

Seabird concentrations in the North Sea

An atlas of vulnerability to surface pollutants



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An atlas of vulnerability to surface pollutants

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Preface

The publication of this document was funded under contract to the United Kingdom Department of the Environment as a contribution to its coordinated programme of research on the North Sea. It is one of the main products of an international project to assess the vulnerability of seabirds in the North Sea and produce a North Sea seabird database with contributions from all countries bordering the North Sea. The project was undertaken at the request of the North Sea Task Force.

This atlas forms part of the product of the fourth phase (1990-94) of the Seabirds at Sea research programme. The programme was started in 1979 and is designed primarily to survey inshore and offshore waters around Britain and locate areas of particular importance to seabirds. Numerous reports have been published describing the results of work in the North Sea and waters to the west of Britain, including a major publication for each of these areas. Work during the fourth phase of the research programme will complete the general survey of Britain's waters by concentrating on the English Channel and the south-west approaches. A further major publication will follow at the end of this phase.

Acknowledgements

Those that participated in this project and supplied data for the North Sea seabird database are named on the title page. In addition, Pim Wolf, Knud Falk, Henning Nohr and Tor Egil Kaspersen provided ideas and advice at project group meetings.

Henk Baptist at Rijkswaterstaat, Tidal Waters Division, Middelburg used a computer program to smooth the vulnerability maps. The results were of considerable help in producing the final maps used in this atlas.

David Fleet, Peter Meininger, Greg Mudge and Hans-Ulrich Rösner provided additional information on coastal areas in the form of published reports or summaries of raw data. Paul Walsh supplied data from the JNCC/Seabird Group Seabird Colony Register and advice on data presentation. Nigel Clark and Ray Waters provided summaries of data from the Birds of Estuaries Enquiry (British Trust for Ornithology/JNCC/Royal Society for the Protection of Birds/Department of the Environment for Northern Ireland). Data from the Moray Firth Seabirds at Sea study (RSPB under contract to Britoil plc) has been included in the North Sea seabird database.

Nigel Clark commented on the wader sections of the monthly texts. Any remaining errors and omissions are entirely the responsibility of the authors.

Information on Ramsar sites and Special Protection Areas was kindly supplied by Steinar Eldøy, David Fleet and Miriam Langeveld.

Robin Sheehan and Andy Tabor provided valuable advice which enabled an interface between the North Sea seabird database and UKDMAP to be written.

Peter Creed, Amanda Holmes and Joe Little prepared the maps included in this atlas.

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Other projects were funded by the following organisations: Belgium, Free University of Brussels; Denmark, National Forest and Nature Agency; Netherlands, Tidal Waters Division, Netherlands Institute for Marine Research; Norway, Conoco Norway Inc., Norsk Hydro A/S, Saga Petroleum A/S, NorskeShell A/S, Statoil; Sweden, Swedish Environmental Protection Agency, World Wide Fund for Nature (Sweden).

We would like also to thank all those many people who have helped us during our surveys, in particular operators of ships who provided free transport and captains on ships and aircraft. We would like to thank all those observers not mentioned previously for all of the hours of work given to data collection.

Finally, we thank Nicky Fraser and Tracey Quice for help during the production of this document.

Figure 1
 The North Sea showing localities mentioned
 in the text.



Introduction

The Ministerial Declaration of the Third North Sea Conference included the decision "to integrate and update national data on sea and coastal birds at sea on a standardised basis to enable identification of vulnerability standards for species and areas to be available to pollution response authorities and sea users". The North Sea Task Force agreed to coordinate this measure and as a result, the United Kingdom Department of the Environment funded a project to set up an international North Sea seabird database and produce this vulnerability atlas.

This atlas has been designed for those concerned with the control of surface pollutants in the North Sea and presents information on vulnerable concentrations of seabirds in an easily accessible form. It is the result of international co-operation between all countries bordering the North Sea and includes information collated from organisations in Belgium, Denmark, the Netherlands, Norway, Germany, Sweden and the United Kingdom. Throughout the introduction of this document the term 'North Sea' is used to include the Skagerrak and the Baltic Sea west of 14° East. The area covered and place names used in the text are shown in Figure 1.

Sources of information

The monthly maps and text which make up the major part of this document have been compiled from two main data sources. Data from offshore, ship-based and aerial surveys have been combined to form a North Sea seabird database which is held and maintained by the Joint Nature Conservation Committee's Offshore Animals Branch. Some offshore seabird data were not suitable for inclusion in the database but have been used to provide information for areas not adequately covered by the database. Information on coastal areas has been gathered mainly from published reports summarising the most recent data available. Counts of birds used in these reports are mostly land-based with a few based on aerial surveys of coastal waters. A full list of data sources is given at the end of this document.

The birds

Birds using the North Sea may be conveniently divided into three groups - offshore, inshore and coastal. The offshore group includes members of several families, most notably petrels, gulls, auks and gannets. All species in this group are heavily reliant on the marine environment and some only come ashore to breed. Even in the breeding season many of these birds spend the majority of their time feeding at sea, often tens of kilometres away from their colonies. In winter they mostly disperse from breeding sites and may range considerable distances in search of food.

Inshore birds include seaduck, divers, cormorants and terns; some gull species and one auk (black guillemot) are included in this group. These birds normally occur within sight of land although they may move further offshore, especially in areas of shallow water. Although some breed in substantial numbers, the North Sea is of greatest importance to most inshore species in autumn and winter. Large numbers of seaduck and divers move into the southern and eastern North Sea in autumn from breeding grounds to the north, with species such as eider and common scoter forming flocks of many thousands of birds. As with some auk species, most seaduck and divers are particularly vulnerable for a period at the end of the breeding season when they become flightless during wing moult.



Adult little tern
Photograph by Paul Doherty

Table 1

Numbers of seabirds breeding around North Sea coasts (not Baltic): data from Tasker *et al.* (1987), Dunnet *et al.* (1990) and Seabird Colony Register (unpublished). Figures are pairs or apparently occupied sites unless otherwise stated. The proportion of the relevant biogeographical population for each species is also indicated. * = more than 5%, ** = more than 10%.

Red-throated diver	800 **	Herring gull	237,100 **
Fulmar	308,000	Great black-backed gull	24,400 **
Manx shearwater ¹	250	Kittiwake	415,400 **
Storm petrel ¹	>1,000	Sandwich tern	30,500 **
Leach's petrel ¹	1-500	Roseate tern	38
Gannet	43,800 **	Common tern	61,500 **
Cormorant	2,200	Arctic tern	74,700 *
Shag	19,800 **	Little tern	2,300
Arctic skua	3,200 **	Guillemot (individuals)	680,400 **
Great skua	7,300 **	Razorbill (individuals)	73,100 **
Black-headed gull	129,300 *	Black guillemot (individuals)	23,700 **
Common gull	73,300 **	Puffin (individuals)	226,000 **
Lesser black-backed gull	49,300 **		

¹ Petrel and shearwater numbers are very approximate

Table 2

Qualifying levels for international importance of wetlands to waterfowl. Only species that use intertidal or coastal areas of the North Sea on a regular basis are included. Figures are 1% of the north-west European population for wildfowl (Pirot *et al.* 1989) and 1% of the east Atlantic flyway population for waders (Smit & Piersma 1989).

Mute swan	1,800	Goosander	1,250
Whooper swan	170	Oystercatcher	9,000
Pink-footed goose	1,100	Avocet	700
European white-fronted goose	3,000	Ringed plover	500
Dark-bellied brent goose	1,700	Golden plover	10,000
Light-bellied brent goose (Svalbard)	40	Grey plover	1,500
Shelduck	2,500	Lapwing	20,000 *
Wigeon	7,500	Knot	3,500
Teal	4,000	Sanderling	1,000
Mallard	50,000 *	Purple sandpiper	500
Pintail	700	Dunlin	14,000
Shoveler	400	Ruff	10,000
Pochard	3,500	Snipe	10,000
Tufted duck	7,500	Black-tailed godwit	700
Scaup	1,500	Bar-tailed godwit	1,000
Eider	20,000 *	Whimbrel	700
Long-tailed duck	20,000 *	Curlew	3,500
Common scoter	8,000	Spotted redshank	?
Velvet scoter	2,500	Redshank	1,500
Goldeneye	3,000	Greenshank	?
Red-breasted merganser	1,000	Turnstone	700

* The north-west European or east Atlantic flyway population of these species exceeds 2,000,000 but a site holding more than 20,000 waterfowl qualifies as internationally important by virtue of absolute numbers.

Birds that feed on intertidal areas such as sand and mud flats make up the coastal bird group. The North Sea is particularly suited to these species because of its large tidal amplitude and relatively mild climate, which prevents mud flats freezing for most of the winter. The coastal margins of the North Sea support these birds at all times of the year, but by far the highest numbers occur from autumn to spring. For some species the North Sea is mainly a staging post for birds on passage between breeding grounds to the north and wintering areas further south. Other species spend the winter along North Sea coasts. The Wadden Sea and estuaries of the British east coast are especially important for coastal birds.

Numbers of offshore and some inshore seabird species breeding on North Sea coasts are included in Table 1. For sixteen species the North Sea breeding numbers represent more than 10% of the relevant biogeographical population. The North Sea also supports internationally important numbers of many offshore, inshore and coastal species in the non-breeding season.

International wildlife treaties and bird conservation

There are several international wildlife treaties intended to help protect habitat supporting important numbers of coastal and inshore birds. All coastal states around the North Sea have ratified the Ramsar Convention on Wetlands of International Importance. Under this convention, states are asked to designate wetlands of international importance, including wetlands that regularly hold 1% or more of a population of one species or subspecies, or support a total of over 20,000 waterfowl. The qualifying levels for different species are given in Table 2 and Ramsar sites designated or proposed are shown in Figure 2. Many of these wetlands, together with other sites, qualify as Special Protection Areas under the EC Directive on the Conservation of Wild Birds, 1979. Among other measures this directive requires member states to designate and protect sites in order to conserve vulnerable and migratory bird species. North Sea sites so far designated or proposed under this directive are shown in Figure 2. All these sites are coastal areas or shallow inshore waters, although work is underway in several countries to recommend offshore sites for

designation. The recently approved EC Habitats and Species Directive promotes the designation and protection of sites falling into certain habitat categories. These include estuaries and coastal mudflats as well as offshore marine habitats such as sandbanks and shallow inlets and bays.

Surface pollutants

The term surface pollutants covers a wide range of substances including mineral oils, vegetable oils and chemicals such as nonylphenol and dodecylphenol. Although vegetable oils and chemicals which float on water have resulted in some seabird deaths, it is mineral oils that pose by far the greatest threat to seabirds in the North Sea. The threat of mineral oil pollution in the North Sea increased with the development of the offshore oil industry in the 1970s. Although damage to bird populations resulting from an oil spill is difficult to demonstrate, oil pollution does kill large numbers of birds every year and there remains the risk that a future spill could cause major damage. Surveys of coasts around the North Sea (beached bird surveys) continue to find high numbers of dead seabirds and although the proportion of birds oiled has declined along the British coast, it remains high for coasts around the rest of the North Sea. Oil spills in sensitive areas can kill very large numbers of birds and lead to increased public awareness of the problem. However, such incidents are rare and the majority of oil related bird deaths result from the small but frequent discharges that lead to chronic oil pollution. The continuing threat from oil pollution is one of the main reasons for carrying out offshore seabird surveys as they provide the only means of assessing the importance to birds of different areas of the North Sea.

Bird vulnerability

Birds utilising coastal and offshore waters of the North Sea face a range of possible threats, including destruction of habitat, the harmful effects of organochlorines and heavy metals in the environment and declining fish stocks. Surface pollution, especially oil, is an additional threat for many bird species in the North Sea. Because of differences in factors such as behaviour and distribution, the threat from surface pollutants is much higher for some species than it is for others. The main objective of this document is to assess the

Figure 2

Locations of designated and proposed sites on North Sea coasts notified under the 'Ramsar' Convention and as Special Protection Areas under the EEC directive on the Conservation of Wild Birds 1979.

