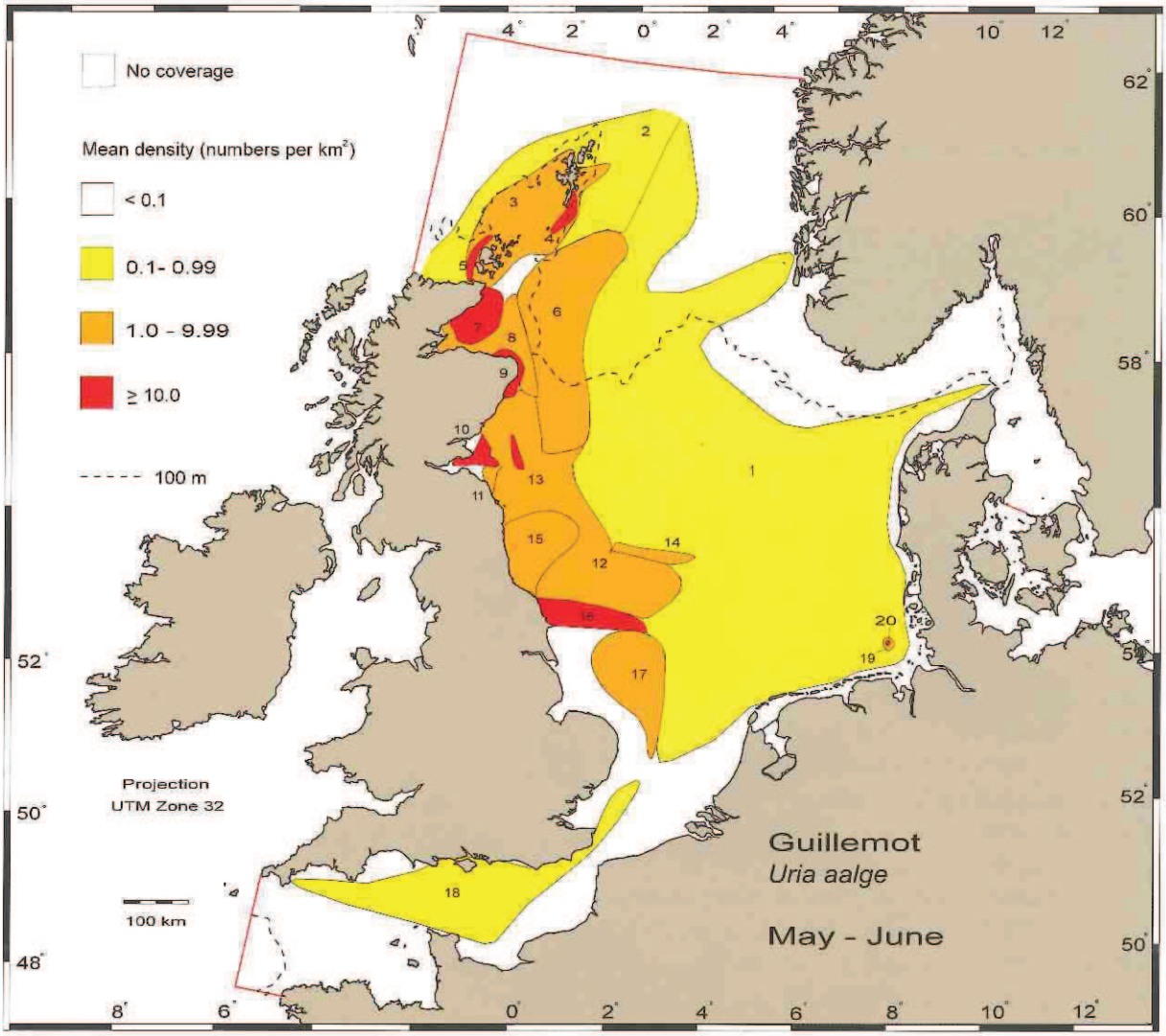
Locality	Density	Km²	Estimate	%
1 Cape Wrath – Viking Bank	0.48	34155	16000	1.02
2 Orkney-Shetland, east	1.19	81350	97000	6.21
3 Fair Isle Bank	2.79	6665	19000	1.22
4 Northern England – Scotland	7.52	37435	282000	18.05
5 Moray Firth	12.80	6000	77000	4.93
6 Firth of Forth – Scalp Bank	**15.40**	**3465**	**54000**	**3.46**
7 East Bank – Farn Deeps	10.88	17000	185000	11.84
8 Off Norfolk	2.27	1970	4500	0.29
9 West Deep Water	0.51	21200	11000	0.70
10 Baie de la Seine	9.44	450	4000	0.26
11 Channel	0.27	40660	11000	0.70
12 Dover Strait	0.94	8075	7600	0.49
13 Dogger Bank – southeastern North Sea	2.42	59400	144000	9.22
14 Central North Sea	2.00	86000	172000	11.01
15 Horns Rev, periphery	1.82	4745	8600	0.55
16 Horns Rev, central	2.60	3755	9800	0.63
17 Fladen Ground – Monkey Bank	1.53	65500	100200	6.41
18 Fladen Ground	7.74	15000	116000	7.42
19 Outer Boknafjord	0.74	2700	2000	0.13
20 Outer Oslo Fjord	3.71	500	2000	0.13
21 Norwegian Trench, north	1.15	11200	13000	0.83
22 West Bank	**35.60**	**165**	**41000**	**2.62**
23 Skagerrak, medium	3.14	20870	66000	4.22
24 Western Skagerrak, high	6.90	5700	39000	2.50
25 Eastern Skagerrak	1.96	2265	4000	0.26
26 Kummel Banke	8.41	600	5000	0.32
27 Kattegat, medium	2.36	11345	27000	1.73
28 Middelgrundene	9.38	1610	15000	0.96
29 Middelgrundene, core	15.91	1000	16000	1.02
30 Ålborg Bugt	2.49	675	1700	0.11
Residual			12000	0.77
Total			**1562400**	**100.00**



Distribution and density of Guillemot Uria aalge *in the North Sea, the Channel and the Kattegat from March to April 1980-1994.*

The average numbers of Guillemot *Uria aalge* in key areas from March to April 1980-1994. Areas marked with bold are of international importance (MCC criteria).

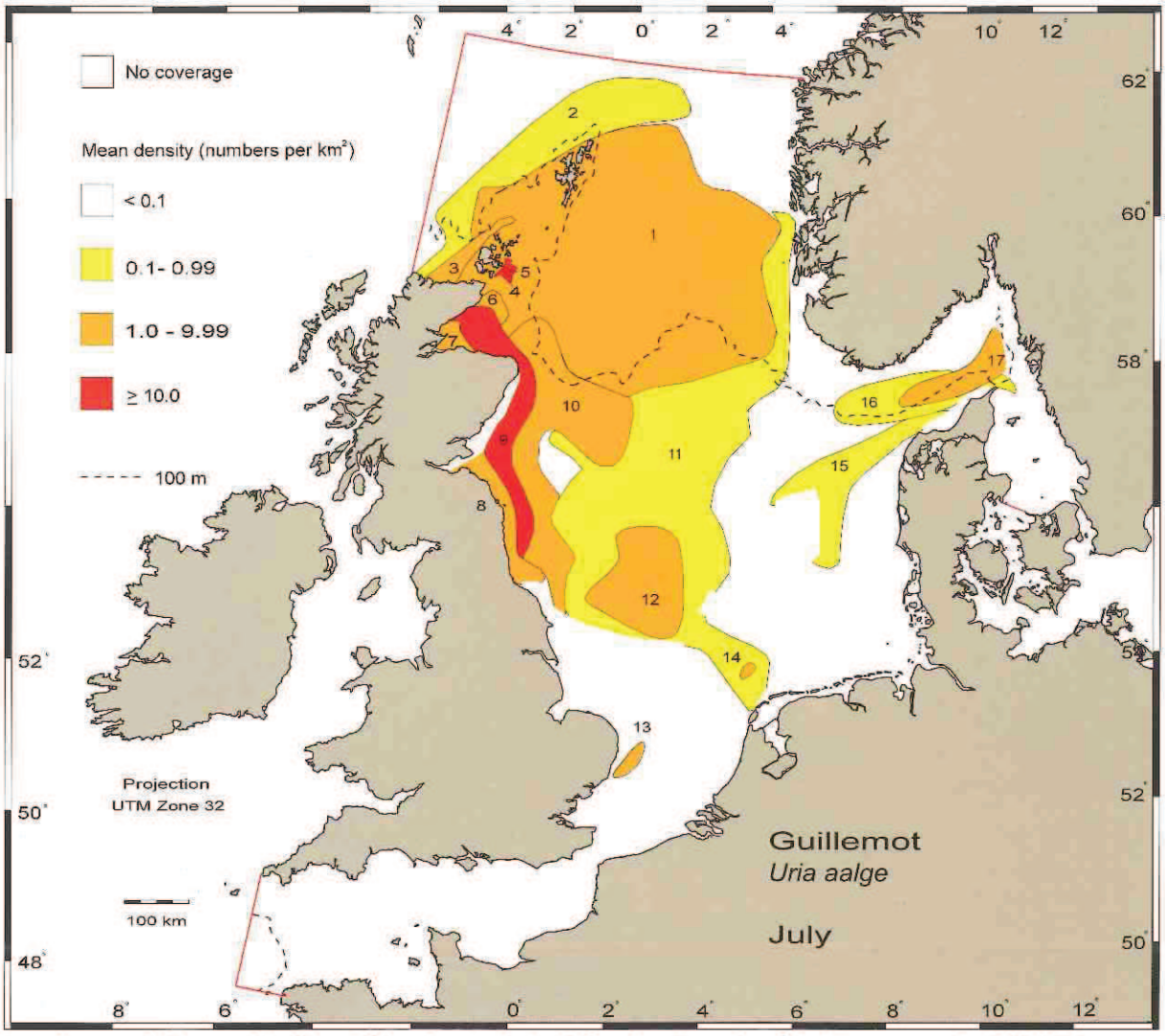
Locality	Density	Km²	Estimate	%	Locality	Density	Km²	Estimate	%
1 Southeast Shetland	21.20	1320	28000	3.49	16 Firth of Forth	4.39	3160	14000	1.74
2 Foula	13.70	2640	36200	4.51	17 Flamborough Head	18.20	1320	24000	2.99
3 Fair Isle	13.25	2640	35000	4.36	18 Outer Silver Pit	15.00	1300	20000	2.49
4 Cape Wrath	20.54	1800	37000	4.61	19 Southern North Sea,				
5 Orkney – Shetland South	8.98	14280	128000	15.95	medium	2.75	50600	140000	17.44
6 Westray	**18.60**	**2640**	**49000**	**6.10**	20 Southern North Sea, low	0.39	113400	44000	5.48
7 West Orkney	8.60	1320	11400	1.42	21 Falmouth Bay	0.83	475	400	0.05
8 Southwest Orkney	13.50	2370	32000	3.99	22 Ringkøbing Grund	0.90	2550	2300	0.29
9 Fladen Ground	0.51	83850	43000	5.36	23 Jutland Bank				
10 Bressay bank	2.12	3500	7400	0.92	– Little Fisher	1.43	7435	11000	1.37
11 Outer Moray Firth	5.91	4371	26000	3.24	24 Tannis Bugt	4.78	180	1000	0.12
12 Northern Moray Firth	**37.12**	**1360**	**50000**	**6.23**	25 Skagerrak – Kattegat	1.23	5660	7000	0.87
13 Inner Moray Firth	12.57	725	9000	1.12	26 Læsø Trindel	7.15	190	1500	0.19
14 Southern Moray Firth	15.73	330	5000	0.62	Residual			1500	0.19
15 Fowlsheugh	21.10	1860	39000	4.86	**Total**			**802700**	**100.00**



Distribution and density of Guillemot Uria aalge *in the North Sea, the Channel and the Kattegat from May to June 1980-1994.*

The average numbers of Guillemot *Uria aalge* in key areas from May to June 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 North Sea, low	0.11	245000	27000	3.47
2 Orkney Shetland, low	0.50	32000	16000	2.06
3 Orkney Shetland, medium	4.71	21000	99000	12.74
4 Shetland south & southeast	16.73	1100	18000	2.32
5 West Orkney	**37.16**	**1100**	**41000**	**5.27**
6 Aberdeen Bank – Fladen Ground	1.97	30000	59000	7.59
7 Northern Moray Firth	**21.89**	**4600**	**101000**	**12.99**
8 Central & Outer Moray Firth	8.27	5400	45000	5.79
9 Banff – Aberdeen	15.84	1500	24000	3.09
10 Firth of Forth	10.09	1700	17000	2.19
11 St. Abb's Head	7.61	600	4600	0.59
12 Aberdeen – Dogger Bank	3.00	38000	114000	14.67
13 Scalp Bank – Wee Bankie	58.99	500	30000	3.86
14 Northern Dogger Bank	9.88	1275	13000	1.67
15 Tees – Barmade Bank	2.35	9200	22000	2.83
16 Flamborough Head – Silver Pit	**21.98**	**4900**	**108000**	**13.89**
17 Leman Bank	2.12	13000	28000	3.60
18 Channel	0.19	34350	6500	0.84
19 Helgoland, medium	2.51	270	700	0.09
20 Helgoland, high	29.35	50	1500	0.19
Residual			2000	0.26
Total			**777300**	**100.00**



Distribution and density of Guillemot Uria aalge *in the North Sea, the Channel and the Kattegat in July 1980-1994.*

The average numbers of Guillemot *Uria aalge* in key areas in July 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Northern North Sea, medium	2.41	150000	360000	20.60
2 Northwestern Continental Shelf Edge	0.58	30000	17000	0.97
3 Orkney west, high	7.93	3100	25000	1.43
4 Orkney east, high	17.88	500	9000	0.52
5 Orkney east, very high	33.39	150	5000	0.29
6 Caithness	9.31	900	8400	0.48
7 Inner Moray Firth	7.06	1350	9500	0.54
8 Firth of Forth & North Yorkshire	4.67	4000	18700	1.07
9 Moray Firth – Tees	**19.41**	**16000**	**311000**	**17.80**
10 Aberdeen Bank – Flamborough Head	5.96	32550	194000	11.10
11 Central North Sea	0.78	87000	680000	38.92
12 Dogger Bank – Outer Silver Pit	2.47	17500	43000	2.46
13 Outer Cabban	1.01	1000	1000	0.06
14 Frisian Front	2.90	550	1600	0.09
15 Jutland Bank – Little Fisher	0.74	15650	12000	0.69
16 Skagerrak, periphery	0.98	10000	10000	0.57
17 Central Skagerrak	5.10	8100	40000	2.29
Residual			2000	0.11
Total			**1747200**	**100.00**

Razorbill *Alca torda*

Razorbills breed on cliffs in temperate, boreal and arctic regions on both sides of the Atlantic. About 75% of the world population breeds in Northwest Europe. More than two-thirds of the Northeast Atlantic population breeds in just two large colonies in Iceland. Nearly all Razorbills breeding within the study region breed in Scotland. After breeding, the birds moult and become temporarily flightless. Following moult, many birds move eastward to wintering areas in the Skagerrak and Kattegat. Their principal food is small shoaling fish such as sprat, sandeel and gobies (Blake 1983, 1984).