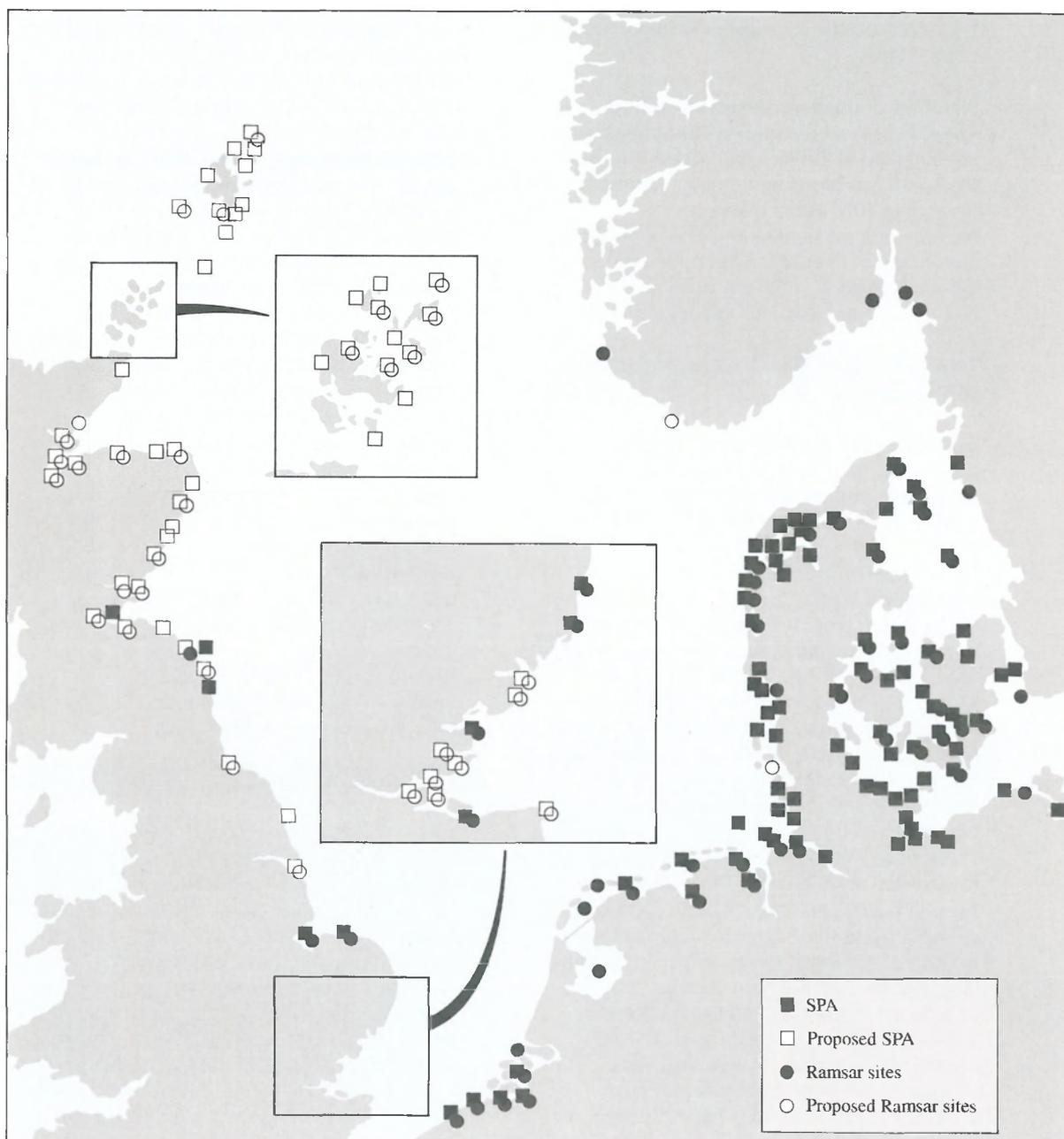


Table 3.

Vulnerability to surface pollutants of seabirds in the North Sea, with offshore vulnerability index scores in brackets.

Red-throated diver (29) *	Eider (16) *	Great black-backed gull (21)
Black-throated diver (29) *	Long-tailed duck (17) *	Kittiwake (17)
Great northern diver (29) *	Common scoter (19) *	Sandwich tern (20)
Great crested grebe (23) *	Velvet scoter (21) *	Common tern (20)
Red-necked grebe (26) *	Goldeneye (16) *	Arctic tern (16)
Fulmar (18)	Red-breasted merganser (21) *	Little tern (19)
Sooty shearwater (19) *	Arctic skua (24)	Guillemot (22) *
Manx shearwater (23) *	Great skua (25)	Razorbill (24) *
Storm petrel (18)	Little gull (24)	Black guillemot (29) *
Gannet (22)	Black-headed gull (11)	Little auk (22) *
Cormorant (20)	Common gull (13)	Puffin (21) *
Shag (24) *	Lesser black-backed gull (19)	
Scaup (20) *	Herring gull (15)	

* = large proportion of time spent on the surface of the sea and therefore *individuals* of this species are at high risk from surface pollutants.

vulnerability to surface pollutants of bird concentrations in different areas of the North Sea.

The previous atlas of vulnerable bird concentrations in the North Sea, (Tasker and Pienkowski 1987) rated the vulnerability of seabird species intuitively. Each species was ranked as having a very high, high or moderate vulnerability to oil pollution according to the amount of time spent on the water, the importance of the North Sea population and the size of the world population of the species. The maps were drawn using information on the numbers of birds present in each area of the North Sea in each month and the vulnerability ranking of each species. Several workers have suggested

using an index to assess species vulnerability to threats such as oil pollution. Camphuysen (1989) proposed an oil vulnerability index based on twenty factors for birds using marine habitats in the North Sea. However, there is not enough information available to accurately score most of these factors for all species commonly found in the North Sea and an index based on factors scored intuitively would be little better than simply assigning species to categories of vulnerability.

The offshore vulnerability index used here consists of four factors; the amount of time spent on the water, total biogeographical population, reliance on the marine environment and potential rate of population recovery (for example following a reduction caused by surface pollution). A more detailed description of the offshore vulnerability index is given in Appendix 1 and the index scores for each species are shown in Table 3.

The maps

The main body of this document is a series of vulnerability maps (one for each month) showing vulnerable concentrations of birds in the North Sea. Vulnerability scores for offshore areas were determined by combining the density of each species of bird present with its vulnerability index score using a procedure described in Appendix 2.



Red-throated diver
Photograph by Paul Doherty

Areas holding high densities of the most vulnerable species are shown as dark blue on the maps, with progressively lighter shades of blue indicating reduced vulnerability. Symbols are used to show which groups of birds are important in areas holding vulnerable bird concentrations. Areas which have not yet been surveyed in sufficient detail are shown as the lightest shade of blue. Coastal areas that support internationally important concentrations of shorebirds are highlighted using a shorebird symbol; the size of the symbol indicates the scale of importance of the concentration.

A page of text accompanying each monthly map highlights major movements of birds relevant to the map and describes important concentrations of birds.

Use of the maps

This document has been designed to provide information on the vulnerability of areas of the North Sea to surface pollution, in terms of the birds they support. In the event of a pollution incident the importance to birds of the affected area may be rapidly assessed by consulting the relevant monthly map(s). Reference to this document should be a part of contingency plans, both for dealing with pollution incidents and for carrying out new offshore operations where there is a risk of pollution. It is anticipated that the amount of resources allocated to deal with a pollution incident will reflect the information presented here.

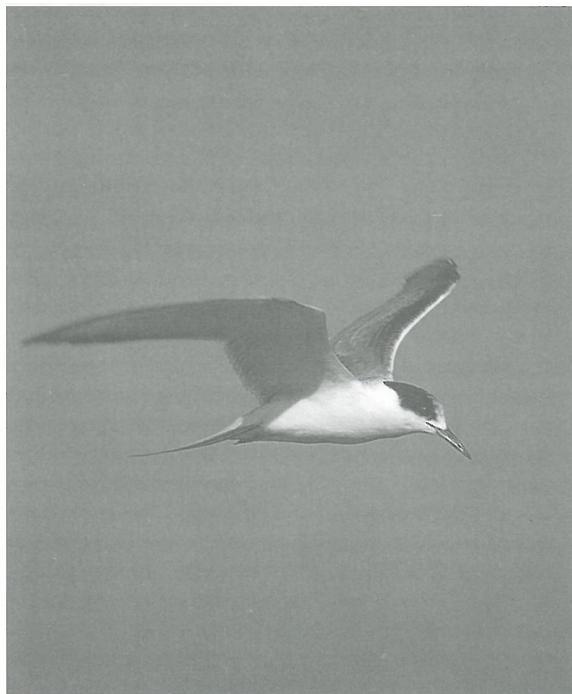
It is important to understand the limitations of the monthly vulnerability maps when formulating contingency plans or considering the response to a pollution incident. Birds are capable of rapid movement from one site to another and an area holding high densities of birds in one year may hold fewer in a later year. This is especially true for offshore species where food resources and environmental conditions can be unpredictable. An example of this is provided by the large numbers of guillemots and razorbills that breed in Shetland. These birds move south and east at the end of the breeding season and large numbers are found off eastern Scotland and north-east England by August. The location of this concentration has been found to vary from year to year, with the largest numbers off Grampian and the Moray Firth in some years and as far

south as north-east England in others.

The vulnerability maps are based upon seabird data collected over ten years and therefore show only average levels of vulnerability over this period. To obtain accurate and up to date information for a potentially vulnerable area affected by an oil spill, the best option may be to carry out a rapid aerial survey.

When consulting this document it is important to refer to the maps and text for at least one month before and after the month when the incident occurred. This will provide a much fuller picture of bird concentrations and movements than referring only to the information provided for a single month.

Several countries around the North Sea have produced a seabird vulnerability atlas covering waters around their country in more detail than is possible for an atlas covering the whole of the North Sea. The names and addresses of organisations that contributed to this atlas are given on the title page; they should be contacted if more detailed information is required for a particular area of the North Sea.



Immature common tern
Photograph by Paul Doherty

Details are given here of organisations that may be contacted in the event an oil spill in the territorial waters of the following countries:

Belgium: Ministry of Public Health and Environment,
UGMM, Gulledele 100,
B-1200 Brussels
Tel. (+ 32) 277 321 11

Germany: Zentraler Meldekopf,
P.O. Box 766
D-2190 Cuxhaven
Tel. (+ 49) 4721 106 485

Norway: State Pollution Control Authority,
P.O. Box 125
N-3191 Horten
Tel. (+ 47) 33 44 161

Denmark: Miljøstyrelsen,
Strandgade 29,
1401 Copenhagen K
Tel. (+ 45) 31 578 310

Netherlands: Netherlands Coastguard centre,
IJmuiden
Tel. (+ 31) 255 034 344

United Kingdom: Marine Pollution Control Unit
Department of Transport
Sunley House,
Holborn,
London, WC1V 6LP
Tel. (+ 44) 71 405 6911

January

Inshore and coastal species

An estimated 20-30 thousand red-throated and black-throated divers winter inside the 25 metre depth contour in the German Bight. A further 6-10 thousand are found off areas further south to Cap Gris Nez. To the north and east of Denmark, concentrations of 1000-3000 divers are found in the Jammerbugt, Ålborg Bugt and the Baltic Straits. Up to 1000 divers, mostly red-throated, are present in inshore waters off the Thames estuary. Scapa Flow and Wyre/Rousay Sound in Orkney and Yell Sound in Shetland hold important numbers of great northern divers.

Shelduck are widely distributed in January with several sites supporting internationally important numbers. Around 40,000 are found in the Dutch Wadden Sea, representing 15% of the north-west European population. Up to 10% of the north-west European population occur on the Wash as numbers peak in January. There is a peak in the numbers of European white-fronted geese using the Netherlands Delta in January when about 30% of the north-west European population may be present.

The most important area for eider is the western Kattegat and Baltic Straits where flocks totalling more than 700,000 birds are present. Further south, over 100,000 are found in the southern Baltic off the coast of Germany. About 150,000 birds occur in the Dutch Wadden Sea with a similar number in the combined German and Danish sectors of the Wadden Sea. Danish waters also hold large flocks of scoter. Over 500,000 common scoter are present in the shallow waters of the north-western Kattegat and up to 100,000 are found in coastal waters of the Skagerrak during hard winters. About 40,000 occur off the Danish Wadden Sea and 50-100 thousand are present in Dutch waters. More than 100,000 velvet scoter occur in much the same areas as the common scoter. Goldeneye concentrate in sheltered inshore waters, particularly around the coasts of Denmark, Sweden and eastern Germany. About 60,000 are present in Danish waters with highest numbers in Limfjorden in the north and in the Baltic Straits. More than 25,000 are found off the German Baltic coast with largest flocks around Rügen in the east. Around 5000 birds

have been counted from the southern coast of Sweden. Approximately 150,000 long-tailed duck are present in waters off southern Sweden and around 200,000 are found in the southern Baltic off Germany.

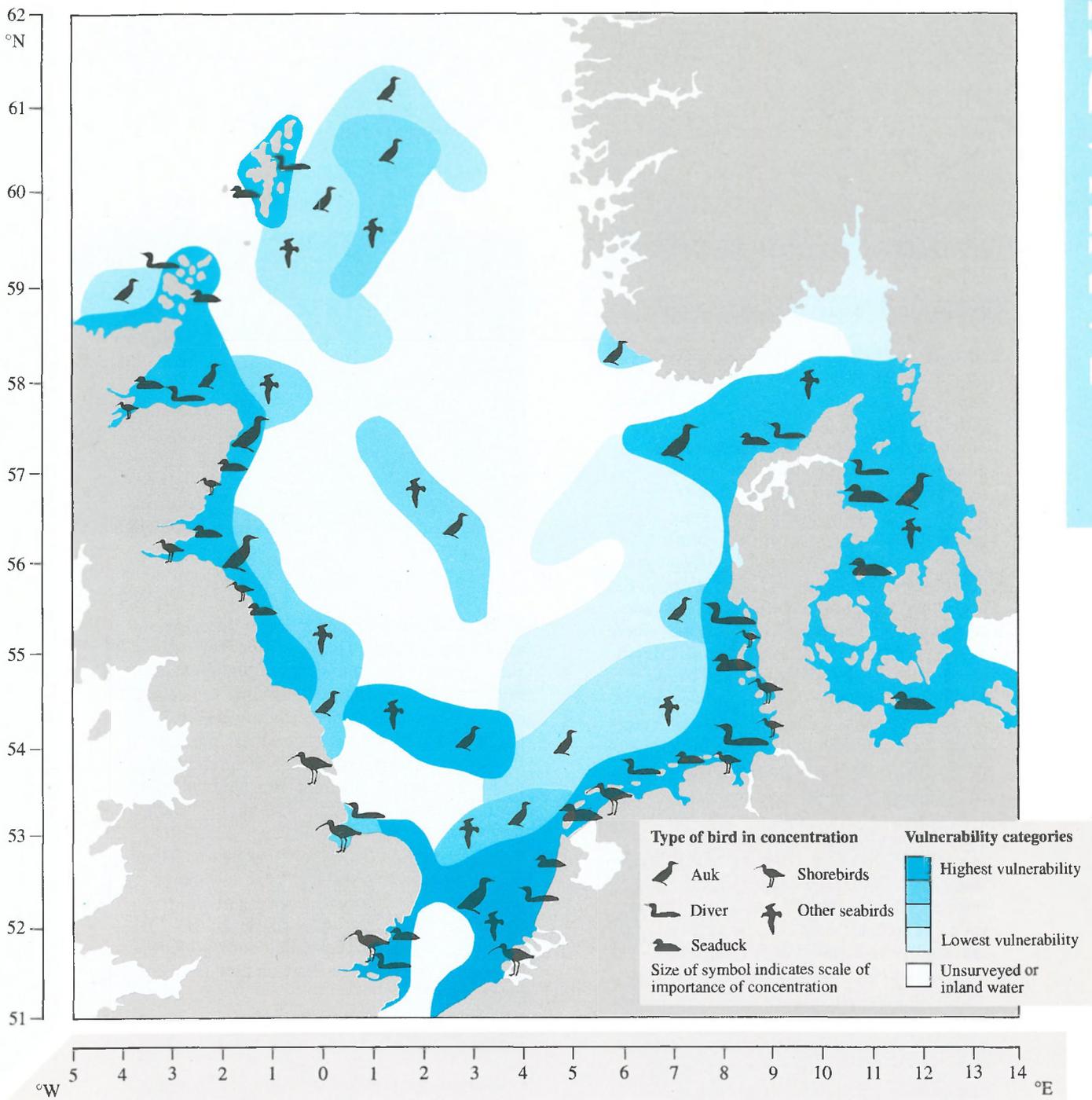
Wading birds are found in internationally important numbers at many sites around the North Sea. Highest numbers are in the Dutch sector of the Wadden Sea where nine species are found in internationally important numbers, including more than 5% of the flyway population of oystercatcher, knot, dunlin, bar-tailed godwit and curlew. The Moray Firth, Humber, Wash, Thames Basin, Netherlands Delta and German sector of the Wadden Sea each hold between six and nine species in internationally important numbers.

Offshore species

Guillemots are widely distributed in the southern North Sea and there are major concentrations off the north-east coast of mainland Britain and in the Skagerrak and Kattegat. Some birds return to waters around Shetland in January. Razorbills occur in similar areas with the Kattegat supporting the highest densities. In January most puffins have been seen in the central and western North Sea and north-east of Shetland. Little auks are present in most areas surveyed in the north and central North Sea; highest densities are found in the Skagerrak and over the Fisher Banks.



Adult kittiwake
Photograph by Ian Carter



Kittiwakes occur throughout the North Sea with high numbers in the Skagerrak, Kattegat and waters to the east of Shetland. Smaller concentrations are found in the Moray Firth, Dogger Bank and in offshore waters of the Southern Bight. Inshore waters in the southern North Sea support moderate numbers of common gulls with highest densities in the German Bight. Herring and great black-backed gulls are numerous in the North Sea in winter with highest numbers in the southern half of the North Sea. Fishing vessels operating over the Dogger Bank attract considerable numbers of both species. The Moray Firth, Skagerrak, Kattegat and Southern Bight are the most important areas for herring gulls. Glaucous gulls reach an annual peak in the northern North Sea in this month.

Moderate numbers of gannets winter in the region with the majority in the western North Sea. Those present over the Dogger Bank and to the east of Shetland are mostly associated with fishing vessels.

Fulmars are numerous and widespread in the North Sea in winter. In January, highest numbers are present in offshore areas around Shetland, in the Moray Firth and over the Dogger Bank.

February

Inshore and coastal species

January and February are often the coldest months of the year and the distribution of many inshore species depends on the severity of the weather. In cold weather, large numbers of species such as great crested grebes, shelduck, scaup, red-breasted mergansers and eiders move out of frozen areas to areas with warmer conditions. These movements typically occur off continental coasts and result in estuaries on the east coast of Britain and the western Dutch Wadden Sea becoming more important for these species. In particularly harsh winters, birds may move as far as western Britain and Ireland. Danish waters, including the Kattegat and Baltic Straits support higher numbers of seaduck in winters when they remain ice free and waters to the north and east freeze over. In normal or mild winters, most species are found in the same areas as in January.

Goosanders are concentrated in waters around Denmark and in the western Wadden Sea. Several thousand occur in Limfjorden and about 8000 in the Baltic Straits if these waters remain ice free. Numbers reach a peak in February and March in the western Wadden Sea when around 25% of the west European population may be present, mainly near the outflow from the IJsselmeer. In years when ice covers parts of the Kattegat and Baltic the North Sea becomes a refuge for more ducks and grebes. Areas such as the Jammerbugt become considerably more important than usual; holding, for example, up to 100,000 common scoter. Up to 100,000 scaup are present in the western Kattegat and the south-western Baltic; the Ålborg Bugt and sheltered waters around Rügen on the Baltic coast of Germany are particularly important sites. In severe winters over 100,000 scaup may be present in the Netherlands with the majority on the IJsselmeer.

An increasing number of cormorants of the *sinensis* race from inland breeding areas around the Baltic spend the winter on nearby coastal waters. Around 15,000 occur in the western Kattegat, Baltic Straits and along the Baltic coast of Germany, with smaller numbers of the *carbo* race.

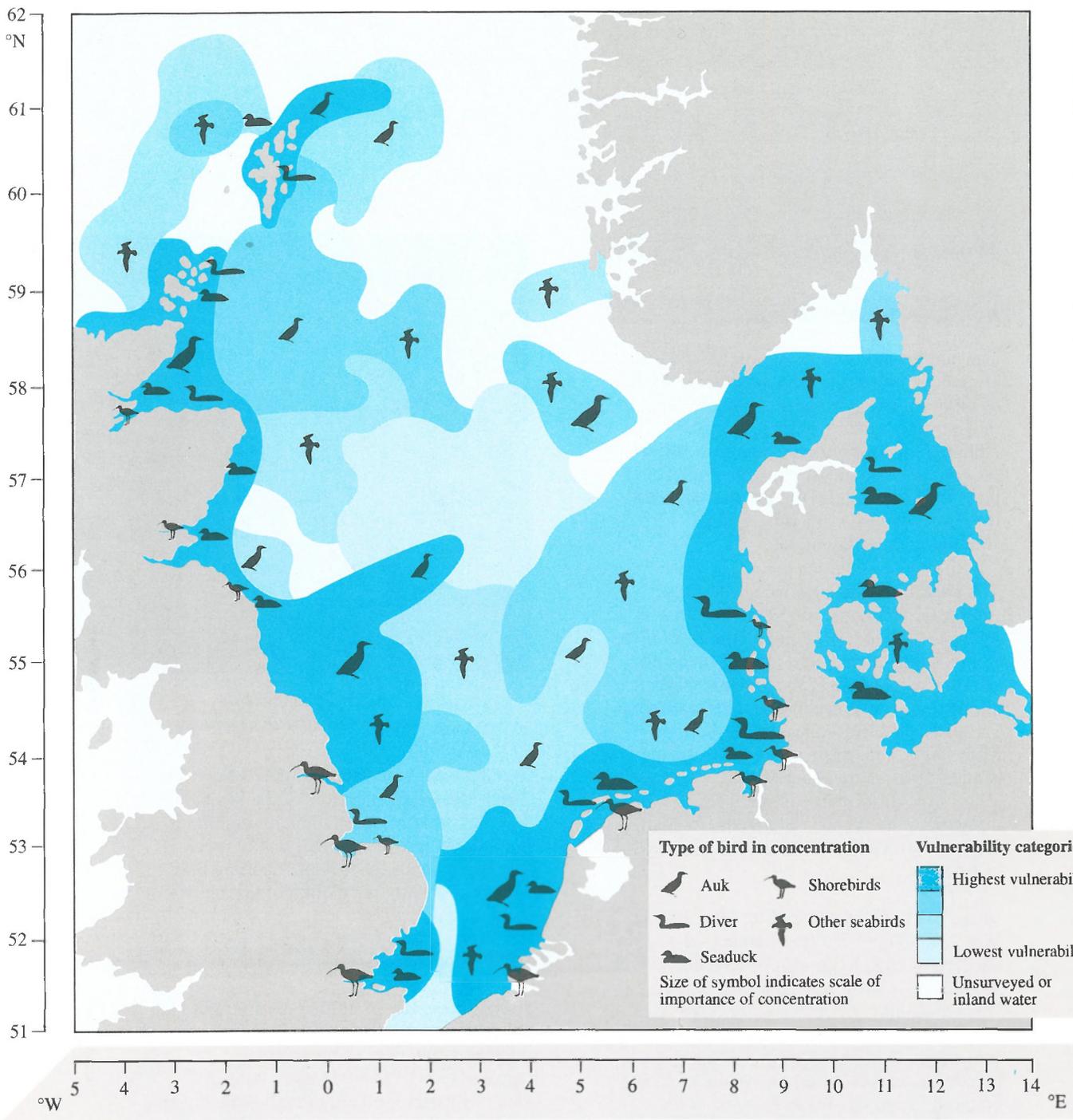


Curlew
Photograph by Paul Doherty

Waders are concentrated in much the same areas as in January. The Wash and Thames Basin complex are the most important areas in eastern Britain with each holding seven or eight species in internationally important numbers. Up to 40% of the east Atlantic flyway population of knot may be present on the Wash during the winter. Bar-tailed godwit numbers in eastern Britain peak in this month when both the Wash and Thames complex hold over 10% of the flyway population. The Dutch Wadden Sea and Delta each support internationally important numbers of eight species of wader. Around a quarter of the flyway population of bar-tailed godwit may be present in the Dutch Wadden Sea in February.

Offshore species

Guillemots are widespread in the North Sea in February. Survey effort in offshore waters of the central and north-western North Sea is greater than in January and shows these areas to be important for guillemots. High densities occur off most of the east coast of Scotland and in the Skagerrak and Kattegat. Although some razorbills return to Shetland waters during this month and numbers off north-east Scotland are higher than in January, the Kattegat remains the most important area for this species. Puffins are widely distributed offshore with highest densities in the north and west of the North Sea. Unlike the previous two species, they are largely absent from waters adjacent to the main colonies. Little auks occur in moderate numbers in offshore areas north of a line from Flamborough Head to northern Denmark. High densities are present in the Skagerrak and over the Fisher Banks.