Importance of the North Sea

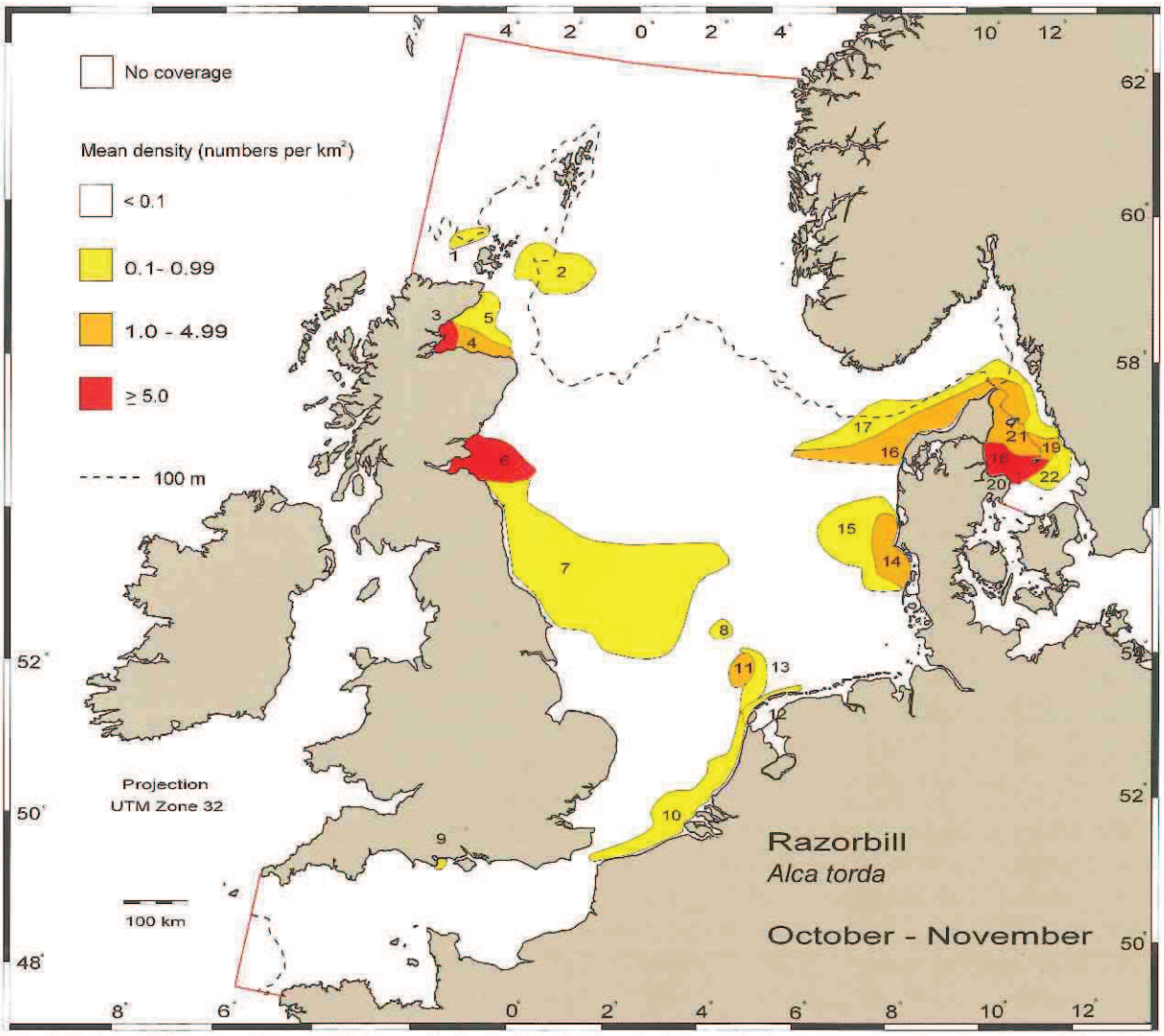
The Northeast Atlantic population is currently estimated at 475,000 breeding pairs (Lloyd *et al.* 1991). This figure includes an estimate for Iceland of 300,000 to 400,000 pairs (Tucker & Heath 1994). About 90,000 pairs breed In Britain and Ireland, 70% of which are found in Scotland. Only small numbers breed in Southwest Norway (but about 20,000-40,000 pairs further north). The Baltic has a largely sedentary population of 15,000 pairs (3% of Northeast Atlantic population). A total of 183,000 birds are considered to be associated with the North Sea colonies in summer (Tasker *et al.* 1987). In the present study 200,000 are estimated in the North Sea, Skagerrak, Kattegat and Channel in summer (20% of the Northeast Atlantic population), 300,000 in autumn (30%) and in winter as many as 440,000 (44%). Given that some Razorbills migrate south in winter, these estimates indicate that Razorbills from Iceland enter the study region in winter.

Main areas

The proportion of the estimated number at sea found in areas of international importance rises from less than 1% during breeding and 29% during moult (late summer) to 45% in autumn and 83% in winter. In spring and early summer (March-June) Razorbills are dispersed at a large number of relatively small to medium sized colonies within the study region. In late summer (July-September) the birds move offshore to moult and raise their chicks, principally off the Scottish north and east coasts. The Moray Firth, Aberdeen Bank and Flamborough Head areas are of international importance, supporting in total 75% of the estimated total number for the study region which is about 50% of the global population. In autumn (October-November), Firth of Forth remains internationally important. The biggest build-up of numbers, however, takes place in the Skagerrak and Kattegat as vast numbers cross the northern North Sea in autumn. The most important areas, internationally, are Fornæs and the Ålborg Bay. In winter (December to February) the birds concentrate in the Middelgrunde and central Kattegat and in the Skagerrak, all of which are internationally important and more birds move to the southern North Sea. The Middelgrunde and central Kattegat support nearly 78% of the total number estimated for the region and is thus of global importance.

Distribution patterns

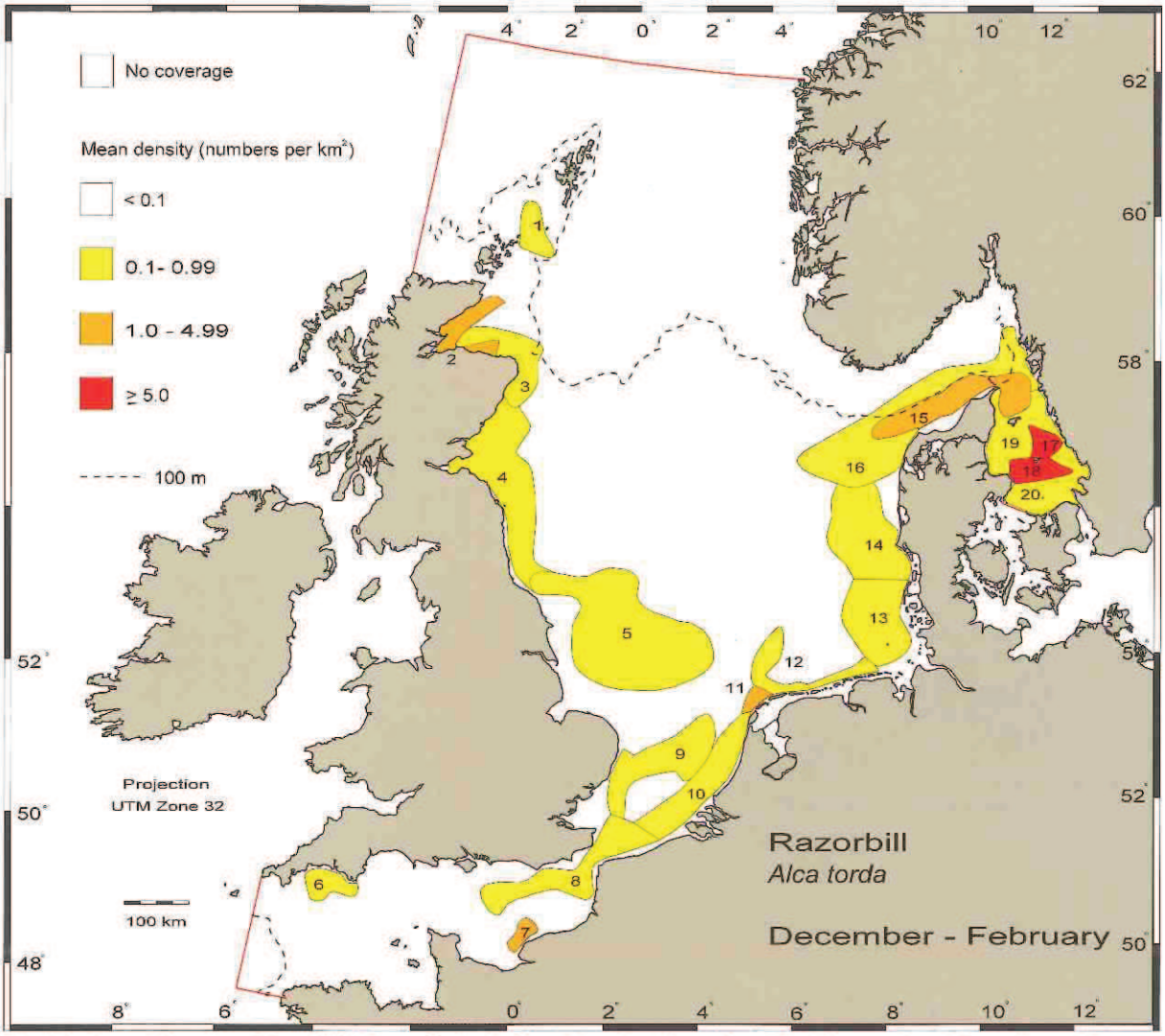
Razorbills are rarely present in the deeper parts of the study region and concentrate in waters shallower than 100 m. The sea off Northeast Britain is the main area for this species in the breeding and moulting period. The chicks fledge in June/July and in this periods the adults start moulting, which renders them flightless. After moulting, many Razorbills cross the North Sea to reach wintering areas in the Skagerrak/Kattegat from early November. At the same time, many birds, mainly immatures from more southerly and westerly colonies, fly into the southern wintering grounds, from the southern North Sea down to the western Mediterranean (Carboneras 1988, Camphuysen & Leopold 1994, Stone *et al.* 1995). Razorbills return to their colonies in the Northern North Sea in February/March (Tasker *et al.* 1987).



Distribution and density of Razorbill Alca torda *in the North Sea, the Channel and the Kattegat from October to November 1980-1994.*

The average numbers of Razorbill *Alca torda* in key areas from October to November 1980-1994. Areas marked with bold are of international importance (MCC criteria).

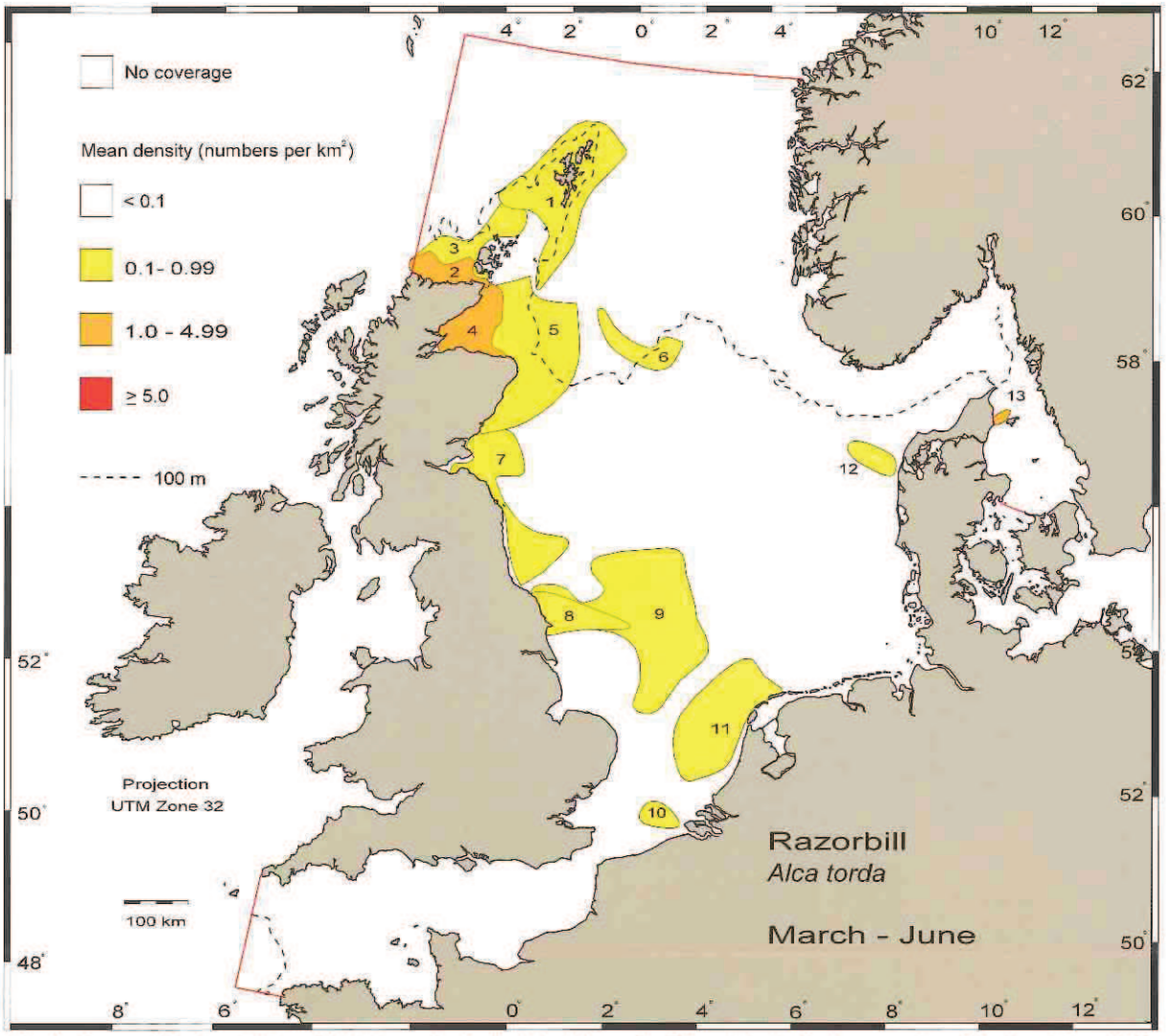
Locality	Density	Km²	Estimate	%
1 West Orkney	0.18	1200	200	0.09
2 East Orkney	0.32	7000	2200	1.01
3 Inner Moray Firth	5.81	1000	5800	2.65
4 Southern Moray Firth	1.23	2200	2700	1.24
5 North Moray Firth	0.29	3340	1000	0.46
6 Firth of Forth	**5.00**	**5700**	**29000**	**13.27**
7 Dogger Bank	0.58	48000	28000	12.81
8 Kvit Bank	0.97	800	800	0.37
9 Poole Bay	0.10	215	20	0.01
10 Belgian-Dutch coast	0.21	9400	2000	0.91
11 Texel Hole	2.94	1600	4700	2.15
12 West Frisian Islands	0.70	900	600	0.27
13 Dutch Frisian offshore	0.26	2200	600	0.27
14 Blåvandshuk	1.68	4430	7400	3.38
15 Horns Rev Outer Grounds	0.10	9570	1000	0.46
16 Southern Skagerrak	1.92	11800	23000	10.52
17 Central Skagerrak	0.41	11200	4600	2.10
18 Ålborg Bay	**6.32**	**3100**	**20000**	**9.15**
19 Middelgrundene	3.24	1100	3600	1.65
20 Fornæs	**98.19**	**520**	**51000**	**23.33**
21 Northern Kattegat	1.10	3800	4200	1.92
22 Southern Kattegat	0.49	2450	1200	0.55
Residual			25000	11.44
Total			**218620**	**100.00**



Distribution and density of Razorbill Alca torda *in the North Sea, the Channel and the Kattegat from December to February 1980-1994.*

The average numbers of Razorbill *Alca torda* in key areas from December to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