Kittiwakes are present in high numbers in offshore waters of the western and southern North Sea and in the northern part of the Kattegat. Highest densities of common gulls are found close to land in the southern North Sea and in the Skagerrak and Kattegat; they are much less numerous further offshore. Black-headed gulls are present in the same areas as common gulls but they are more patchily distributed and occur at lower densities. Herring and great black-backed gulls are present in large numbers over a wide area off the east coast of England and off the Netherlands. Moderate numbers of both species are present in the southern and western North Sea. Herring gulls are also numerous in the Skagerrak and Kattegat. Low numbers of little gulls are present in the southern North Sea, mainly off the

Netherlands and Germany.

Some adult gannets return to the North Sea this month, from wintering areas to the south. They are present in moderate numbers over large areas of the western North Sea from Flamborough Head northwards. Some birds return to waters close to the main colonies in the Firth of Forth and Shetland during this month.

Fulmar distribution is very similar to that in January with large numbers in the north-west and in many offshore areas in the central North Sea.

March

Inshore and coastal species

The numbers of birds using intertidal areas around the North Sea increases during March as birds wintering to the south of the area move towards their breeding grounds. Although highest monthly counts of many species decrease in March, large numbers of birds feed on estuaries around the North Sea for only a few days at a time, before continuing their migration.

The number of shelduck using estuaries declines in February and March as birds return to breeding sites around the North Sea. Barnacle geese are found in the Dutch and German parts of the Wadden Sea in higher numbers than in preceding months, gathering on saltmarshes before leaving in April or May. Highest numbers are in the German Wadden Sea where about 80,000 are present at this time. Dark-bellied brent geese increase throughout the Wadden Sea as overwintering birds are joined by birds from the south-east of England.

Many eiders move to breeding areas during March although very high numbers remain in sheltered waters to the east of Denmark. Over 700,000 have been counted in the Ålborg Bugt and Baltic Straits. Concentrations of long-tailed duck, common scoter and velvet scoter remain high in the same areas as preceding months. Scaup, goosander and red-breasted merganser begin to move north during March, although large flocks are still present in the wintering areas. In most winters goldeneye begin to move north from late February/early March and so large flocks are only present in the North Sea and Baltic early in the month.

Overall numbers of waders decline on British east coast estuaries in March, although the Moray Firth, Firth of Forth, Humber, Wash and Thames Basin remain internationally important for several species. The Wash is the most important of these estuaries, particularly for its high numbers of grey plover, knot, dunlin and bar-tailed godwit. There is a large increase in the numbers of dunlin present in the Wadden Sea in March, as birds that wintered in North Africa and on British estuaries pass through. The Dutch, German and Danish sectors may each hold

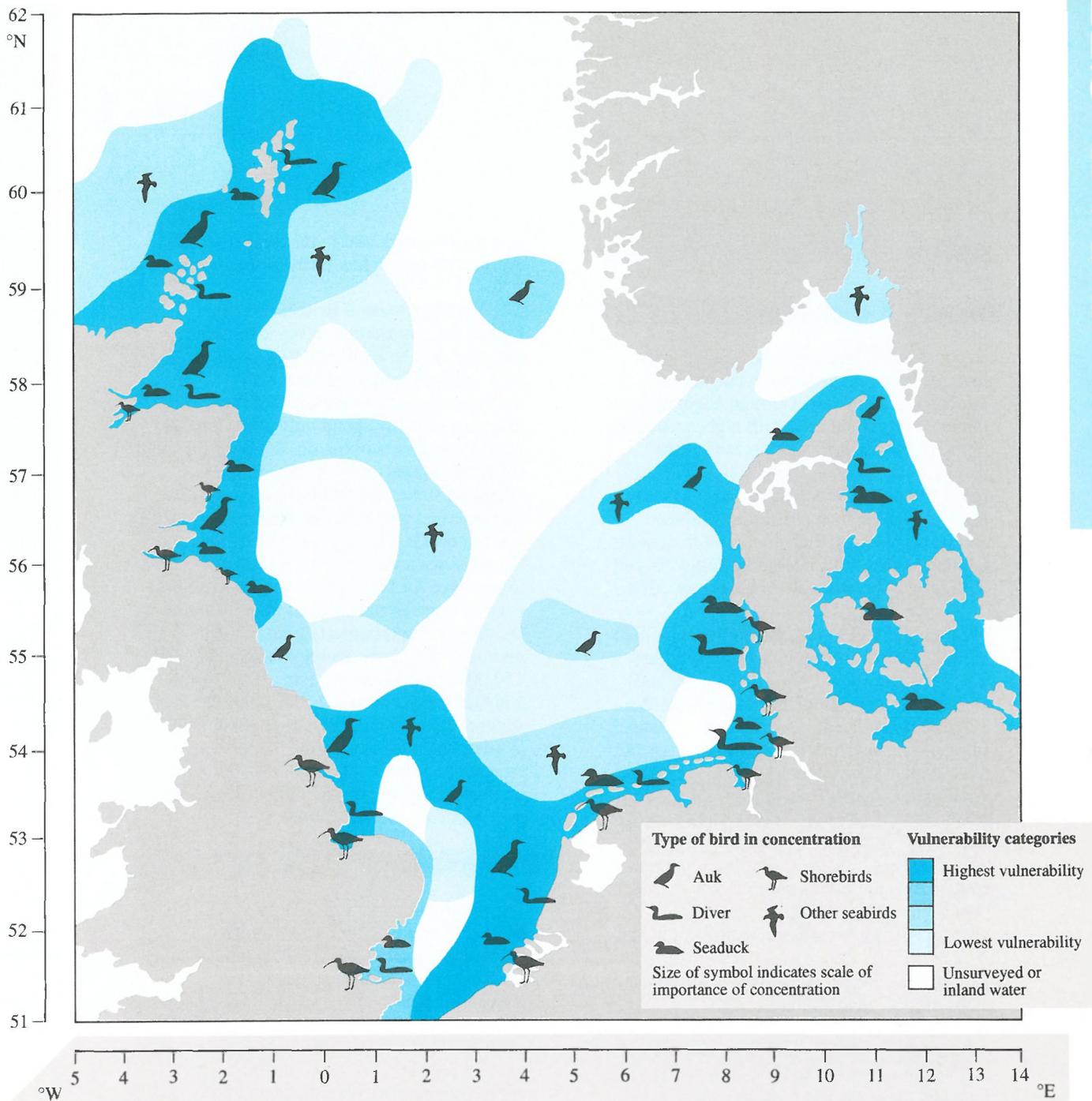


Oystercatchers
Photograph by Paul Doherty

over 100,000 birds from March to May. The Dutch and German sectors of the Wadden Sea each support internationally important numbers of five or six other wader species. The Netherlands Delta supports more than 1% of the flyway population of ten species of wader.

Offshore species

Highest densities of guillemots are found in the north-western North Sea in the vicinity of the major colonies. The moderate concentration over the Dogger Bank and Outer Silver Pit probably involves birds from the large colony on Flamborough Head. Immature, non-breeding birds do not visit colonies in the early part of the breeding season and may be found in southern and eastern parts of the North Sea. Razorbills are present in smaller numbers in much the same areas as guillemots. The inner Moray Firth and Outer Silver Pit are especially important for Razorbills. Some puffins return to waters close to their colonies during this month. The main colonies in the North Sea are in Shetland, the Firth of Forth and the Farne Islands, with substantial numbers in Orkney and on Flamborough Head. Many little auks move north out of the North Sea during March although moderate numbers are still present over the Fisher Banks. A large area to the west of Norway has yet to be surveyed and may prove to be important for little auks at this time.



Larger numbers of kittiwakes are found in the vicinity of the main colonies in March than in last month. Waters around Shetland, Orkney and off most of the east coast of Scotland are of major importance. High numbers are also found over the Fisher Banks and moderate or low numbers occur throughout the southern North Sea. The distribution of common and black-headed gulls is similar to that in February although inshore waters off the Netherlands become more important for common gulls. Many of the herring and great black-backed gulls that winter in the North Sea depart for breeding grounds in Norway during this month. Both species become much less common in the southern North Sea and most of the remaining birds probably stay to breed. The Moray Firth and waters around Orkney and Shetland are important for both

species; birds in these areas are probably a mixture of local breeders and birds on their way to breeding grounds further north. A few lesser black-backed gulls are present in the southern North Sea this month, having returned from wintering grounds further south. Low numbers of little gulls remain in the southern North Sea.

The distribution of gannets is very similar to that in February with areas near to colonies in the western North Sea of highest importance.

Fulmars become further concentrated in the north-west, especially in waters around Shetland. Relatively low numbers of presumably non-breeding fulmars are present in the central and southern North Sea.

April

Inshore and coastal species

Red and black-throated divers move north towards breeding grounds in considerable numbers in April. The German Bight remains the most important area with highest densities in the Danish sector. At least half of the divers in the German Bight at this time are black-throated divers which tend to occur further offshore than red-throated divers. Adult black-throated divers moult their wing feathers at this time, becoming flightless and therefore especially vulnerable to pollution.

Most of the world population of dark-bellied brent geese is concentrated in the Wadden Sea during April and May. The Dutch and German sectors support the majority of the 170,000 birds. Brent geese feed on grassland, saltmarshes and mudflats during the day, but roost on the sea at night and are therefore vulnerable to surface pollutants. Most of the small population of pale-bellied brent geese from Svalbard winter in northern Denmark. The remainder of the population winter in eastern Britain but in spring of most years migrate back to Svalbard via Denmark. Nissum Fjord is an important site at this time.

Seaduck continue to leave their wintering areas during April although large concentrations of most species are still present early in the month. Long-tailed duck and velvet scoter return to breeding sites later than other species and most remain at wintering sites during April. Eiders continue to return to breeding areas near the Tay, Ythan, Lindisfarne and in Orkney and Shetland during this month.

Black guillemots move close to their breeding areas during the early morning in order to display and secure a breeding site. The main concentrations are in Orkney, Shetland and Caithness. These birds remain in coastal waters throughout the year.

Four species of tern breed in numbers around the North Sea. Sandwich terns arrive from mid-March onwards, followed by common and arctic terns in April. Little terns are the last to arrive. In April, highest numbers of common and Sandwich terns are found along southern North Sea coasts and to the west of Denmark. Most arctic terns are seen to the

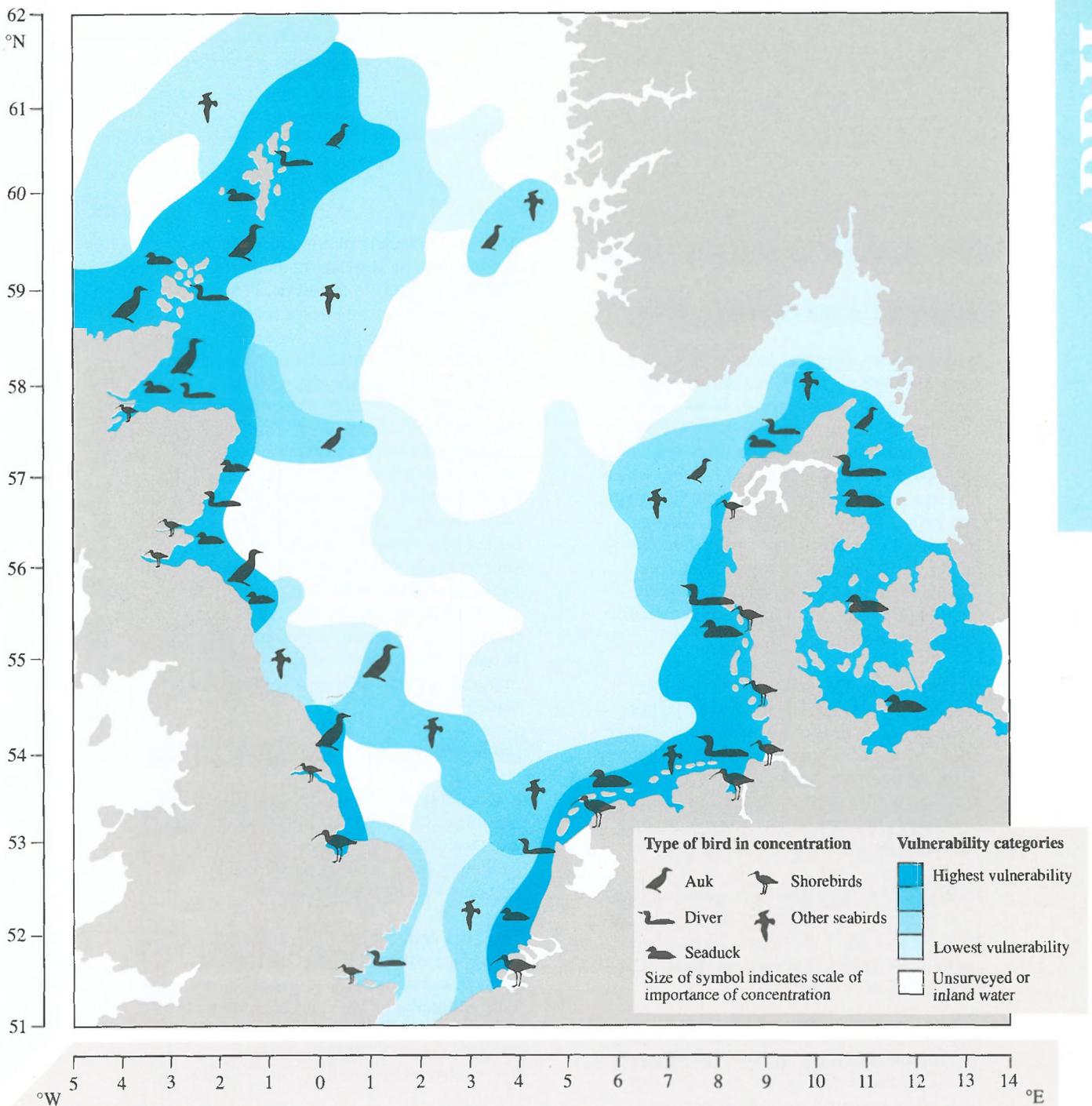
west of Denmark and in the Skagerrak in April, with only a few birds further north.