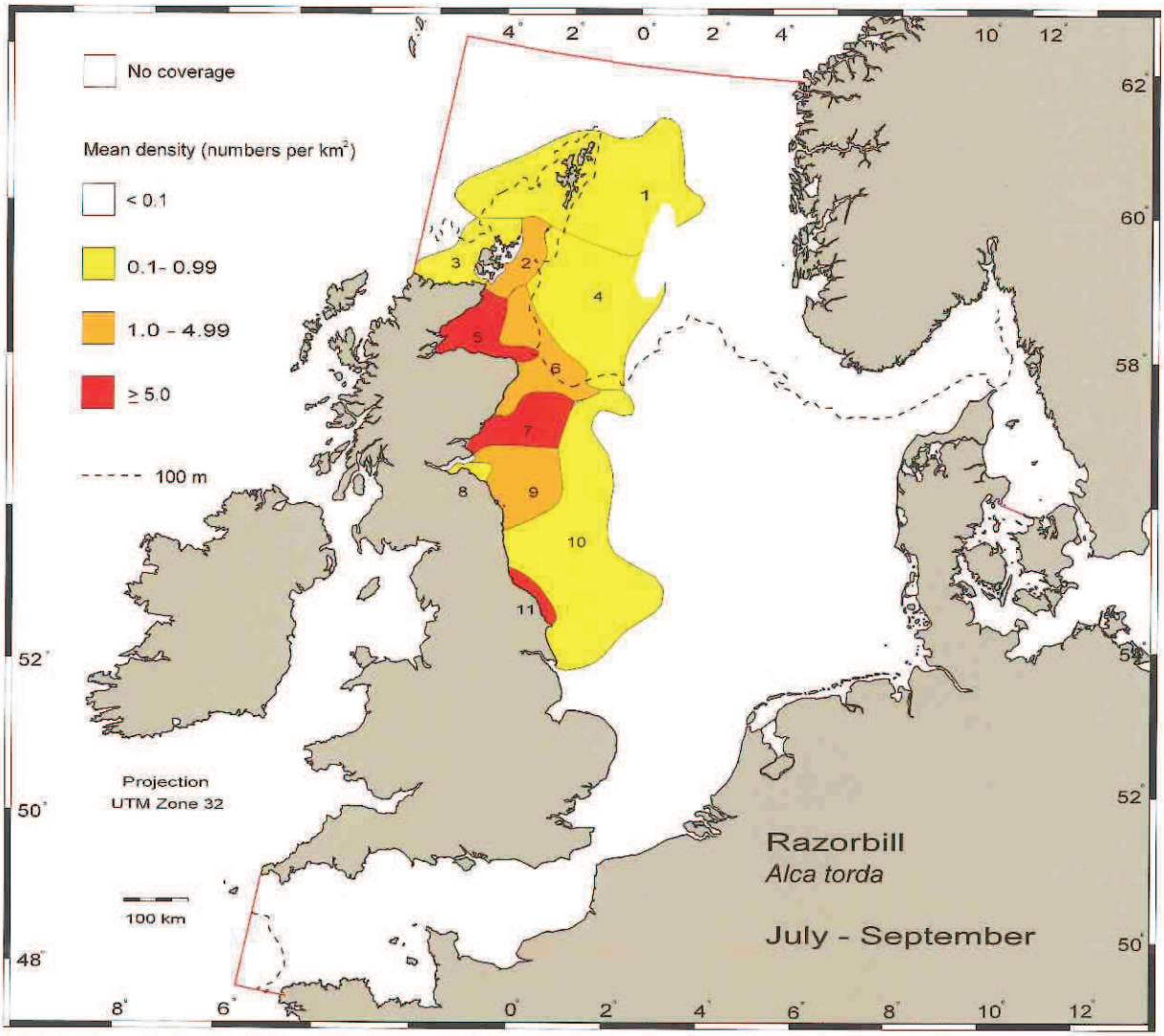
Locality	Density	Km²	Estimate	%
1 Fair Isle Channel	0.42	3000	1300	0.40
2 Moray Firth	1.37	3500	4800	1.48
3 Buchan Deep	0.38	6300	2400	0.74
4 Scalp Bank – Tees Bay	0.36	14500	5200	1.60
5 Southwest Dogger Bank	0.22	31000	6800	2.10
6 Plymouth	0,11	2700	300	0,10
7 Baie de la Seine	1.62	1500	2400	0.74
8 Dover Strait	0.43	7400	3200	0.99
9 Suffolk – Broad Fourteens	0.28	10400	2900	0.90
10 Dutch coast	0.25	9600	2400	0.74
11 Terschelling Bank	1.41	1000	1400	0.43
12 Frisian Islands	0.30	5200	1600	0.49
13 German Bight	0.19	10900	2100	0.65
14 Horns Rev	0.20	13400	2700	0.83
15 Southern Skagerrak	**4.50**	**9800**	**44000**	**13.58**
16 Jutland Bank – Skagerrak	0.37	6800	2500	0.77
17 Middelgrunde	**103.60**	**1800**	**186000**	**57.41**
18 Central Kattegat	**13.32**	**2800**	**37000**	**11.42**
19 Northern Kattegat	0.42	7200	3000	0.93
20 Southern Kattegat	0.37	6100	2300	0.71
Residual			10000	3.09
Total			**324000**	**100.00**



Distribution and density of Razorbill Alca torda *in the North Sea, the Channel and the Kattegat from March to June 1980-1994.*

The average numbers of Razorbill *Alca torda* in key areas from March to June 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Shetland	0.30	20700	6200	8.28
2 Cape Wrath – Pentland Firth	2.86	4000	11500	15.35
3 Orkney west	0.55	6000	3300	4.41
4 Western Moray Firth	2.24	6200	14000	18.69
5 Moray Firth – Scalp Bank	0.49	21200	10000	13.35
6 Fladen Ground – Lingbank	0.21	4600	1000	1.34
7 Firth of Forth – Tees Bank	0.55	12500	6900	9.21
8 Filey – Outer Silver Pit	1.16	5200	6000	8.01
9 Southwestern Dogger Bank	0.32	28600	9200	12.28
10 Broad Fourteens	0.21	15200	3200	4.27
11 Voordelta	0.21	1900	400	0.53
12 Jutland Bank	0.13	2500	300	0.40
13 Læsø Rende	2.26	400	900	1.20
Residual			2000	2.67
Total			**74900**	**100.00**



Distribution and density of Razorbill Alca torda *in the North Sea, the Channel and the Kattegat from July to September 1980-1994.*

The average numbers of Razorbill *Alca torda* in key areas from July to September 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Shetland	0.12	18500	2220	1.03
2 East Orkney	2.84	5000	14200	6.57
3 West Orkney	0.30	11800	3500	1.64
4 Little Halibut Bank	0.18	32000	5800	2.72
5 Moray Firth	**6.12**	**8200**	**50000**	**23.45**
6 South Bank Bosies	2.07	13000	27000	12.66
7 Scalp Bank – Aberdeen Bank	**7.10**	**8900**	**63000**	**29.55**
8 Firth of Forth	0.51	1400	700	0.33
9 Wee Bankie – Farn Deeps	1.21	14200	17000	7.97
10 West Dogger Bank	0.29	48000	14000	6.57
11 Tees Bay – Flamborough Head	**6.35**	**1900**	**12000**	**5.63**
Residual			4000	1.88
Total			**213200**	**100.00**

Black Guillemot *Cepphus grylle*

Black Guillemots breed along rocky shores at both sides of the Atlantic, and in the Arctic Ocean. The species breeds dispersed in small colonies. In Europe, all countries north of the line United Kingdom – Denmark – Estonia generally have population sizes of pairs 10,000 or more pairs, Ireland, Wales, England and Denmark forming the southern limit of the species' breeding range (Lloyd *et al.* 1991, Petersen 1994). The species is sedentary to a large extent. Black Guillemots forage by diving to the seafloor, taking benthic fish and invertebrates.

Importance of the North Sea

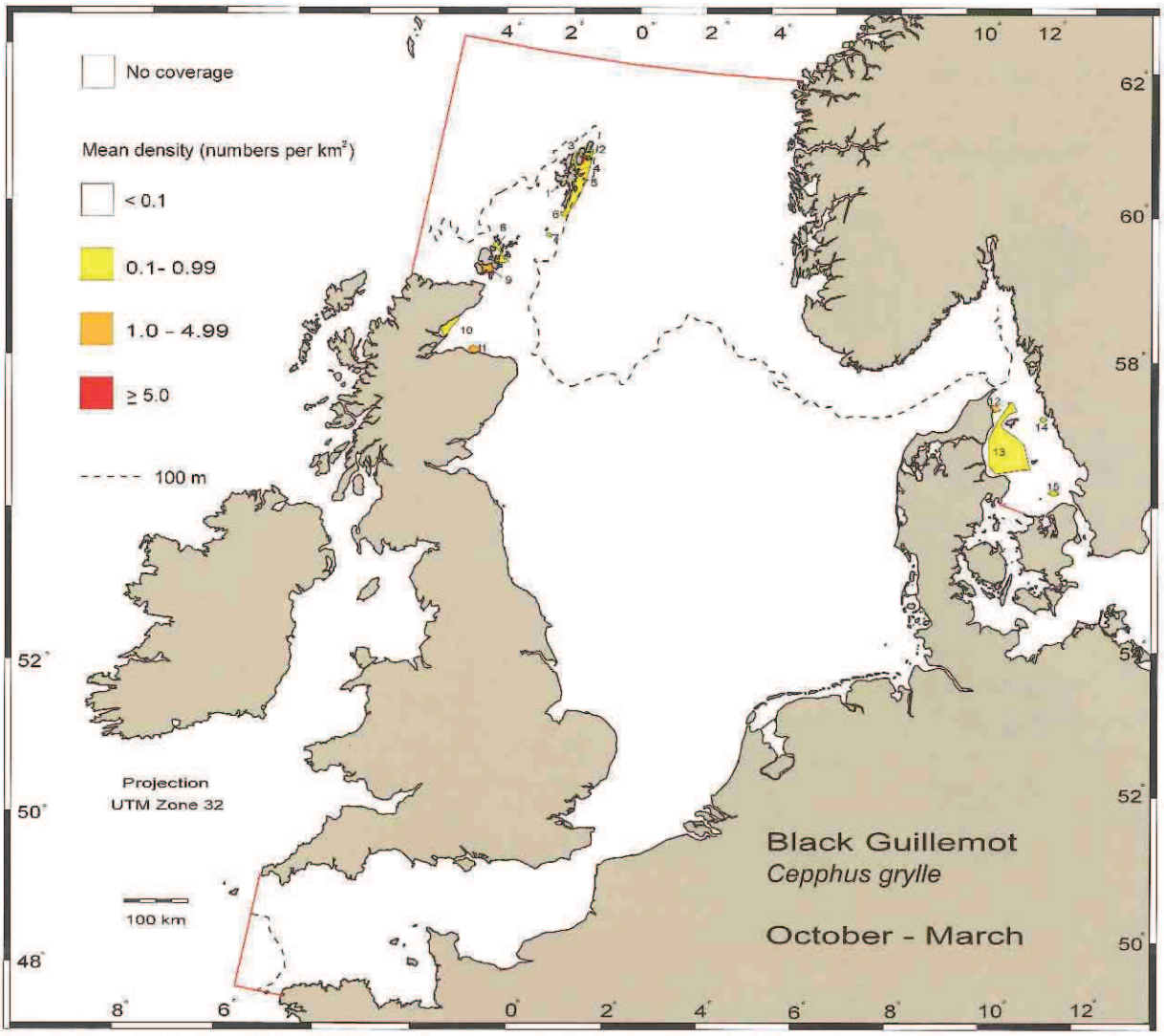
The world total of Black Guillemots is estimated to be 300,000 – 350,000 pairs, of which 20,500 pairs breed in the Britain and Ireland, 16,000 in the Baltic proper and 94,000 in northern Europe, excluding Greenland (Mehlum & Bakken 1994, Petersen 1994). Three areas are important in the North Sea: Orkney-Shetland and Moray Firth with over 20,000 birds, west and southwest Norway with 1450 birds and the Kattegat with 2600 birds (Tasker *et al.* 1987, Durinck *et al.* 1994b). Long-distance movements are rare in the Scottish and Kattegat populations (Ewins 1988, Jönsson 1989) and there is little evidence that birds from elsewhere winter in these areas. Some northern Norwegian birds show southward migration after breeding and these birds may winter in the northeast of the study region (Myrberget 1973).

Main areas

As Black Guillemots live close to the shore at all times of the year in most areas, probably only a fraction of the total numbers in the study region was detected during at sea surveys. The concentrations of Black Guillemots which were found near the breeding areas do therefore not provide a complete picture of their main feeding areas. Several areas around Shetland and Orkney were found to hold important numbers, both in summer and winter. The largest offshore concentration was found in the central Kattegat, where Danish and Swedish birds winter.

Distribution patterns

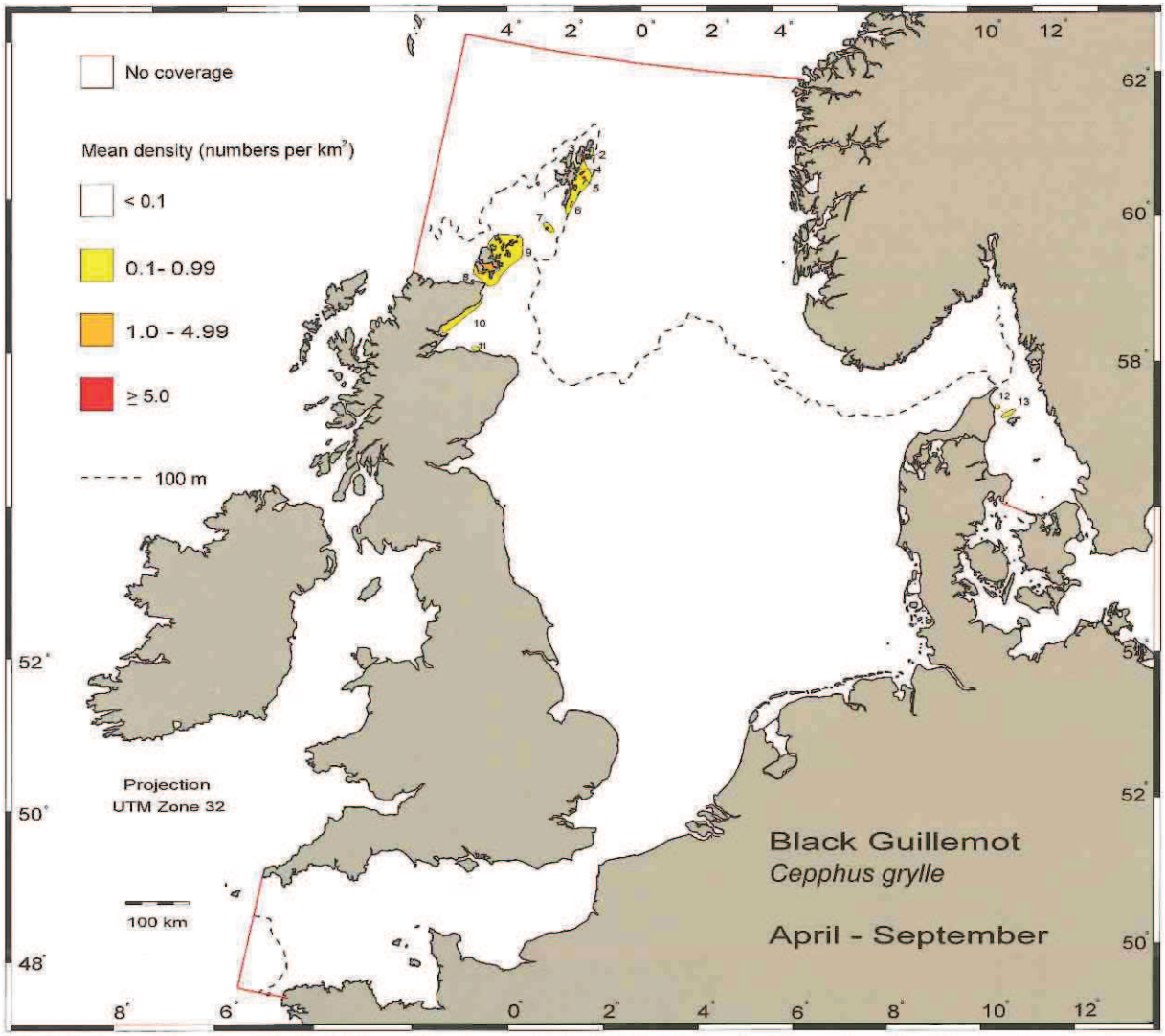
Black Guillemots move about only little and are usually found within tens of kilometers of their breeding sites. Inshore waters in the breeding areas are always the most important habitats for the species, the only exception being the winter concentration in the central Kattegat.



Distribution and density of Black Guillemot Cepphus grylle *in the North Sea, the Channel and the Kattegat from October to March 1980-1994.*

The average numbers of Black Guillemot *Cepphus grylle* in key areas from October to March 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Vaila	**52.00**	**10**	**520**	**7.89**
2 Lamgarth Head	**28.00**	**20**	**560**	**8.50**
3 Colgrave Sound	**9.33**	**15**	**440**	**6.67**
4 Hamna Voe	**64.00**	**10**	**640**	**9.70**
5 Whalsay	**48.00**	**20**	**960**	**14.56**
6 Shetland, low	**0.35**	**1600**	**560**	**8.50**
7 Fair Isle	0.40	50	20	0.25
8 Stronsay & Westray Firths	0.70	300	210	3.15
9 Scapa Flow	**1.90**	**210**	**400**	**6.07**
10 Northern Moray Firth	0.53	375	200	3.03
11 Buckie – Cullen, offshore	2.60	140	365	5.53
12 Hirsholmene	2.34	50	115	1.74
13 Northwestern Kattegat	**0.41**	**3790**	**1555**	**23.58**
14 Nidingen	0.47	50	25	0.38
15 Lysegrunde	0.63	50	30	0.45
Residual			0	0.00
Total			**6595**	**100.00**



Distribution and density of Black Guillemot Cepphus grylle *in the North Sea, the Channel and the Kattegat from April to September 1980-1994.*

The average numbers of Black Guillemot *Cepphus grylle* in key areas from April to September 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Vaila	**52.00**	**10**	**520**	**9.91**
2 Lamgarth Head	**30.00**	**20**	**600**	**11.44**
3 Colgrave Sound	**29.33**	**15**	**440**	**8.39**
4 Hamna Voe	**64.00**	**10**	**640**	**12.20**
5 Whalsay	**48.00**	**20**	**960**	**18.30**
6 East Shetland	0.09	2000	180	3.43
7 Fair Isle	0.18	200	35	0.67
8 Scapa Flow	**1.90**	**210**	**400**	**7.63**
9 East Orkney	**0.38**	**2200**	**840**	**16.20**
10 Northern Moray Firth	**0.55**	**850**	**4701**	**9.00**
11 Buckie – Cullen	0.27	100	30	0.58
12 Hirsholmene	0.56	50	30	1.90
13 Nordre Rønner	0.79	120	100	0.58
Residual			0	0.00
Total			**2545**	**100.00**

Little Auk *Alle alle*

Little Auks are the most abundant breeding bird species in the high-arctic region from Baffin Island (Canada) to Severnaya Zemlya (Russia). The largest numbers breed in Greenland and Svalbard. The birds winter in a large area extending southward into the study region. Zooplankton forms the staple diet of Little Auks in summer. In winter, when plankton abundance is low, small fish such as gobies and sprat may supplement this diet (Blake 1983).

Importance of the North Sea

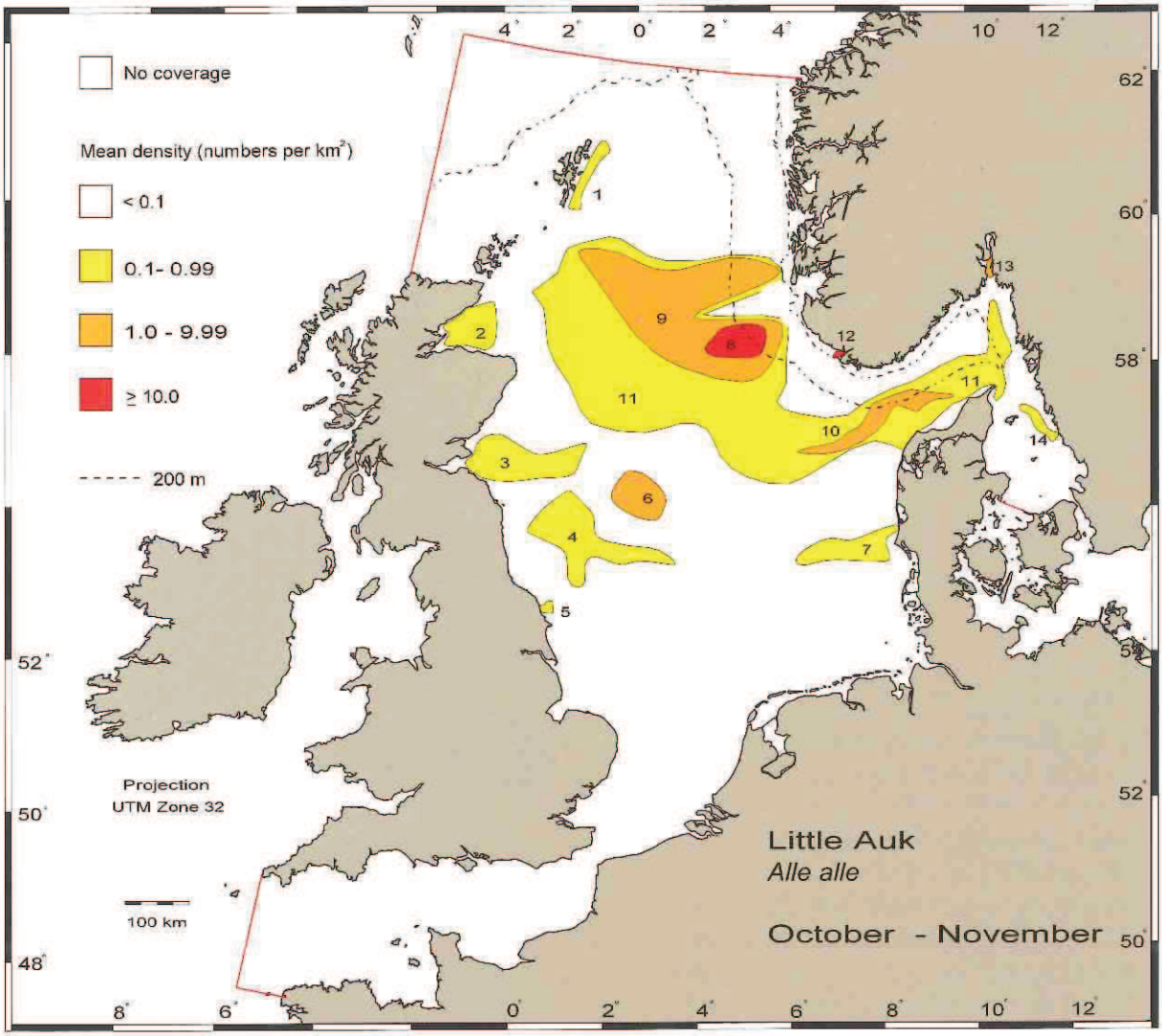
The world population is estimated at 12.75 million pairs of which some 10 million breed in Greenland. The Northeast Atlantic population (east of Greenland) is in the order of 2.75 million birds (Nettleship & Birkhead 1985). On average, 180,000 (autumn) and 850,000 (winter) are estimated in the (northern) North Sea, Skagerrak and Kattegat. Thus, the study region holds up to 31% of the Northeast Atlantic, and 7% of the world population.

Main areas

In October/November 130,000 birds are found dispersed in a large area in the central northern North Sea. In winter the area of main concentration is situated over the southwest rim of the Norwegian Trench and the central Skagerrak, representing an estimated 700,000 birds wintering in 3% of the study region. This area is clearly of international importance in winter: 83% of the total number of Little Auks present in the study region are found here, or 26% of the Northeast Atlantic population. A further 90,000 birds winter over the Northwest Dogger Bank (3% of Northeast Atlantic population).

Distribution patterns

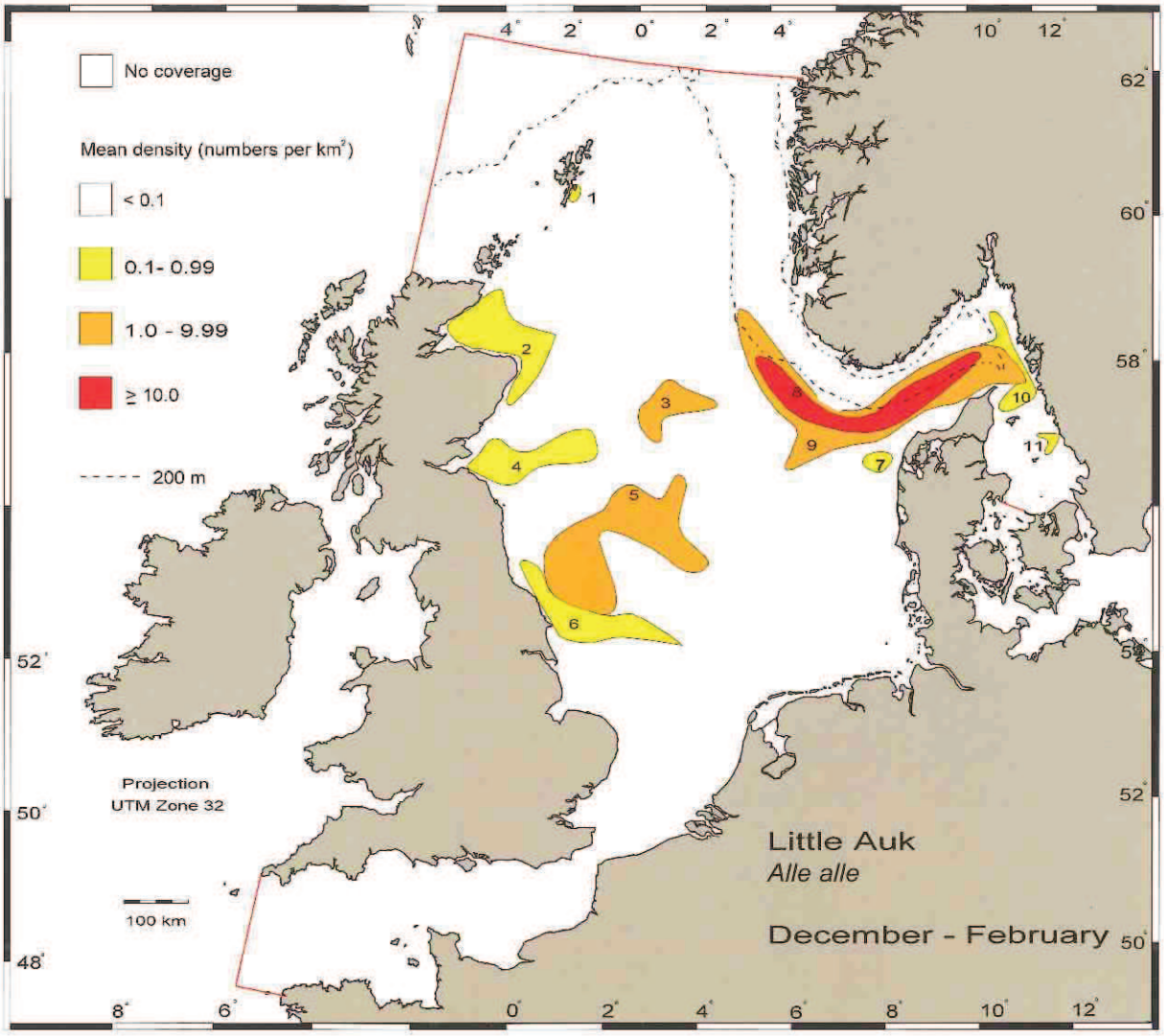
Little Auks abandon their breeding colonies in the Arctic in July and after moulting, move to their wintering areas in October and November. They return to their colonies in May (Nettleship & Birkhead 1985). Recoveries of ringed birds suggest that many of these birds spend the winter off Greenland, but in autumn and winter the birds also disperse southward, into the Norwegian Sea (Brown 1984, Bakken & Mehlum 1988). The distribution of Little Auks at sea within the study region is much more concentrated than that of many species. In both autumn and winter the majority was concentrated in relatively small areas: northwest of the Dogger Bank and notably along the western and southern edges of the Norwegian Trench. In autumn local concentrations have also been found in the Norwegian fjords where they may associate with gobies (Skov *et al.* 1989). Outside these main areas the species was widespread but at low densities throughout the northern half of the North Sea and the eastern Kattegat. North of the study region, concentrations have been found off western Norway, both in winter and in spring (Follestad 1990). There may be a connection with the concentrations found in the present study region and those to the north of it, but lack of coverage prevents the demonstration of that. The species is rare to the west of Scotland (Stone *et al.* 1995), and in the southern North Sea and the Channel it is only an irregular visitor.



Distribution and density of Little Auk Alle alle *in the North Sea, the Channel and the Kattegat from October to November 1980-1994.*

The average numbers of Little Auk *Alle alle* in key areas from October to November 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 East Shetland	0.15	1750	250	0.14
2 Moray Firth	0.12	4450	500	0.28
3 Firth of Forth – Devil's Hole	0.42	8800	400	0.22
4 Northwestern Dogger Bank	0.41	11300	4600	2.58
5 Filey	0.63	300	190	0.11
6 Middle Rough	2.09	4700	9800	5.50
7 Horns Rev Outer Grounds	0.15	5100	750	0.42
8 North East Rough	**17.15**	**4000**	**69000**	**38.69**
9 Klondyke – Bressay Bank	1.84	33000	61000	34.20
10 Little Fisher Bank – Skagerrak	1.02	5200	5300	2.97
11 Fladen Ground-Skagerrak	0.23	85800	20000	11.21
12 Flekkefjord	40.97	133	5500	3.08
13 Oslo Fjord	5.91	155	900	0.50
14 Middelgrundene	0.15	1000	150	0.08
Residual			0	0.00
Total			**178340**	**100.00**



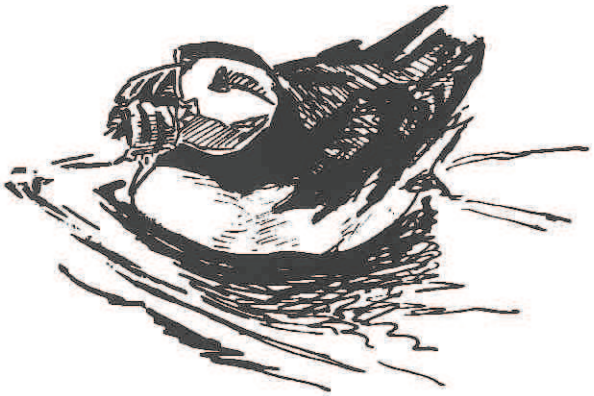
Distribution and density of Little Auk Alle alle *in the North Sea, the Channel and the Kattegat from December to February 1980-1994.*

The average numbers of Little Auk *Alle alle* in key areas from December to February 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 East Shetland	0.71	350	250	0.03
2 Moray Firth – Turbot Bank	0.14	11400	1600	0.19
3 Fladen Ground	1.65	5200	8600	1.01
4 Firth of Forth-Devil's Hole	0.26	8900	2300	0.27
5 Northwestern Dogger Bank	3.77	24000	90000	10.55
6 Barmade Bank-Silver Pit	0.12	9300	1100	0.13
7 Jutland Bank	0.68	1100	750	0.09
8 Northeast Rough – Skagerrak	**56.84**	**12400**	**705000**	**82.68**
9 Klondyke – Skagerrak	1.53	20900	32000	3.75
10 Eastern Skagerrak	0.22	3400	750	0.09
11 Middelgrundene	0.57	600	340	0.04
Residual			10000	1.17
Total			**852690**	**100.00**

Puffin *Fratercula arctica*

The Puffin is one of the most abundant species of seabird in the northern Atlantic. A world total of some 6.5 million pairs breeds from Brittany northward to Greenland, Svalbard and Novaya Zemlya; 95% of these breed in Europe. The North Sea lies on the edge of this distribution, and the breeding population in the study region belongs to *F.a. grabae*. The largest numbers, from hundreds of thousands to millions, are found in Iceland, Norway, northwest Scotland and the Faroe Islands. During the breeding season the birds rely on predictable food sources near their colonies, clupeids in the south, Capelin in the north and sandeels in most areas. Large scale changes in these food stocks have affected breeding numbers (Brown 1985, Vader *et al.* 1990a, Tucker and Heath 1994).