The Wadden Sea and British east coast estuaries are important in April for waders moving north to their breeding grounds. The peak monthly counts of birds will underestimate the importance of these estuaries as many spend only a few days at each site before moving on. Many of the long distance migrants rely on several sites as 'stepping stones' between wintering areas and breeding grounds. The Netherlands Delta and Dutch, German and Danish sectors of the Wadden Sea are each of international importance for between five and ten species, even in terms of absolute numbers. Dunlin are present in particularly high numbers with up to 180,000 in the Dutch Wadden Sea and 150,000 in the German sector. The Danish and German sectors of the Wadden Sea each support up to 40,000 bar-tailed godwit. The Wash is the most important site for waders on the east coast of Britain with six species in internationally important numbers including grey plover, dunlin and knot.

Offshore species

The distribution of most offshore species becomes heavily influenced by colony location in April as the breeding season starts. Guillemots and razorbills are concentrated in waters close to the colonies although some birds may commute a considerable distance between the colony and feeding grounds. For example, the concentration of guillemots over the Dogger Bank probably involves birds from the colony at Flamborough Head, about 100 km away. Low densities of immature guillemots remain in the southern and eastern North Sea with waters around Jutland of moderate importance. Razorbills have a similar distribution to that of guillemots in the western North Sea but few are found in the south and east. During April most adult puffins return to breeding areas; waters around Shetland, where the largest colonies are found, become particularly important.

Kittiwakes are widely distributed in the western half of the North Sea with highest densities near to the main colonies. They can range over large areas to feed and some concentrations occur up to 120 km from the nearest colony. Highest numbers of common and black-headed gulls are present close to



land in the southern North Sea and the Skagerrak and Kattegat; many of the common gulls move to breeding grounds further east during the month. The Moray Firth and Firth of Forth continue to support high numbers of herring gulls from nearby colonies. The inshore waters of the southern North Sea and the Skagerrak are also important for herring gulls in April. Great black-backed gulls are found in much the same areas as in March. Lesser black-backed gulls become more numerous in the North Sea in April with large numbers in the Skagerrak and moderate numbers in the southern North Sea and off the east coast of Britain.

Great skuas are present around the breeding colonies in Orkney and Shetland in April.

Few are seen elsewhere in the North Sea suggesting that they arrive from the west of Britain. Arctic skuas also begin to enter the North Sea in small numbers during this month.

Shetland waters and the Firth of Forth are of high importance to the large numbers of gannets that breed in these areas. The rest of the western North Sea supports much lower densities.

Fulmars are present in high densities in the same areas as in March.

May

Inshore and coastal species

Red and black-throated divers continue to move through the North Sea during May. Numbers peak in the German Bight in the first half of the month when up to 30,000 may be present. The majority of these birds are thought to be black-throated divers which undergo a complete moult of flight feathers in the spring. Those moulting into breeding plumage for the first time moult later than the adults and some may be flightless during April and the first half of May. Relatively small numbers of red-throated divers occur off eastern Scotland in May.

Most of the waders and wildfowl present around North Sea coasts in May are either local breeding birds or are preparing to move north. Most of the species moving so late nest in the arctic where severe conditions prohibit breeding earlier in the spring. Non-breeding individuals of some species remain around the North Sea during the summer.

Numbers of dark-bellied brent geese reach a peak in the Wadden Sea early in May before they depart later in the month. Most other estuarine wildfowl species have returned to their breeding sites by now.

High numbers of long-tailed duck and velvet scoter remain in the wintering areas until the middle of the month, before moving north to their arctic breeding grounds. Danish and Dutch waters continue to support considerable numbers of non-breeding and immature common scoter; these birds remain through the summer rather than moving north. Eiders are the only seaduck to breed in large numbers around the North Sea. The main breeding areas are in Shetland, Orkney, Grampian, the Firth of Forth, the Farne Islands, the Dutch Wadden Sea and Amrum in the German Wadden Sea. They are present in lower numbers along much of the rest of the Scottish, Danish and Norwegian coasts.

During April and May there is a movement of over 10,000 common terns along the Danish Skagerrak coast. Small groups of arctic terns seen well offshore in the south and east of the North Sea are probably migrants moving to colonies further north.

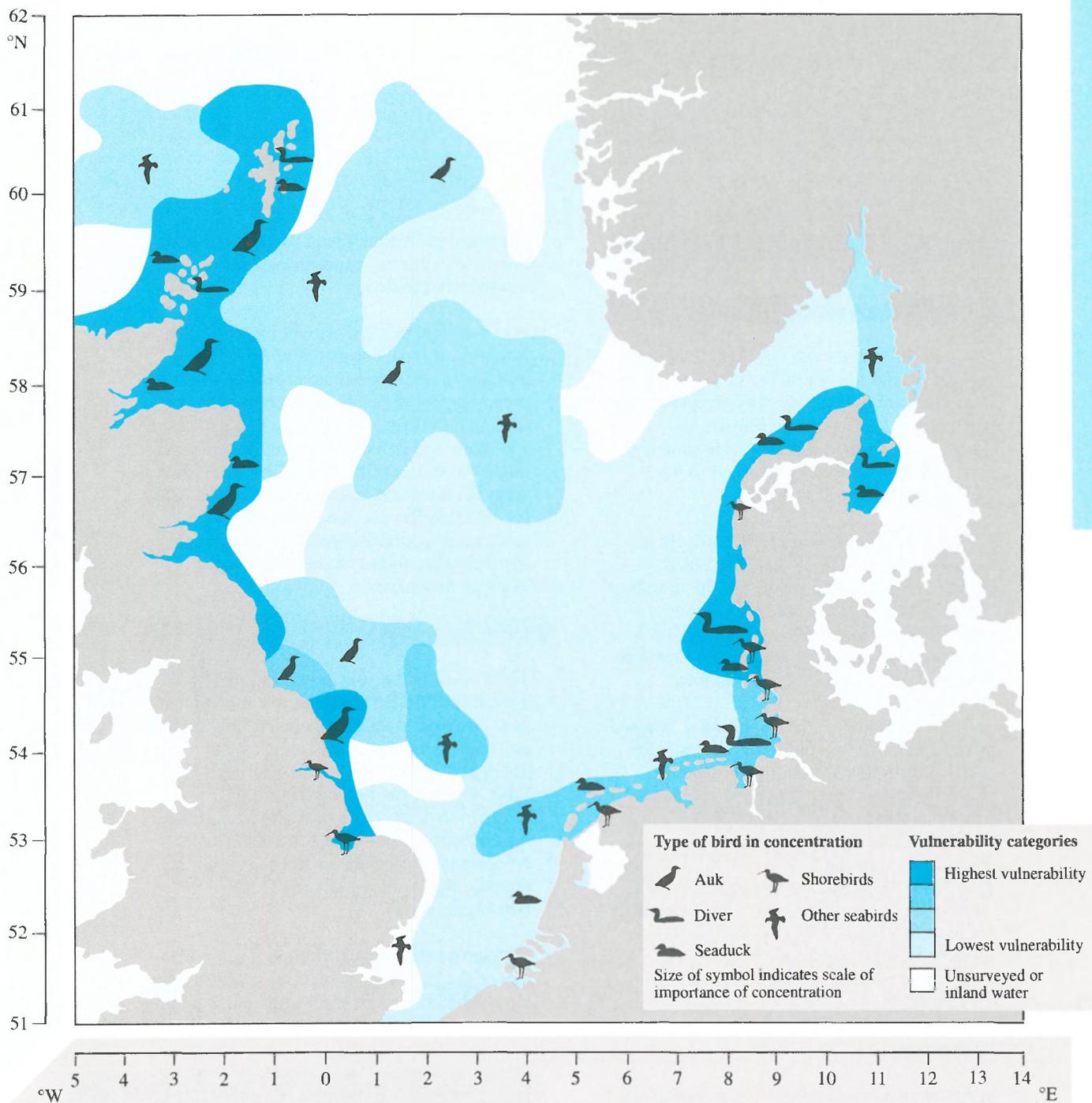
Most of the waders moving through the Wadden Sea in May are on their way to breeding grounds in the arctic. Peaks in numbers on migration occur for ringed plover, grey plover, knot, sanderling, dunlin, bar-tailed godwit and turnstone. Counts in the German sector include about 10,000 sanderling, 15,000 grey plover and 10-20 thousand bar-tailed godwit. The Dutch sector supports more than 15,000 sanderling and very high numbers of bar-tailed godwit. The Danish, Dutch and German sectors each have over 100,000 dunlin present at any one time during May. The German Wadden Sea supports peak numbers of spotted redshank in May when around 4000 are present. The Wash, Humber and Thames Basin are the most important areas on the east coast of Britain; each support internationally important numbers of several species of wader in May.

Offshore species

During May most breeding seabirds are either attending colonies to lay and incubate eggs or are present in waters close by. Birds seen well away from these areas are likely to be immatures and/or non-breeders.

The main areas of importance for auks are around the colonies in Shetland, Orkney, eastern Scotland and north-east England. Concentrations of breeding birds may occur up to 60 km away from colonies at this time of year (during the chick rearing period in June and July, birds tend to stay closer to the colonies).

Kittiwakes are also concentrated in the northern and western North Sea, although they range further from colonies than the auks. The Dogger Bank and Outer Silver Pit continue to be important for birds from the Flamborough Head colony. Only small numbers of other gull species are seen at sea during this month. Many have moved out of the North Sea to breeding areas further north and east. Of those that are present in the region, some breed well inland and do not feed offshore, and even birds from colonies on the coast may spend some of the time feeding inland. Despite this, the Moray Firth remains important for herring and great black-backed gulls and the Skagerrak is of moderate importance for lesser black-backed gulls.



Some summer visitors continue to arrive during May, including the few Manx shearwaters that breed in Shetland and most of the storm petrels that breed in Shetland and Orkney. Few storm petrels are seen offshore in the North Sea in the early part of the summer. Non-breeding Manx shearwaters and storm petrels spend longer in wintering areas and arrive in the North Sea later in the year. All breeding arctic and great skuas have returned to colonies by the end of the month.

Gannets are most common around the main colonies (Firth of Forth and Shetland) but may travel over 100 km to feed.

Most fulmars are found in the northern North Sea, many in offshore areas away from the colonies. Females do not generally lay their

single egg until around the middle of May and often leave the colonies for about ten days before laying. Birds can range some distance during this time, probably to build up fat reserves before the long incubation period begins.

June

Inshore and coastal species

Many of the waders and wildfowl that were present around the North Sea in winter, or on migration, are now at breeding grounds to the north, as far apart as arctic Canada and Siberia. Some failed breeders, non-breeding and immature birds have returned to the North Sea by the end of June.

A significant proportion of the north-west European population of shelduck breed around North Sea and western Baltic coasts; the Wadden Sea is a particularly important area. Shelduck may feed on intertidal areas throughout the breeding season and therefore remain at risk from surface pollutants.

Immature and male eider, common scoter and goldeneye move to moulting grounds in the eastern North Sea and Baltic during June. Large flocks of eider are present off south-western Jutland (around 100,000), the Dutch and German sectors of the Wadden Sea and the western Kattegat by the end of the month. The area off Grampian also supports a large flock of moulting eider and smaller numbers of common scoter. Waters west of Jutland support the most important flocks of moulting common scoter in late June when over 100,000 are present. Lower numbers moult in the western Kattegat and Jammerbugt.