Importance of the North Sea

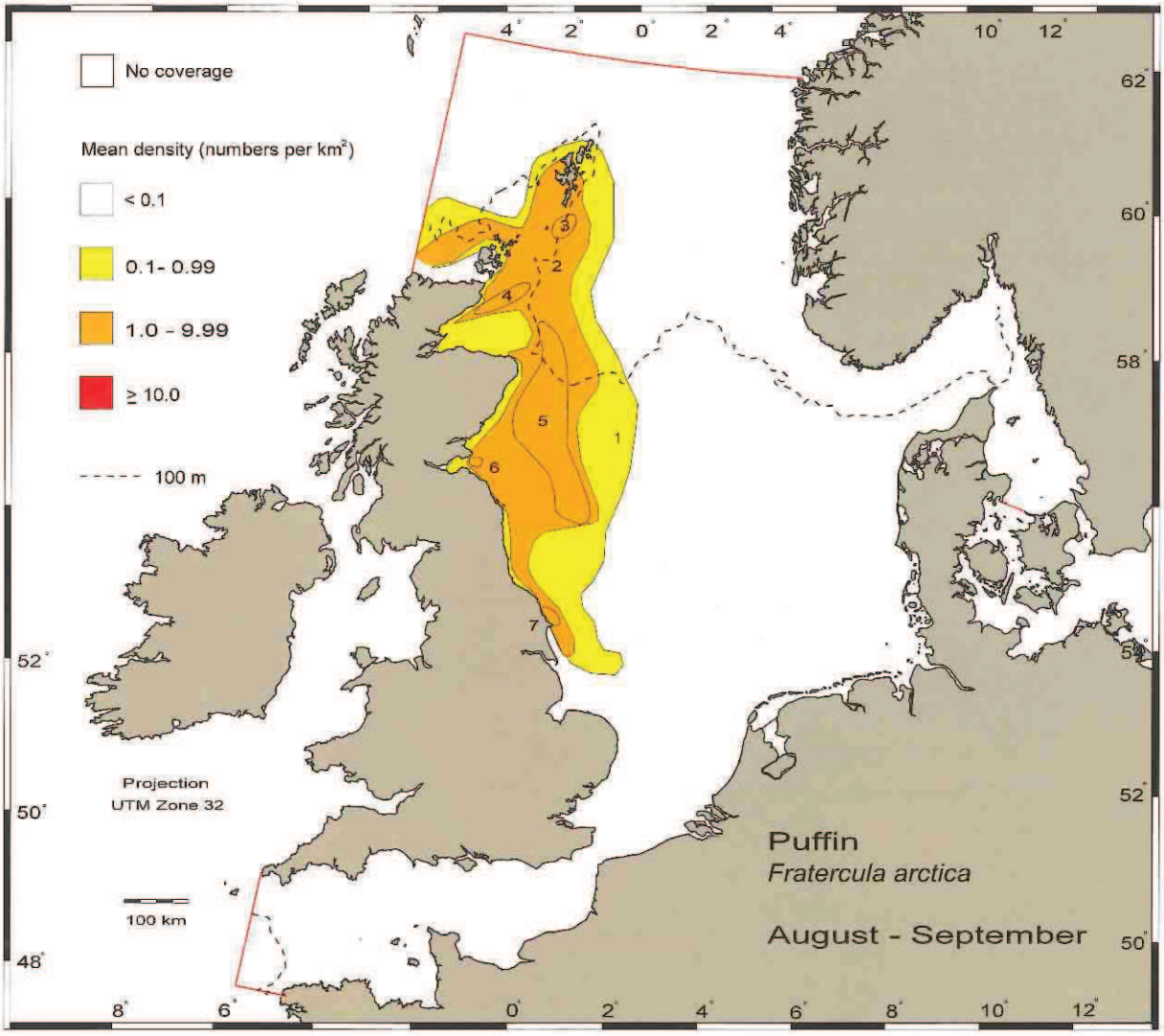
About 113,000 pairs breed in North Sea colonies (less than 2% of the Northeast Atlantic population). The majority of these (55%) breed in Shetland/Orkney, with further important colonies at the Isle of May, Farne and Coquet Islands (Lloyd *et al.* 1991). After breeding, the birds disperse to offshore waters. Ringing studies suggest that breeding birds from the region are joined offshore by birds from the Faroese and northern Norwegian colonies. The estimated total number offshore in the North Sea never exceeds 1.4 % of the Northeast Atlantic population. However, due to poor recovery rates of ringed birds, the frequency of immigrants in the study region cannot be safely assessed. Thus, it is currently not possibly to identify a proper reference population for the Puffins wintering in the North Sea .

Main areas

No areas in the North Sea are of international importance to Puffins. In the pre-breeding and breeding seasons (April-July) the birds are found mainly in the northwest and mid-west of the North Sea. Compared to the North Sea breeding population, important numbers occur in Shetland and Orkney waters, the Firth of Forth area, Farne Islands and off Flamborough Head. After breeding (August-September), birds from Shetland and Orkney move south and southern birds move north, resulting in a concentration of Puffins near the Aberdeen Bank. In winter (October-March) the birds still are found mainly at this latitude, but more dispersed and further offshore. The Northwestern Dogger Bank area is important and some birds move to the Skagerrak and waters off Shetland.

Distribution patterns

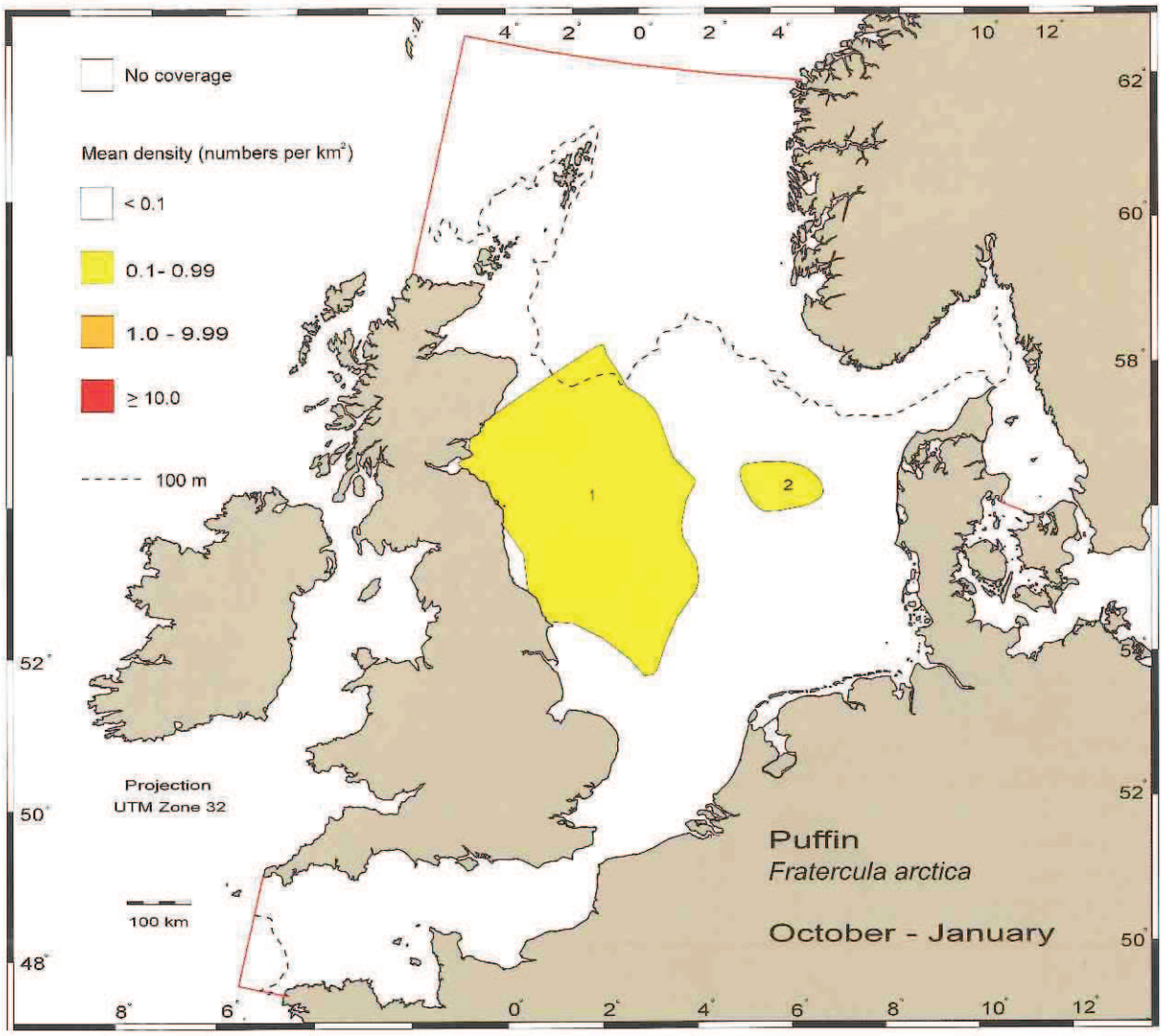
Puffins typically have a dispersed distribution and only when close to the colonies do they form dense rafts (Harris 1984). In all seasons most birds occur in the northwestern part of the North Sea. In winter, some birds are present in the eastern North Sea and the Skagerrak.



Distribution and density of Puffin Fratercula arctica *in the North Sea, the Channel and the Kattegat from August to September 1980-1994.*

The average numbers of Puffin *Fratercula arctica* in key areas from August to September 1980-1994. Areas marked with bold are of international importance (MCC criteria).

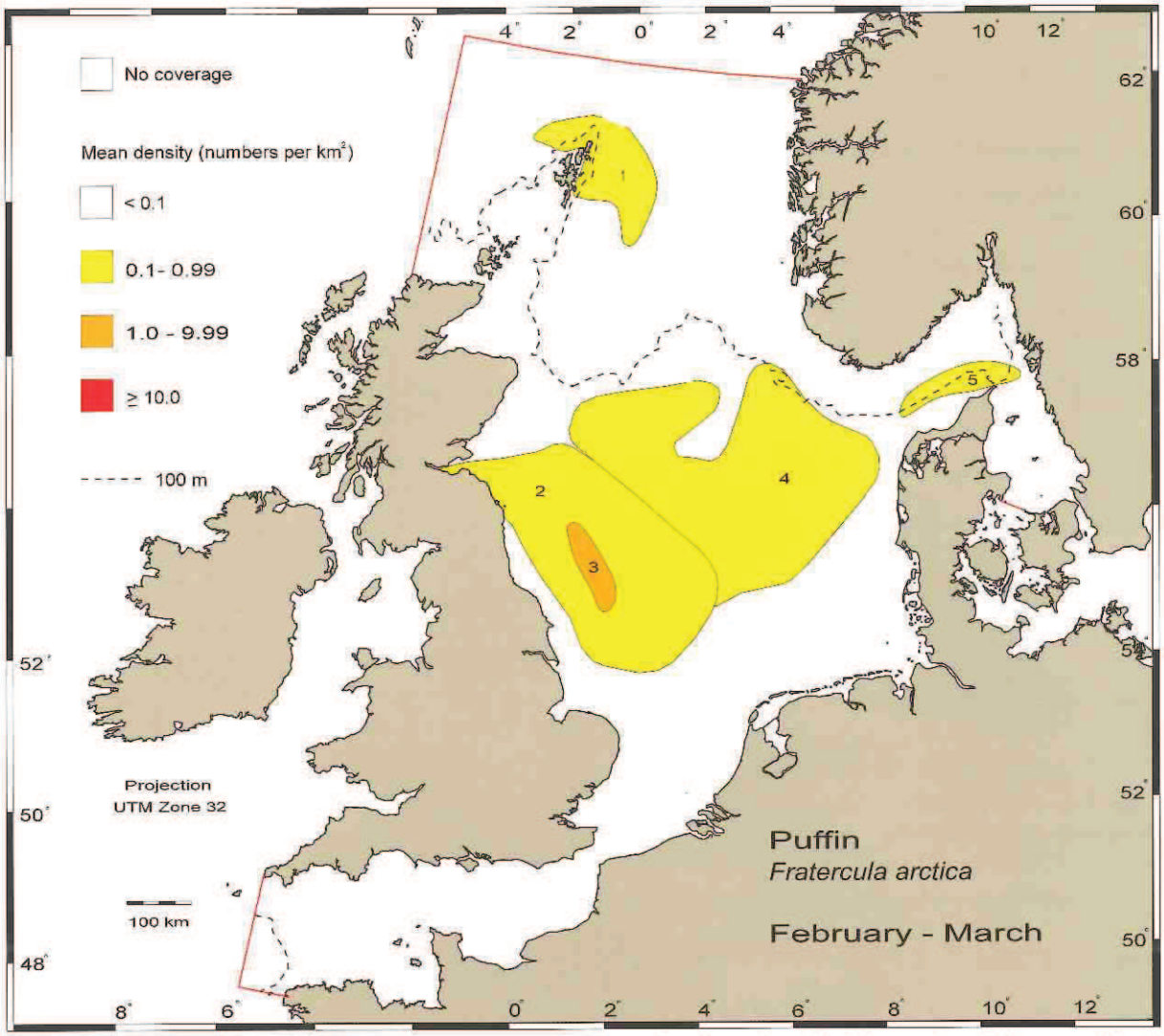
Locality	Density	Km²	Estimate	%
1 Northwestern North Sea, low	0.30	72550	22000	12.28
2 Northwestern North Sea, medium	1.02	70380	72000	40.20
3 Fair Isle	7.57	1300	10000	5.58
4 Moray Firth	1.89	2180	4000	2.23
5 Northeast Bank – Aberdeen Bank	2.90	20000	58000	32.38
6 Isle of May	7.54	320	2400	1.34
7 Flamborough Head	2.46	670	1700	0.95
Residual			9000	5.03
Total			**179100**	**100.00**



Distribution and density of Puffin Fratercula arctica *in the North Sea, the Channel and the Kattegat from October to January 1980-1994.*

The average numbers of Puffin *Fratercula arctica* in key areas from October to January 1980-1994. Areas marked with bold are of international importance (MCC criteria).

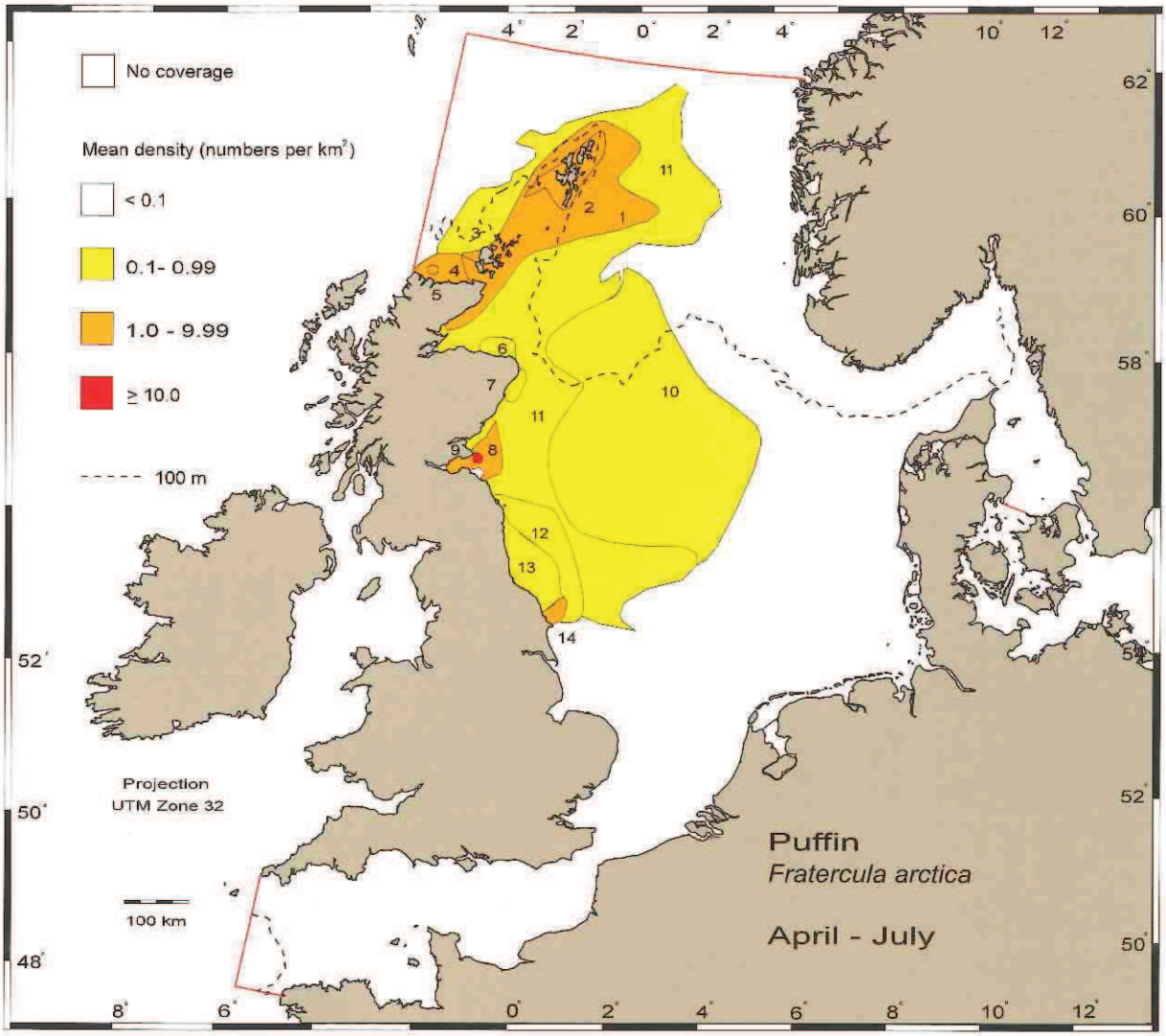
Locality	Density	Km²	Estimate	%
1 Western North Sea	0.18	116000	20900	80.38
2 Monkey Bank	0.11	11000	1200	4.62
Residual			3900	15.00
Total			**26000**	**100.00**



Distribution and density of Puffin Fratercula arctica *in the North Sea, the Channel and the Kattegat from February to March 1980-1994.*

The average numbers of Puffin *Fratercula arctica* in key areas from February to March 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Shetland	0.26	23300	6100	8.18
2 Bruceys Garden – Northeast Bank	4.44	5720	25000	33.51
3 Dogger Bank – East Bank	0.33	75735	25000	33.51
4 Central North Sea	0.10	100000	10000	13.40
5 Skagerrak	0.46	7650	3500	4.6
Residual			5000	6.70
Total			**74600**	**100.00**



Distribution and density of Puffin Fratercula arctica *in the North Sea, the Channel and the Kattegat from April to July 1980-1994.*

The average numbers of Puffin *Fratercula arctica* in key areas from April to July 1980-1994. Areas marked with bold are of international importance (MCC criteria).

Locality	Density	Km²	Estimate	%
1 Orkney – Shetland, medium	1.40	34190	48000	30.97
2 Shetland	4.43	6500	29000	18.71
3 East Orkney	8.48	250	2000	1.29
4 Cape Wrath – Pentland Firth	1.17	1945	2000	1.29
5 Cape Wrath	4.91	200	1000	0.65
6 Southern Moray Firth	0.53	1540	800	0.52
7 Aberdeen – Peterhead	0.62	1000	600	0.39
8 Firth of Forth	3.29	4660	15000	9.68
9 Isle of May	16.32	200	3300	2.13
10 The Gut – Fladen Ground	0.10	86950	8700	5.61
11 Northwestern North Sea, low	0.28	91800	26000	16.77
12 Barmade Bank – Northeast Bank	0.64	9000	5800	3.74
13 Yorkshire	0.48	5800	2800	1.81
14 Flamborough Head	6.39	1000	6400	4.13
Residual			3600	2.32
Total			**155000**	**100.00**

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Appendix

Methods

Survey methods used for determing densities and numbers of birds. X indicates origin of the most important data used in the analyses of distribution patterns and in determining densities, (X) indicates origin of supplementary data.

Species	Ship	Air	Land
Red-/Black-throated Diver *Gavia stellata/arctica*	X	(X)	(X)
Great Northern Diver *Gavia immer*	X		X
Great Crested Grebe *Podiceps cristatus*	X		X
Red-necked Grebe *Podiceps grisegena*	X		X
Cormorant *Phalacrocorax carbo*	X	X*	X
Shag *Phalacrocorax aristotelis*	X		X
Fulmar *Fulmarus glacialis*			X
Gannet *Morus bassanus*	X		
Scaup *Aythya marila*		X	X
Common Eider *Somateria mollissima*	(X)	X	(X)
Common Scoter *Melanitta nigra*	X	X	(X)
Velvet Scoter *Melanitta fusca*	X	(X)	(X)
Goldeneye *Bucephala clangula*		X	X
Red-breasted Merganser *Mergus serrator*	X	X	X
Goosander *Mergus merganser*		X	X
Great Skua *Catharacta skua*	X		
Little Gull *Larus minutus*	X		
Common Gull *Larus canus*	X		
Lesser Black-backed Gull *Larus fuscus*	X		
Herring Gull *Larus argentatus*	X		
Great Black-backed Gull *Larus marinus*	X		
Kittiwake *Rissa tridactyla*	X		
Sandwich Tern *Sterna sandvicensis*	X		X
Common Tern *Sterna hirundo*	X		X
Black Guillemot *Cepphus grylle*	X		
Guillemot *Uria aalge*	X		
Razorbill *Alca torda*	X		
Little Auk *Alle alle*	X		
Puffin *Fratercula arctica*	X		

**Only total counts in the Kattegat, Skagerrak and the Continental coast north of France where Shag is a rare vagrant.*

Databases on total counts

The databases used in the project are only those in which the area covered was known. Land-based counts organised by the Wildfowl and Wetlands Trust in the United Kingdom were carried out throughout the year in most years, while the land-based counts from the remaining areas were made in mid-January. Counts outside the United Kingdom were co-ordinated by the International Waterfowl and Wetland Research Bureau (IWRB). The total counts were made mainly from aircraft in France, Belgium, Netherlands, Denmark and Sweden. Counts in France, Belgium and Sweden were usually made only in the winter, while these in the Netherlands and Denmark were carried throughout the year.

Few data on divers, grebes and cormorants were available from the routine land-based counts carried out in France. Prior to 1990, Great Crested Grebes and Cormorants were not counted during the Wetland Bird Survey in the United Kingdom. In general, coastal data on gull and tern distribution were lacking from all the land-based counts carried out in the region until very recently. As a consequence, land-based gull and tern data were excluded from the analyses of gull and tern distribution.

A number of reports covering the results of local and regional surveys performed on a standardised basis in British inshore waters have been consulted: Aspinall & Tasker 1990 & 1992, Barrett & Barrett 1985, Bell 1981, 1982, 1984 & 1985, Benn 1985, Bird 1989, Booth *et al.* 1983, 1984, 1985, 1991 & 1994, Campbell 1986, Christer 1989, Ewins & Kirk 1988, Grimmet & Jones 1989, Lloyd *et al.* 1991, Harding-Hill 1993, Heubeck 1987, Hodge 1992, Hogg 1985, 1987, 1988 & 1989, Keenan &

MacGowan 1987, Knox 1981, Murray 1992, 1993 & 1994, Reynolds 1985, Ribbands 1990, Sharrock 1976, Suddaby 1992, Tasker 1987, 1988, 1989 & 1990, Webb 1991, 1992, 1993 & 1994, Webb & Tasker 1988 & Wood 1991.

Not all data from surveys of offshore areas off France were, unfortunately, not fully available for analysis. Both aerial and ship-based surveys have been carried out by French teams in the Channel. For comparison of distribution patterns, the following publications were consulted: Berthelot (1990a, 1990b), GONm (1989), Maout (1990), Sveir & Commecy (1990), Rocamora (1995), Siorat (1992) and Siorat & Rocamora (in press).

No data were available from the counts made along the coasts of Norway included in this analysis. For comparison with our estimates, we consulted the reviews by Nygård (1985) and Nygård *et al.* (1988).

The years and seasons from which counts of coastal birds were available. Note that not all areas were covered in each year/season.

Country	
France (winter)	land-based 1980-1994, aerial 1991-1995
United Kingdom (all seasons)	land-based 1980-1994
Norway	–
Belgium (winter)	land-based 1989-1994, aerial 1991-1994
Netherlands (all seasons)	land-based 1993-1994, ship-based 1989-1994, aerial 1991-1994(Voordelta)
Germany (winter)	aerial 1987-1993
Denmark (all seasons)	aerial 1987-1992
Sweden (winter)	land-based and aerial 1980-1994

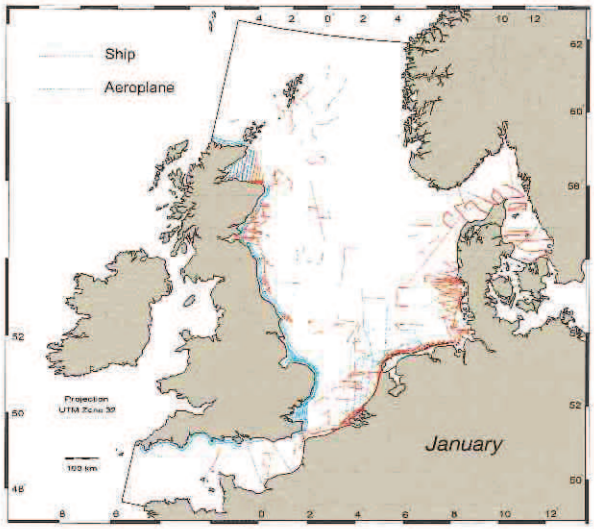
Density estimation from line transects

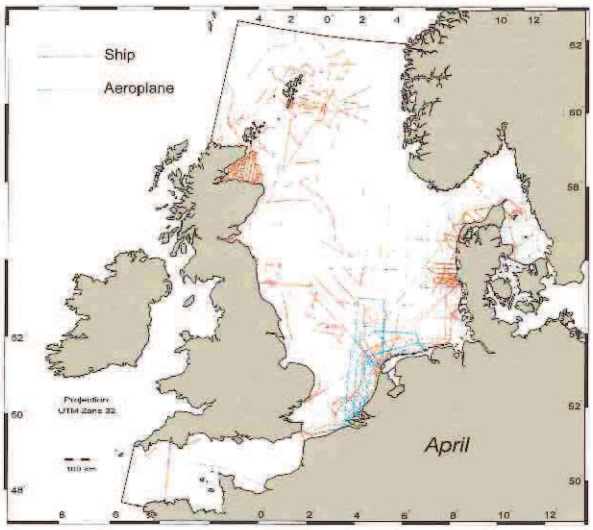
More than 90% of the survey effort in offshore areas of the region included in the analyses stem from the ship-based counts made within transects of 300 m width. The estimation of densities of birds on the water derived from these surveys was made using line transect theory. The calculation of incomplete detection of seabirds from line transects rests on the following two assumptions: a) all birds sitting on the water are detected in the first sub-band, from 0-100 m, and b) perpendicular distances are accurately recorded. To account for incomplete detection of birds in ship-based 200 m transects, the correction factors listed in Stone *et al.* (1995, Table 3c) were used. Counts from narrow (< 200 m) ship-based transects and aerial transects were used on the assumption that all birds in the transects were seen. Numbers of flying birds were not corrected.

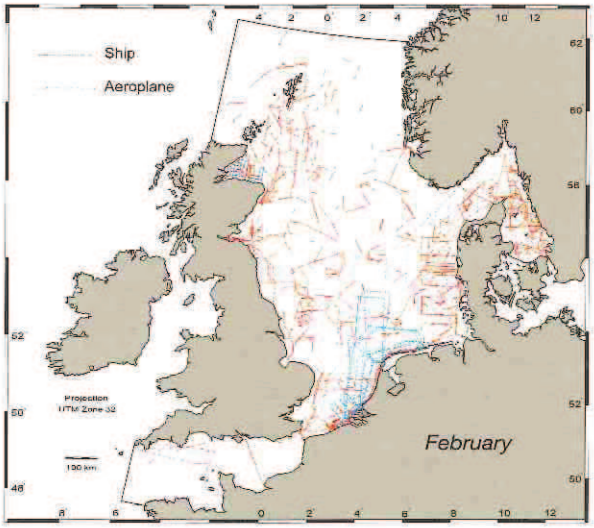
Factors influencing the detectability of seabirds

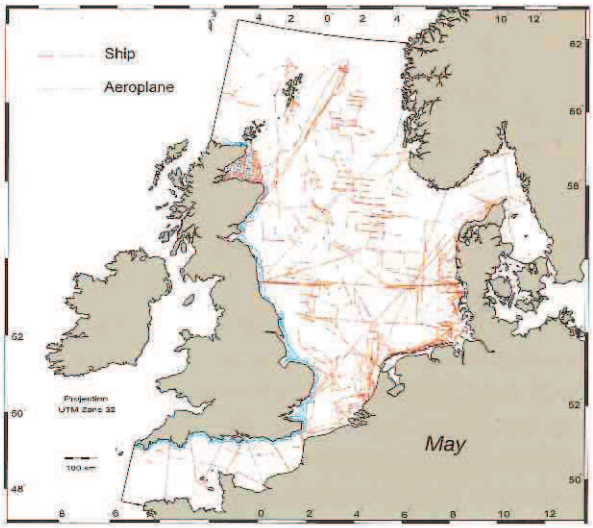
When counting birds from ships at sea, using a line transect procedure, some birds will be missed by the observers. The probability of missing a bird within the counting strip increases with distance to the observer. However, the experience from surveys of seabirds at sea shows that detection probability is not only a function of distance, but it is also dependent on weather and type of ship. As both of these parameters have been recorded routinely by all teams in the region, it was possible to make estimates separately for different categories of weather and ship type which influenced observation efficiency. Furthermore, different teams applied different search modes for seabirds. Some teams habitually used binoculars to detect birds swimming in the counting strip, while others used only the naked eye for detection. We used sea state 0-1, sea state 2-3 and sea state 4 as weather categories, while ship speeds of less than 7 knots/hour, between 7 and 15 knots/hour and above 15 knots/hour were used to categorise major ship types used. The search mode could not be identified within the database, but a rough division of the source databases was made into databases which used 'naked eye' detection, databases with 'binocular' detections and databases with observations with both types of detection.