Shags and cormorants breeding around North Sea coasts use inshore waters throughout the year. Most of the 20,000 pairs of shag in the North Sea (10% of the world population) breed on rocky coasts in the north-west, with low numbers along the Norwegian coast. The majority of coastal breeding cormorants in the North Sea are also found in the north-west. About half of the 2100 pairs breeding on the coasts of north-eastern Britain are found in Orkney and Shetland.

All breeding terns have arrived at the colonies by June and feed mainly close to land during the breeding season. Arctic terns and common terns breed on most coasts around the North Sea. About three-quarters of the arctic terns are found in Shetland and Orkney, while about half of the North Sea common tern population breeds around the Skagerrak. Most of the rest of the common

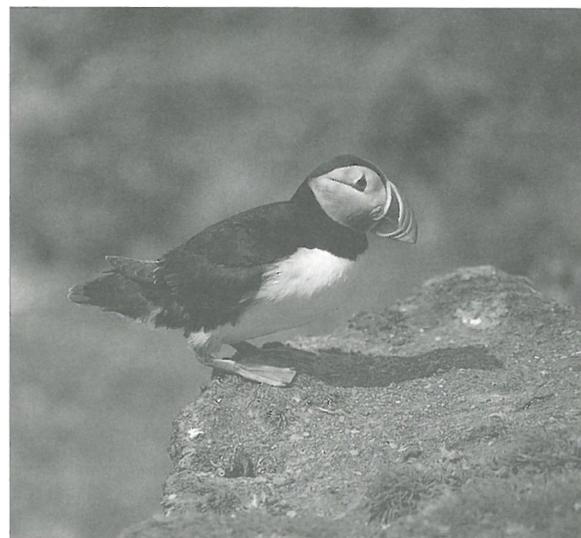
terns nest on Wadden sea coasts. Little and Sandwich terns are concentrated in the southern North Sea.

Few wading birds are present on North Sea estuaries in June, compared with the large numbers that use these areas outside the breeding season. Substantial proportions of the small north-west European populations of spoonbill, redshank and ringed plover breed along the shores of the North Sea. Important areas for redshank and ringed plover include the Wadden Sea and the Wash. The only remaining spoonbills breeding around the North Sea are found on the Netherlands Wadden Sea coast.

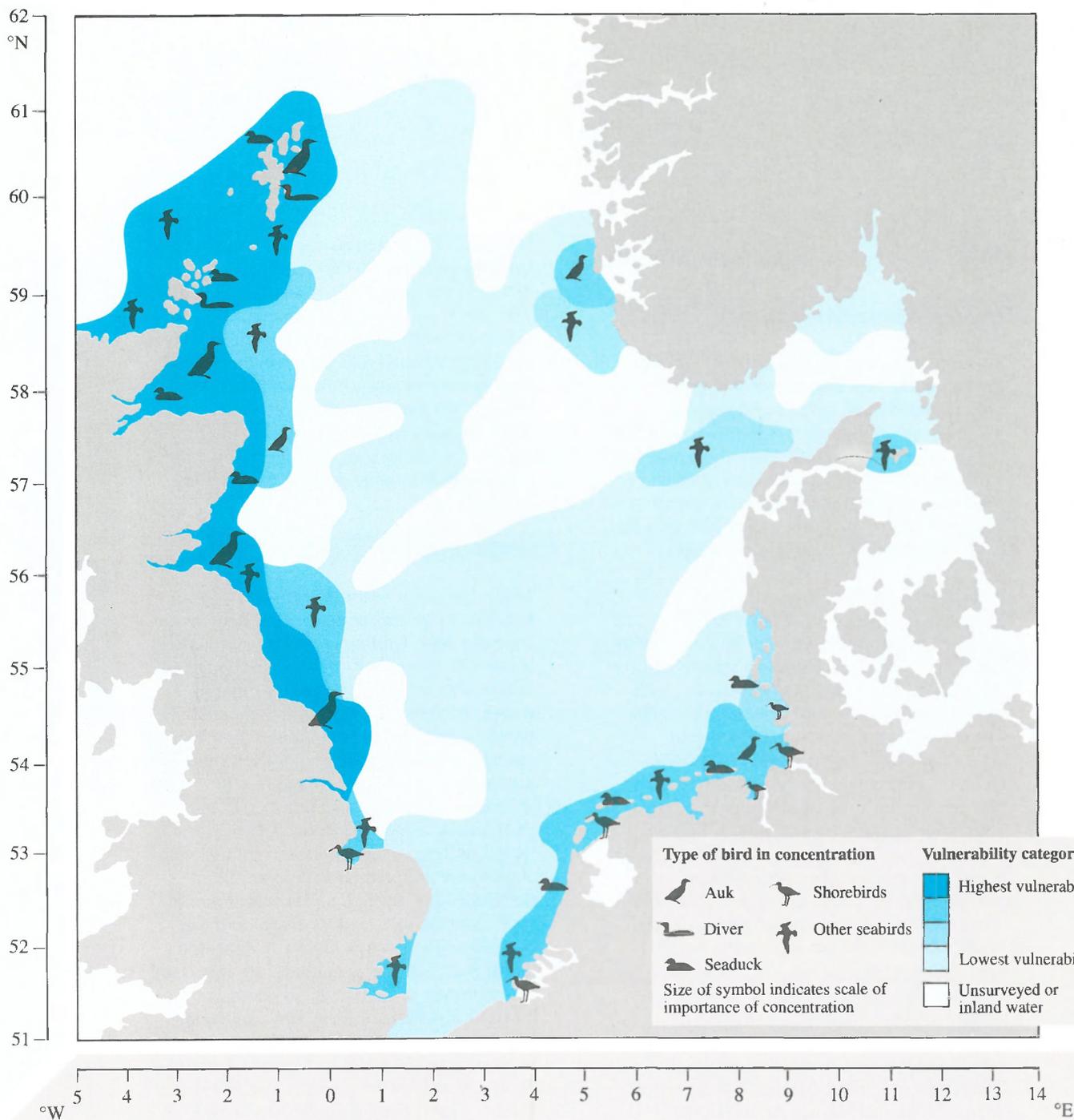
Offshore species

The three offshore species of auk that breed around the North Sea are more concentrated in areas close to their colonies in June than at any other time of year. Waters close to Shetland, Orkney, north-east Scotland, the Firth of Forth, the Farne Islands and Flamborough Head are of major importance for all three species. There are also small colonies of guillemots on Helgoland in the German Bight and on Utsire off the Norwegian coast.

Kittiwake breeding distribution is similar to that of the guillemot, with largest numbers in the north and west of the North Sea. Breeding birds are largely concentrated in areas close



Adult puffin
 Photograph by
 Ian Carter and Selena Trikilis



to colonies although they may travel greater distances than most auks to feed. Relatively few birds are seen in the central North Sea at this time. Other gull species remain scarce offshore with breeding birds spending most of their time at the colonies or feeding inland. However, the Moray Firth and inshore waters in the southern North Sea are of moderate importance for all three large gull species and relatively small numbers of lesser black-backed gulls continue to feed at sea in the Skagerrak. Some herring gulls breeding in north-east England and south-east Scotland also feed offshore.

Relatively few great skuas are seen offshore in June. Most of the breeding birds in Orkney and Shetland are at the colonies defending territories or incubating eggs, and even non-

breeding birds spend much time around the colonies. Lesser numbers of arctic skuas breed in similar areas and also spend much time on, or close to land.

High densities of gannets occur around the entrance to the Firth of Forth near to the large colony on Bass Rock. Numbers breeding on four islands within the Shetland group are about the same as the numbers on Bass Rock (over 20,000 pairs).

Fulmars are found in highest densities close to the large colonies in Shetland, Orkney and north-east Scotland. High densities are also found over the Fisher Banks and in the Skagerrak, with moderate densities offshore in the central and southern North Sea.

July

Inshore and coastal species

The end of June or beginning of July marks the end of the breeding season for many coastal and inshore species. Adults and juveniles of some species start moving south to coastal sites around the North Sea, either to wintering areas, or stopover sites to feed before continuing to migrate south. Other species move to moulting sites which may be well away from the final wintering areas.

A large proportion of the north-west European population of about 270,000 shelduck moult on the Grosser Knechtsand in the Helgoland Bight. Numbers start to build up in June and reach a peak in August, with some moulting birds still present in October. These birds are flightless for about four weeks sometime between early July and October, and remain on the water over high tide periods; they are therefore particularly vulnerable to surface pollutants at this time.

There is a major influx of several species of seaduck into the North Sea in July. Numbers of moulting eider and common scoter build up during the month at sites mentioned in June. Many of these birds are particularly vulnerable to pollution from mid-July into August as they moult their wing feathers simultaneously and become flightless. Male velvet scoter arrive at moulting areas in Danish waters during July and by the end of the month up to 5000 are present in the western Kattegat. These birds become flightless at the end of July and through the first few weeks of August. Peak numbers of moulting male red-breasted mergansers are present in waters around Denmark towards the end of July. Up to 2000 birds are present in Limfjorden with further flocks around the Baltic islands.

Many terns finish breeding in July and begin to move south along coasts on both sides of the North Sea.

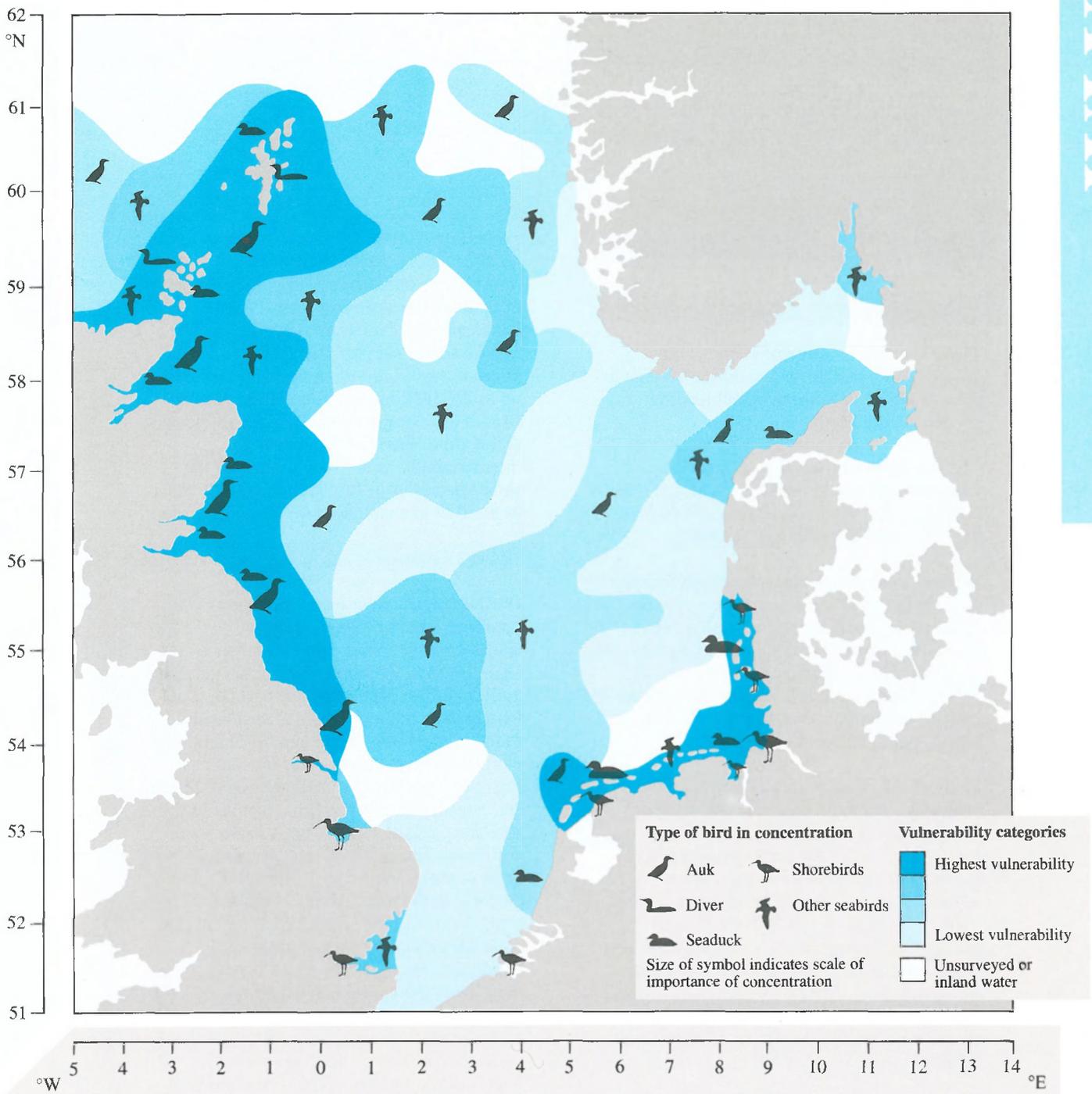
Wading birds arrive at North Sea estuaries and mudflats in huge numbers in July as birds return from breeding grounds. All sectors of the Wadden Sea support internationally important numbers of between five and ten species with particularly high numbers of knot, dunlin, bar-tailed godwit, curlew and

redshank. The Dutch sector has up to 30,000 bar-tailed godwit, 70,000 curlew, 30-40 thousand redshank and around 10,000 avocet. The Dutch and German sectors hold important numbers of passage curlew sandpiper, spotted redshank and greenshank. On the western side of the North Sea the Wash is the most important site with internationally important numbers of ten species, including grey plover, dunlin, knot, sanderling, bar-tailed godwit, curlew and redshank.