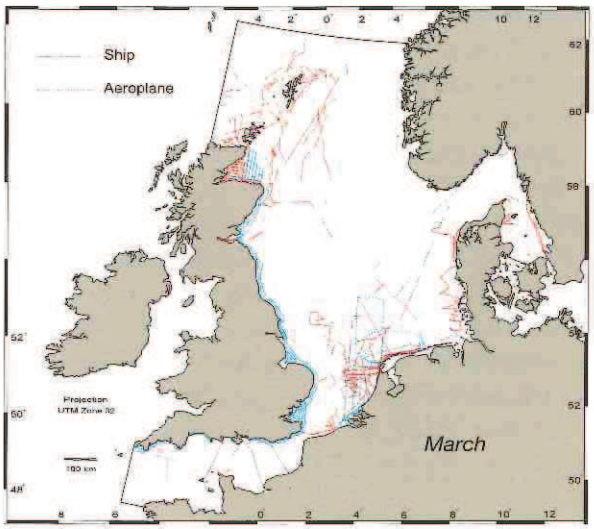
The effects of sea state, ship type (speed) and source database on the encounter rate (number of birds per sailed km) of birds on the water in transect were studied by an analysis of variance using generalized linear modelling. The analysis was made on the entire database of 106,000 10-minute periods. The analysis of variance calculated the effects of each variable on the variation in encounter rate after the effects of the other two variables had been allowed for. To minimise the possible

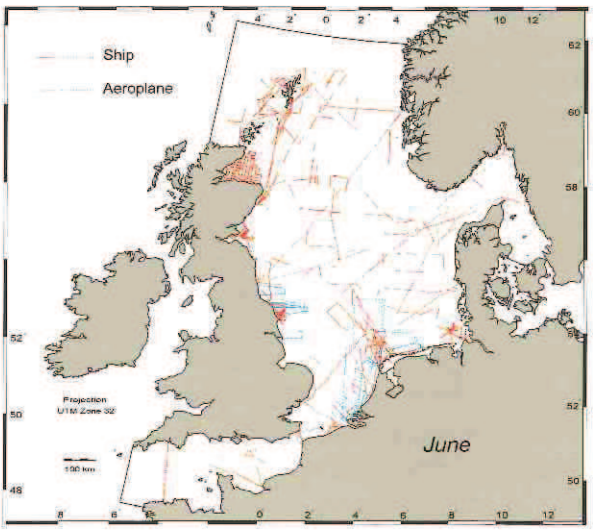




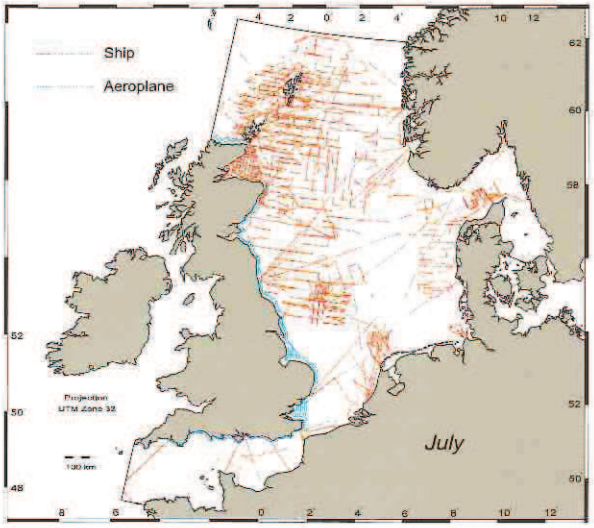


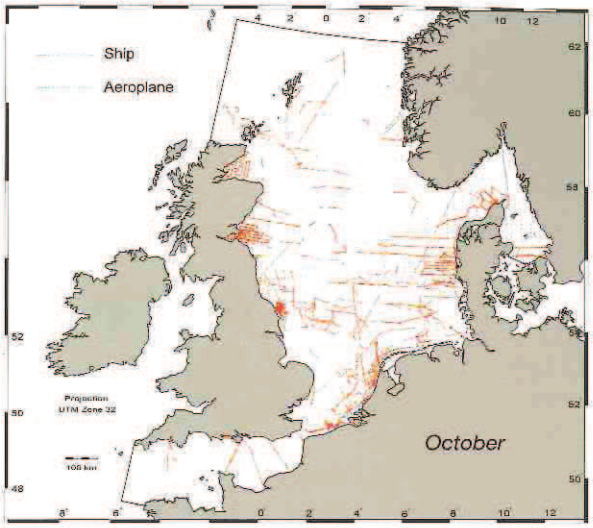


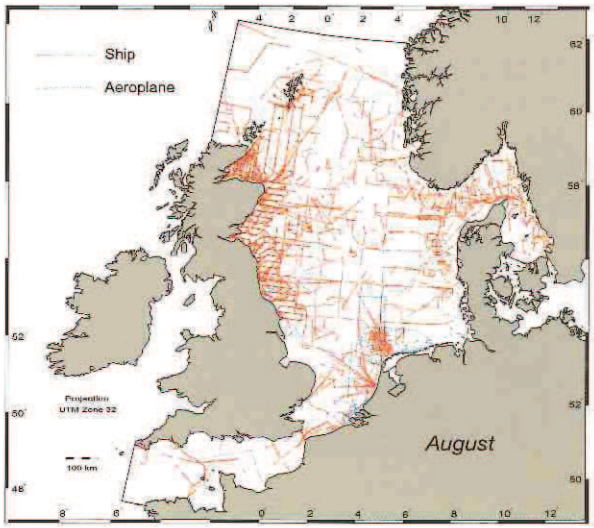




Line transects used in analysis in this report from ship (red colour) and aeroplane (blue colour) in the study region 1980-94 (broken down by months).


Ship
Aeroplane
July


Ship
Aeroplane
October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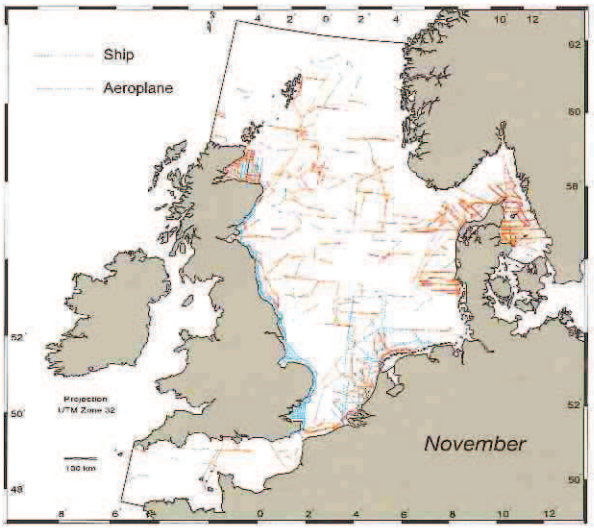
August


Ship
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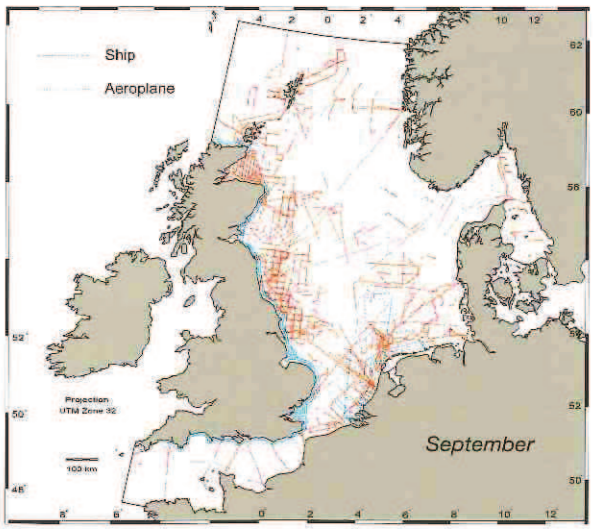
November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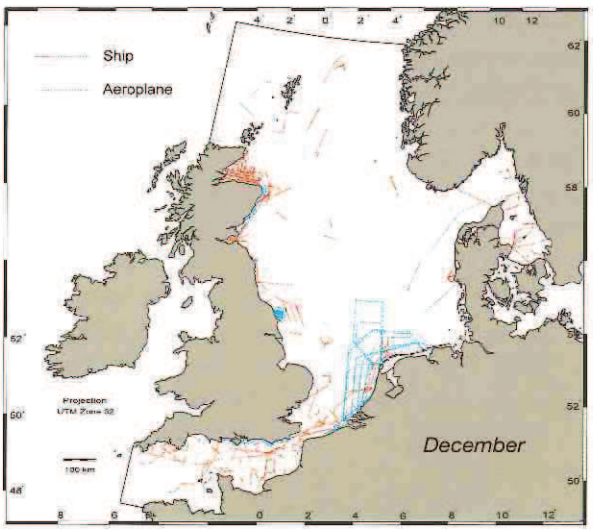
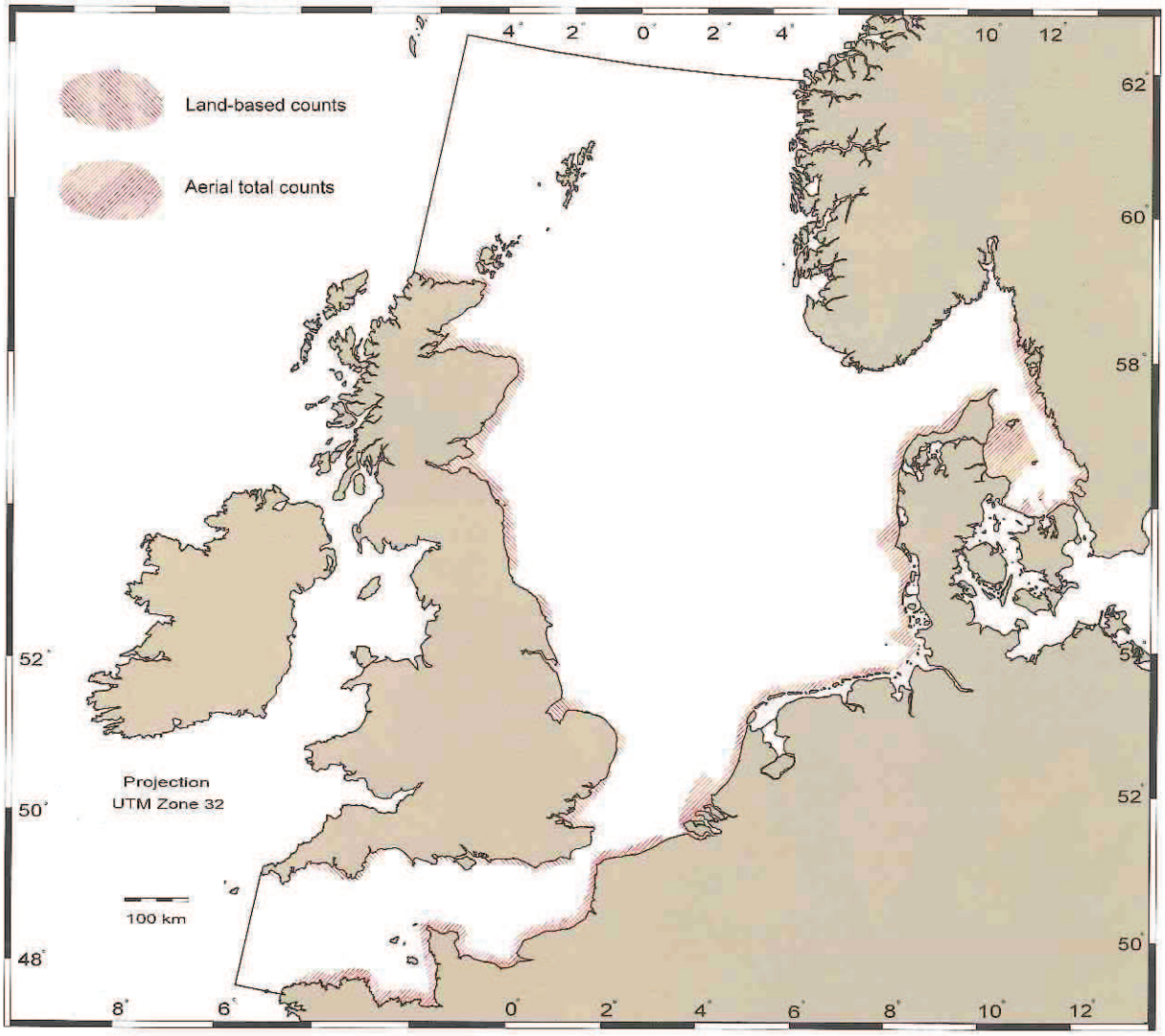
September


Ship
Aeroplane
December



The location and extent of coastal counts.

geographical bias in calculating such effects, we added geographical regions (west and Northwestern North Sea, the Channel-German Bight and northeast North Sea-Kattegat) to the model. The significant effects as interpreted by the size of the sums of squares were used as a means to order the levels of stratification. For those subsets where there were more than 100 birds in transect, detection statistics were calculated for each of the above variables which proved to have a significant influence on the number of birds observed ($p<0.01$).

The two assumptions that these corrections rest on may not always be met. Some parameters which are likely to affect the detection of seabirds can, unfortunately, not be accounted for with our present databases. If the assumption of seeing all birds within the 0-100 m sub-band is not met, the calculated detection function can only be used to correct for the numbers of birds missed at greater distances, relative to the number detected in the first band. Extrapolated densities of bird species that dive in response to an approaching ship, such as grebes and auks, may thus be underestimated. Testing the observations of these species within the 0-50 m sub-band against those of the first 100 m did not indicate an improved detection close to the ship. Although the best detection was often seen in the sub-band 50-100 m, this band could not be used either, due to the potential bias from late encounters of birds which react on the ship by moving away from the 0-50 m band. Correcting for birds missed in the first 100 m requires more elaborate field methods than those used in our studies (Hammond *et al.* 1995). Correct measurements of perpendicular distances may be violated in cases where birds often dive or fly off before the ship reaches them. Simple rangefinders (Heinemann 1981) were used to train observers in distance assessment and to check distances judged by eye. In the inner German Bight and in the waters around Denmark, observers often encountered high densities of divers and seaducks. These birds often

flush at great distances, and a method, using angle and distance to the flushing bird, was developed to better cope with this problem (Durinck *et al.* 1993c).

Calculation of correction factors

In order to correct for birds missed on the water we determined a detection function for numbers of birds observed at different distances, perpendicular to the ship's course line using the software package DISTANCE (Buckland *et al.* 1993, Laake *et al.* 1991). Data input consisted of total numbers of a given species observed from 0-100 m, from 100-200 m and from 200-300 m.

Detection probability functions were calculated using the half-normal function available in DISTANCE (with cosine adjustments), on the basis of narrow confidence limits around the model parameters. The correction factors used (see table), were calculated by dividing the strip width used at sea (300 m) by the effective strip width as calculated by DISTANCE. This factor was used to correct the individual 10 minute bird counts in the appropriate section of the database, by multiplication. Seabird density at the midpoint of each 10 minute count was then calculated by summing the densities of sitting birds (corrected where relevant) and that of flying birds, and dividing the total number by the area (km^2) in which the 10 minute count was made (transect width times length).