Offshore species

Many species of seabird begin to disperse from their colonies and nearby waters in late June and July. Guillemot and razorbill chicks leave cliff ledges before they can fly and are dependent on the male parent for many weeks. At the same time, immature and non-breeding birds leave the colonies and disperse out to sea. Towards the end of the month full grown birds start to moult and lose the ability to fly. For these reasons both species are particularly vulnerable to oil pollution at this time. Guillemots tend to move rapidly south and/or east from the large colonies in the north-western North Sea. They are found in high numbers across most of the northern North Sea and in large areas of the central North Sea. Very large numbers are found off the east coast of Britain as far south as Yorkshire, with the Moray Firth and waters off Grampian supporting the highest densities in most years. Guillemots begin to arrive in the Skagerrak by the middle of July and are present there in large numbers by the end of the month. Razorbills do not disperse to the same extent as guillemots at this time and few are present in the central and eastern North Sea. The most important areas for razorbills are off Grampian and the Moray Firth. Puffins continue to attend colonies in July and so waters around the largest colonies remain important.

Many kittiwakes are feeding chicks during July and highest densities are therefore found in the western North Sea near to the major colonies. Large numbers are found over a wide area to the south and south-east of Shetland and Orkney, and off eastern Britain at least as far south as Flamborough Head. The Dogger Bank and Outer Silver Pit are also important for kittiwakes. Most other gull species remain close to their breeding grounds. Small numbers of migrant common



gulls occur in the southern half of the North Sea along with smaller numbers of black-headed gulls. Herring and great black-backed gulls are found in much the same areas as in June. Moderate numbers of lesser black-backed gulls are present in waters off the Netherlands and in the Skagerrak.

There is an influx of Manx shearwaters and storm petrels into the north-western North Sea during July. Many of the storm petrels are concentrated around Shetland and Orkney near to the breeding grounds. Some of those present further offshore are likely to be non-breeding birds.

There is also an influx of great skuas into the North Sea in this month. Highest numbers occur around the colonies in Shetland and

Orkney. Lower numbers are present across much of the North Sea, including the Southern Bight and the Skagerrak.

Gannets are still in the middle of their breeding season and so adults are concentrated around the main colonies (Shetland and the Firth of Forth). Non-breeding birds occur throughout the North Sea.

August

Inshore and coastal species

There is a steady influx of waders and wildfowl into the North Sea during August as birds continue to migrate from breeding grounds to the north.

The flock of moulting shelduck on the Grosser Knechtsand peaks in August at over 100,000 birds; this represents about 40% of the north-west European population.

Seaduck continue to enter the North Sea and western Baltic in large numbers as female and juvenile birds of species such as eider and velvet scoter migrate to moulting areas to join birds already present. Large flocks of common scoter and red-breasted merganser remain throughout August in the moulting areas mentioned previously.

Many of the *sinensis* race of cormorant breeding at inland colonies in the western Baltic move to coastal waters in late July and August. About 50,000 cormorants (most of the *sinensis* race) are present in Danish waters in August, mainly on the east coast of southern Jutland and around the Danish islands. Smaller numbers are found along the Baltic coast of Germany and in the German and Dutch Wadden Sea. Highest numbers of cormorants of the race *carbo* are found along the coasts of eastern Scotland, Shetland and Orkney.

Terns continue to move southwards along North Sea coasts in August. Most common, arctic and Sandwich terns are found off southern Norway, the Skagerrak and along the continental seaboard, with fewer along the east coast of Britain.

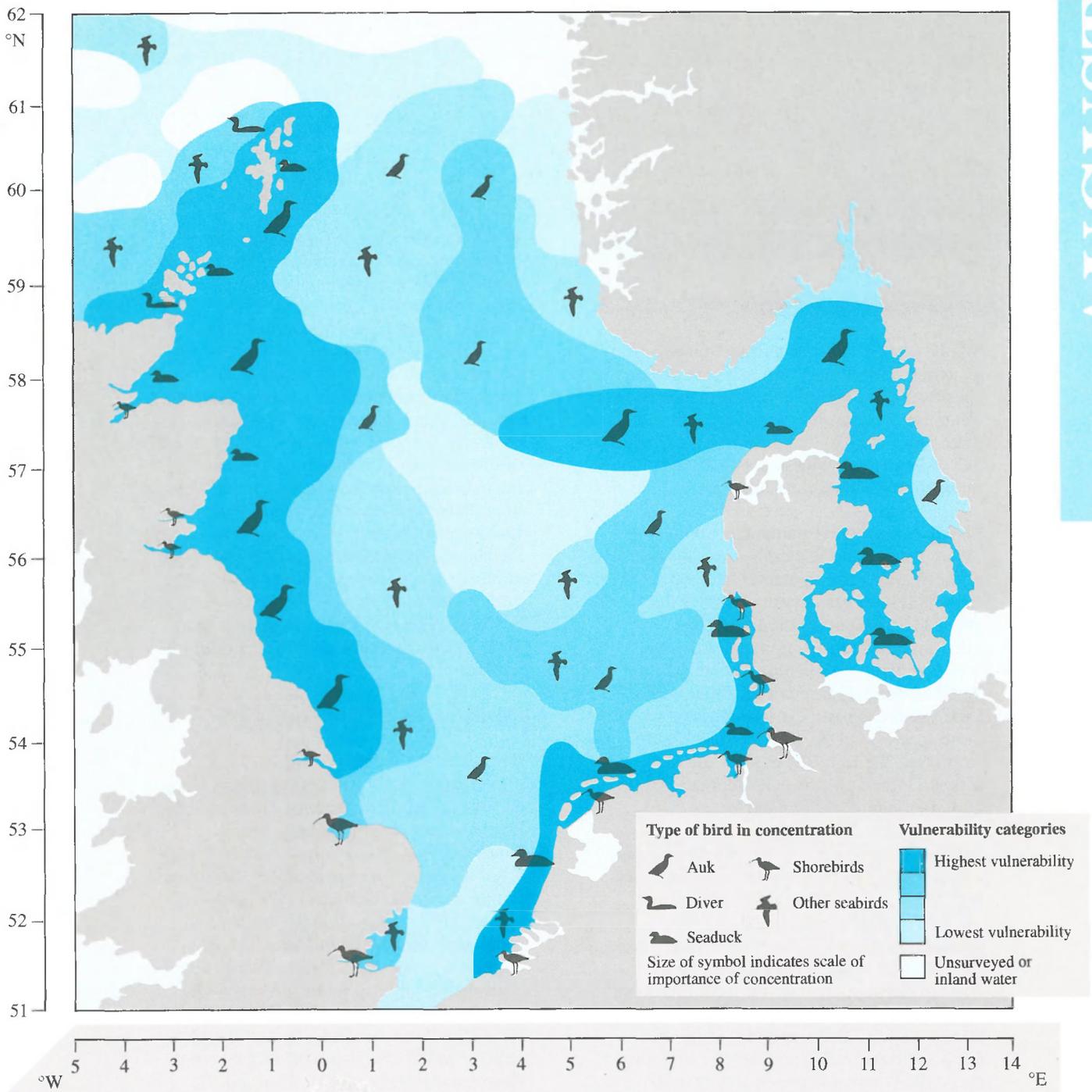
Several hundred spoonbills from coastal and inland colonies move to the Dutch Wadden Sea in August to feed before migrating south. Huge numbers of wading birds move onto estuaries and mudflats around the North Sea during August and all sectors of the Wadden Sea support hundreds of thousands of birds. In August of most years, peak numbers of avocet, sanderling, curlew, spotted redshank, greenshank and turnstone are recorded in the Wadden Sea. The Dutch sector supports the highest numbers of most of these species, including about 15,000 avocet, 7000

sanderling, 70,000 knot, 150,000 dunlin, 70,000 curlew, 5000 greenshank and 5000 turnstone. Internationally important numbers of up to eleven species occur in each of the Dutch and German sectors in August. The Danish sector supports six species in internationally important numbers, including up to 250,000 dunlin. Estuaries in eastern Britain also support large numbers of waders at this time. The Wash supports internationally important numbers of the same species as in July including up to 12% of the flyway population of bar-tailed godwit

Offshore species

During August colonies of guillemots and razorbills become largely deserted as the last adults disperse to sea. Huge numbers of flightless, and therefore extremely vulnerable guillemots are present off the east coast of Britain. The highest densities are usually found in the Moray Firth and off Grampian, with lesser concentrations as far south as Flamborough Head. Waters between Shetland and Norway hold fewer birds than in July and it seems likely that these birds move south-east to the Fisher Banks and Skagerrak where large concentrations occur. Razorbills do not disperse to the same extent as guillemots and birds from colonies in Shetland and Orkney concentrate in the Moray Firth and off Grampian. Most puffins finish breeding this month and the young leave their burrows for the sea. Moderate concentrations are present east of Britain in a wide area from Shetland south to Yorkshire, and to the west of Shetland and Orkney. Birds from Shetland and Orkney may disperse offshore to the west of Britain.

Kittiwakes also disperse from their colonies in August. They move south from Shetland and Orkney and large numbers are present to the east of Britain in the same areas as the auks. Some move offshore and moderate numbers return to the southern and eastern North Sea. Common gulls become widespread in the southern and eastern North Sea as local breeding birds leave colonies and migrants continue to arrive from the Baltic. The numbers of lesser and great black-backed gulls at sea increases in August. Both species are most numerous in the southern and eastern North Sea and there are also moderate concentrations off north-eastern Britain. The Skagerrak and northern Kattegat are especially important for lesser black-backed



gulls at this time of year. Herring gulls generally remain near to the coast as in July. Little gulls move into the southern North Sea in August with highest numbers in waters off the Netherlands. A few are present off the east coast of Britain, especially near the Firths of Forth and Tay.

Peak numbers of petrels and shearwaters are found in the North Sea in August. The storm petrels and Manx shearwaters present in the north and west of the North Sea probably originate from populations breeding in the north and west of Britain.

Great skuas leave their breeding grounds and spread south and east, becoming widespread in the North Sea.

Young gannets start to leave the colonies towards the end of the month. They are flightless for a short time after leaving the nest and so are especially vulnerable to surface pollution.

Some fulmars are still feeding young during August and high numbers remain in the north and west near to the colonies. Adults that have finished breeding and young that have fledged move south and east, and high densities may be found almost anywhere in the North Sea.

September

Inshore and coastal species

Wildfowl and waders continue to move onto estuaries around the North Sea with some species present in higher numbers than at any other time of year. It is estimated that over three million birds are present on the Wadden Sea in September with many species in internationally important numbers.

Shelduck disperse from the Helgoland Bight in late August and September and all sectors of the Wadden Sea then hold internationally important numbers. Various parts of the Wadden Sea support internationally important numbers of brent and barnacle geese, wigeon, teal, mallard and pintail, as numbers build up through the month. The Dutch sector is particularly important for all these species. On the western side of the North Sea, the Lindisfarne flats and the Moray/Dornoch Firths hold internationally important numbers of wigeon.

Large numbers of eider, common scoter and velvet scoter continue to enter the North Sea and Baltic in September as female and juvenile birds return from the breeding grounds. Waters to the west of Jutland, the Kattegat, the Baltic Straits and the Baltic coast of Germany remain the most important areas. Most common scoter in Danish waters have completed their moult by September and some travel south and west to wintering areas. Many move to Dutch waters or the Thames estuary, but others winter well south of the North Sea.

Most terns have left the region by the end of September. Inshore waters along the Netherlands Wadden Sea coast continue to support significant numbers of common, arctic and Sandwich terns in the first half of the month.