The half-normal model could not be applied to large groups of birds, due to an effect of group size on the detection probability. For this reason, groups (>2 in the Gannet, >9 in most gulls and >49 in the Common Scoter) were excluded from the analyses. From the table on the page 153 it is seen that the proportion of the observations of divers, grebes, cormorants, scoters, terns and auks which was corrected was much larger than for Gannet, Great Skua and gulls. This means that the correction factors had the greatest effect on the observations of the former species/species groups. In this group are the least conspicious of the seabirds encountered at sea; grebes and Puffin, for which the correction factors may be underestimated, due to birds missed at close range (diving).

For several species like divers, grebes, Great Skua, Little Gull and Little Auk, the sample of birds on the water was not sufficient for stratification of the correction factors into the main components of variation. For Fulmar, Gannet, Scoters and most gulls and auks, the desired stratification of correction factors could be applied. Adverse weather conditions (rising sea state) had a negative effect on the detection of auks, while the effect of ship type was comparatively less important. Fulmars on the water are easier to observe than all auk species, and weather conditions influenced the observations of this species less. The type of ship seemed to influence Fulmar observations most, as may be explained by the lower encounter rates from fast ships.

The correction factors for the more conspicuous birds, like the Gannet, Great Skua and large gulls are expected to have a correction factor close to 1. In fact, as found by Stone *et al.* (1995) the detection of these species is lower than expected. As we do not know if these species were in fact more difficult to detect than expected, or that distance estimation was faulty, or that there was an effect of group size, in that larger groups at greater distances were systematically underestimated, the correction factors were used, noting that numbers of birds may have been overestimated. Note that the proportions of birds for which the corrections were made, are relatively small, however.

Density estimation from total counts

For the total counts of birds over shallow offshore grounds in the Kattegat the area of sea surface was measured by GIS on the basis of known limits of the aerial survey. For the coastal areas covered from land-based counts the area surveyed was calculated from the total length of near-coastal waters counted, assuming an effective counting zone of 1 km. For the coastal areas covered by total counts from aircraft the area surveyed was calculated by assuming an effective counting zone of 2 km.

Identification of concentrations of single species – procedures for data interpolation

The position of each line transect count unit (one 10 minute time period for ships) and each coastal

count unit was used to plot and group densities of individual counts at the smallest possible scale (ca. 3 km in ship transects). Based on experience from analyses of the structure of pelagic bird distributions (Durinck *et al.* 1994b), we expected most species of interest in the study region to be strongly clustered at the scale of tens of kilometers. From the unified database of line transects carried out from ships and aeroplanes in the region, we had point observations at our disposal which were arranged in a non-random or non-regular lattice. In order to map and estimate numbers of birds in areas with relatively homogenous densities it was necessary to stratify densities into areas of concentration, areas of background levels and areas representing density gradients. By choosing a fixed scale above the scale of patchiness found in some coastal species, the small-scale variation in densities of some species in the coastal zone could not be dealt with. Depending on the size of the areas used by the species, concentrations were separated from background levels by single patches of uniformly elevated densities or by multiple patches occurring frequently at regular intervals in the area. A Microstation PC routine, developed by Ornis Consult Ltd., was used to perform a detailed stratification of species distributions within predefined numeric ranges (see example). Due to the largely overlapping seabird faunas in the Baltic and the North Sea, we chose to use the same numeric ranges as for the analysis of seabird distribution in the Baltic (Durinck *et al.* 1994b). The choice of similar numeric ranges in the North Sea would also enable easy comparisons of the distribution patterns of seabirds in the two regions. Density and population estimation as well as subsequent assessments of the importance of areas were carried out separately for each density stratum or polygon.

Single observations on transect lines or observations which were distant from clusters of observations were treated as not associated with the clusters. These isolated observations were then used to estimate the residual numbers of birds occurring outside areas of concentrations. The maximum range of density interpolation between neighbour transects were set at 3 nautical miles within the inshore zone (from the coast to 5 miles offshore) and at 15 n.m in offshore waters. It may be noted that the maximum ranges for interpolations were not used when estimating residual numbers of birds outside areas of concentration.

The density polygons were smoothed using b-spline approximation techniques. These are piecewise polynomial functions which fit to a small number of data points (densities) exactly, while at the same time ensuring that the joins between one part of the spline and another are continous (Burrough 1986). We found b-splines useful for smoothing the borders of density polygons for display. In very few cases, can the use of b-splines for smoothing polygon boundaries lead to complications when smoothing boundaries with sharp, rectangular corners. The smoothed polygons formed the basis for measurements (km^2) of the areas.

Correction factors used for incomplete detection of birds on the water within 300 m transects from ships. n indicates the sample of all birds (sitting and flying) seen in transect and % corrected shows the fraction of these birds which was corrected. The coefficient of variation of all correction factors listed is less than 10%.

	n	% corrected	factor
Divers *Gaviidae*	5340	97.0	1.4
Grebes *Podicepedidae*	1591	98.0	1.3
Shag & Cormorant *P. aristotelis / carbo*	10988	88.0	1.2
Fulmar *F. glacialis*	231598	80.0	
slow-standard ships, sea state 0-3			1.2
slow-standard ships, sea state 4			1.6
fast ships, sea state 0-1			1.5
fast ships, sea state 2-4			1.7
Gannet *M. bassanus* <	43032	26.6	1.4
Common Scoter *M. nigra* < 50	45626	87.0	1.7
Velvet Scoter *M. fusca*	8005	94.8	1.7
Great Skua *C. skua*	2827	65.9	1.3
Little Gull *L. minutus*	2285	26.1	2.2
Common Gull *L. canus* < 10	18378	32.4	2.2
Lesser Black-backed Gull *L. fuscus* < 10	24157	32.6	
JNCC			1.2
NIOZ			2.4
Other databases			2.0
Herring Gull *L. argentatus* < 10	86402	18.9	
JNCC, sea state 0-3			1.2
JNCC, sea state 4			1.6
NIOZ			1.9
Other database			2.3
Great Black-backed Gull *L. marinus* < 10	32683	32.4	
JNCC			1.7
Other database			2.1
Kittiwake *R. tridactyla* < 10	119743	20.4	
JNCC, sea state 0-3			1.8
JNCC, sea state 4			2.1
NIOZ, sea state 0-1			1.6
NIOZ, sea state 2-4			2.3
Other database			2.6
Terns *S. sandvicensis / hirundo*	2564	84.6	1.5
Razorbill *A. torda*	57571	94.4	
sea state 0-1, slow-standard ships			1.5
sea state 0-1, fast ships			1.7
sea state 2-3, slow-standard ships			1.6
sea state 2-3, fast ships			2.1
sea state 4			1.6
Guillemot *U. aalge*	229141	96.3	
sea state 0-1, slow-standard ships			1.5
sea state 2-3, slow-standard ships			1.6
sea state 4, slow-standard ships			1.6
sea state 4, fast ships			1.7
Little Auk *A. alle*	16404	96.3	2.2
Black Guillemot *C. grylle*	1001	93.4	1.8
Puffin *F. arctica*	24104	90.4	
sea state 0-1, slow ships			1.2
sea state 0-1, standard ships			1.4
sea state 0-1, fast ships			1.6
sea state 2-4			2.0

Classification of area importance to single species

For migratory seabird species wintering in the study region the total winter population of the Northwest European region (Atkinson-Willes 1972) has been used as a reference population. The Northwest European wintering region covers Fennoscandia, the Baltic, Kattegat, the North Sea, the Channel, Britain and Ireland, Iceland and the Bay of Biscay. The study region comprises about 1/3 of this area. For migratory pelagic species the reference populations span the entire Northeast Atlantic region, including Iceland (Lloyd *et al.* 1991). Smaller reference populations have been chosen for sedentary species like Black Guillemot (see table).

Classification systems used for classifying important coastal and inland wetlands are based on two criteria. If 1% of a species population or if 20,000 waterbirds of any species was present, then the area was classified as internationally important (Rose & Scott 1994). This latter criterion is not applicable in marine areas where birds generally use much more extensive areas than those of coastal and wetland habitats (Skov *et al.* 1994b). If the 20,000 birds criterion was applied to the current study region, almost any larger unit of area within the region would at any one season meet the criterion.

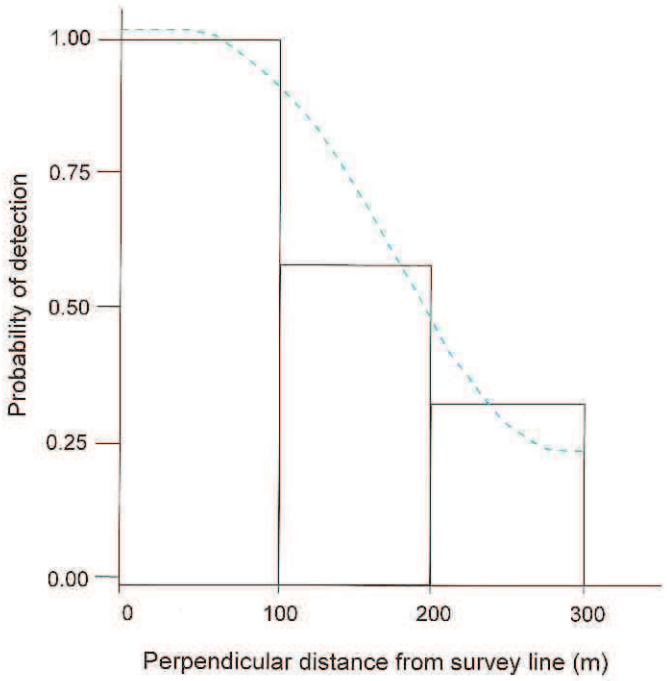
The selection of areas holding at least one percent of the biogeographic population has been based on the assumption that the bird species concentrate in geographically limited areas. However, a number of bird species have a dispersed distribution, and accordingly only a small proportion of their total population can be covered through a network of protected areas identified by the 1% criterion. This has made it necessary to test whether a population of international significance uses a relatively larger area of sea than expected from the proportion of the total population present. The Marine Classification Criterion (MCC) incorporates the international 1% criterion for establishing areas of international importance and a simple test of proportions between the relative size of the population and area of the site. Given a determination of a marine area supporting a minimum of 1% of a total biogeographic population it is tested whether the area of the site is disproportionate to the size of the population by the equation:

MCC = (p/P) x 100 / a/A;

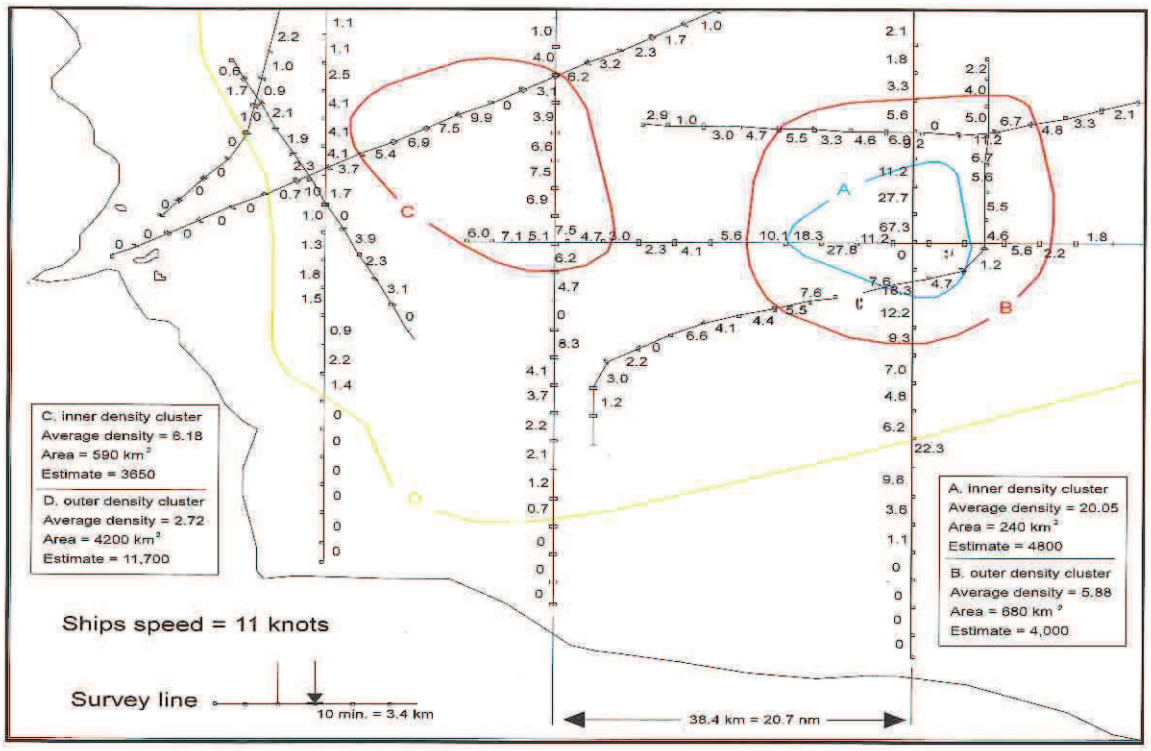
p is the estimated number of birds of the site, P is the total population in the biogeographic region, a is the area of the site and A is 3000 km2. The site is then classified if the criterion exceeds 1. In the development of MCC it has been important to keep it as simple as possible and to ensure that the maximum scale of an area supporting 1% is applicable in a wide range of marine environments. The maximum scale has been set at 3000 km² using average feeding radii of key species from colonies in the region. This scale is obviously conservative, as seabirds tend to select suitable foraging areas within the smallest distance from their colony. During the testing of this approach for identifying areas of international importance at sea it was found that without the application of the MCC, almost the entire study region would satisfy the 1% criterion at any time.

The 1% level of the total breeding individuals or wintering populations in Northwest Europe or Northeast Atlantic according to a) Rose & Scott (1994), b) Fjeldså & O'Dunnell (in press), c) Lloyd et al. (1991), d) Durinck et al. (1994b), e) Nettleship & Birkhead (1985) and f) Tucker & Heath (1994).

Species	1% level	Source
Red-throated & Black-throated Diver *G. stellata/arctica*	1100	d
Great Northern Diver *G. immer*	50	a
Great Crested Grebe *P. cristatus*	1000	b
Red-necked Grebe *P. grisegena*	150	b
Cormorant *P.c. sinensis*	2000	a
Cormorant *P.c. carbo*	1200	a
Shag *P. aristotelis*	2500	c
Fulmar *F. glacialis*	150000	c
Gannet *Morus bassanus*	4600	c
Scaup *A. marila*	310	a
Common Eider *S. mollissima*	27000	a
Common Scoter *M. nigra*	13000	d
Velvet Scoter *M. fusca*	10000	d
Goldeneye *B. clangula*	3000	a
Red-breasted Merganser *M. serrator*	1000	a
Goosander *M. merganser*	1500	a
Great Skua *C. skua*	280	c
Little Gull *L. minutus*	750	a
Common Gull *L. canus*	16000	a
Lesser Black-backed Gull *L. fuscus*	7000	a
Herring Gull *L. argentatus*	27000	a
Great Black-backed Gull *L. marinus*	4800	a
Kittiwake *R. tridactyla*	84000	c
Sandwich Tern *S. sandvicensis*	1500	a
Common Tern *S. hirundo*	7800	a
Guillemot *U. aalge*	40000	c
Razorbill *A. torda*	9900	f
Black Guillemot *C. grylle*, British and Irish population	400	c
Black Guillemot *C. grylle*, Nordic populations of C.g.atlantica	400	c
Black Guillemot *C. grylle*, Baltic population	500	d
Little Auk *A. alle*	2750	e
Puffin *F. arctica*	13700	c



An example of a detection probability plot using the half normal model. The area under the line divided by the total area indicates the probability that the bird species (here Guillemot in sea states below 2) was detected within 300 m.



An example of interpolation of line transect data, showing the contouring of density clusters between counts on neighbouring transects with distances less than 15 nautical miles between them.

Raft of guillemots by D Hoskings (FLPA)

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