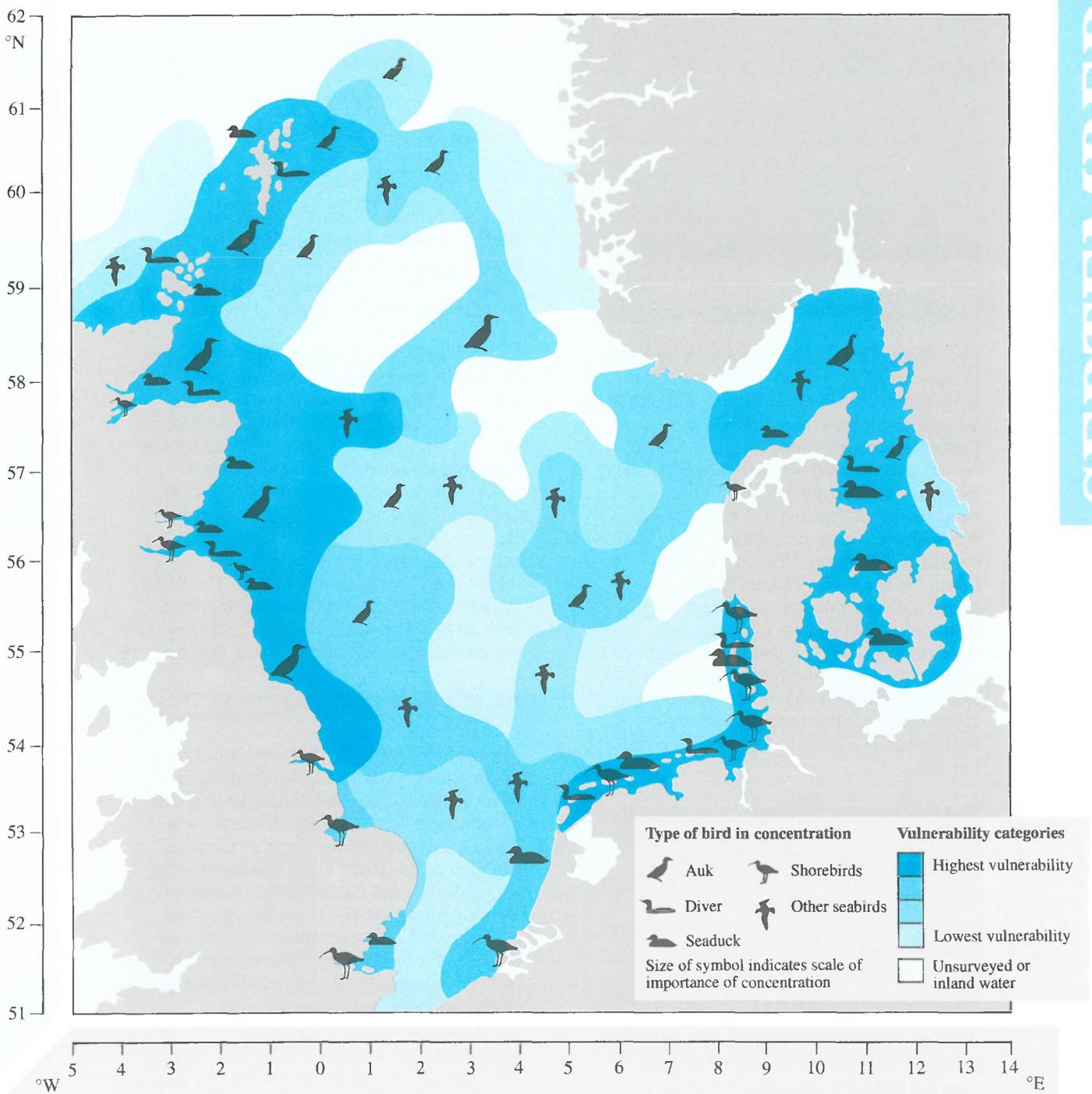
The Wadden Sea supports internationally important numbers of the same species of waders as in August. Numbers of ringed plover, grey plover, knot and dunlin peak in most parts of the Wadden Sea, with the Dutch and German sectors holding highest numbers of most species. About 14,000 grey plover (9% of flyway population), 80,000 knot (20% of the flyway population), and 80,000 curlew (20% of flyway population) are present in the

Dutch Wadden Sea in September. The Wadden Sea in Schleswig-Holstein supports around 10% of the flyway population of ringed plover. All sectors hold over 150,000 dunlin in September and up to 350,000 (25% of the flyway population) are found in the Danish sector. The Wash supports nine species in internationally important numbers, including peak numbers for the year of oystercatcher, grey plover and dunlin. Several of the complex of estuaries in the Thames Basin hold internationally important flocks of grey plover and most hold over 1% of the flyway population of redshank. Further north, the Humber holds internationally important numbers of four species of wader including peak numbers of grey plover for the year. The Firths of Forth and Tay each support two or three species in internationally important numbers.

Offshore species

Large areas to the east of Britain are still important for auks during September. Highest densities of guillemots remain in the Moray Firth and east of Grampian. Large concentrations also occur off eastern Britain as far south as Humberside, over the Fisher Banks and in the Skagerrak. Birds tend to spread further offshore in September and some areas in the central North Sea are important at this time. Razorbill distribution also spreads slightly south and east with a wide area from Orkney to the Firth of Forth supporting large numbers. Waters between Orkney and Shetland and off Flamborough Head are also important. Puffins are uncommon in inshore waters by September; a large area off the Firths of Forth and Tay supports moderate to high numbers.

High numbers of kittiwakes remain off the east coast of Scotland and north-east England, although there is some further dispersal into offshore areas of the North Sea. Herring and great black-backed gulls become more common in the North Sea as birds move into the area from breeding grounds to the north and local birds move away from their colonies. The Skagerrak is the most important area for herring gulls, with smaller numbers in the southern North Sea and off the east coast of Britain. Great black-backed gulls are widespread throughout the North Sea, with highest densities off eastern Britain and in the Southern Bight. Most herring and great black-backed gulls in the northern North Sea



are birds of Norwegian origin. Many lesser black-backed gulls leave the North Sea in September for wintering areas to the south. Significant numbers are still found in the northern Kattegat, Skagerrak and southern North Sea.

Large numbers of arctic and some pomarine skuas move south into the North Sea from August to November. Many move back north and pass out of the North Sea around the north of Scotland, before continuing to migrate south.

Moderate numbers of Manx shearwaters and storm petrels remain in the North Sea in September. Most Manx shearwaters are found in the north-west, with the Moray Firth supporting highest numbers in most years.

Sooty shearwaters arrive in the North Sea during August and September. These are non-breeding birds from the south Atlantic and their numbers vary from year to year. Most remain in the north-western North Sea. Storm petrels are also most frequently seen in the north-west although some move as far south as Humberside in the western North Sea.

October

Inshore and coastal species

Red-throated and black-throated divers begin to leave breeding grounds from mid-August, arriving in waters west of Denmark and in the western Baltic from September to November. Concentrations are found for short periods in coastal areas around northern Denmark, such as the north-western Kattegat. Smaller numbers of red-throated divers are found off the Wadden Sea, in the southern Moray Firth, the Firths of Forth and Tay, off eastern Grampian and in the Thames Basin. Red-throated divers undergo a complete wing moult in autumn and are flightless, and therefore particularly vulnerable to pollution for a few weeks between mid-September and December. Small numbers of great northern divers return to sheltered waters around Shetland and Orkney during September and October.

Shelduck continue to disperse away from the main moulting site on Grosser Knechtsand in October. Around 50,000 are found in the Dutch Wadden Sea and over 20,000 occur in both the German and Danish sectors. Numbers of dark-bellied brent geese build up in the Wadden Sea during October; up to 20% of the north-west European population are present in the Danish sector. Other sectors of the Wadden Sea, the Wash and the Thames Basin support smaller, but still internationally important flocks. Pale-bellied brent geese from the small Svalbard population are concentrated in the Mariager and Randers fjords in eastern Denmark during October and November. Some birds from this population move across the North Sea in October to winter at Lindisfarne. The 50,000 barnacle geese present in the Dutch Wadden Sea in October represent the majority of the Russian breeding population. The remainder of this population winters in the German Wadden Sea. Wigeon, teal, mallard and pintail are found in the same areas as September but in higher numbers. The Dutch sector of the Wadden Sea supports the highest numbers, including about 75,000 wigeon and 20,000 teal.

Common scoter, velvet scoter and goldeneye continue to move into coastal waters around the North Sea and western Baltic. Small numbers of scaup and long-tailed duck arrive

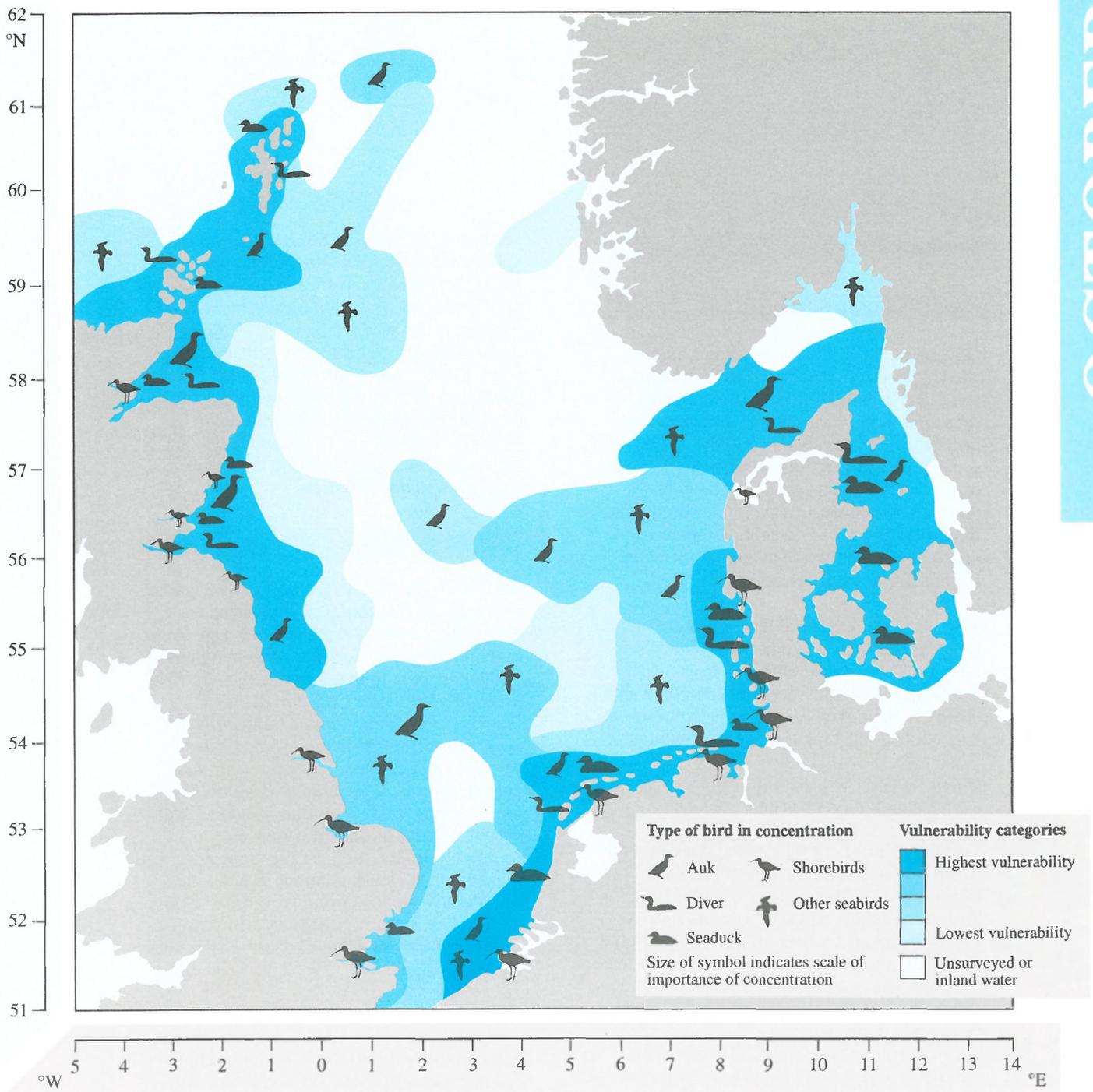
back on wintering grounds during October having moulted further north and east. Important areas are the western Kattegat, Baltic Straits and Baltic coast of Germany.

Fewer waders are present in the Wadden Sea in October compared with September, as large numbers have moved south and west out of the area. However, all species which occur in internationally important numbers in September, with the exception of ringed plover, remain above these levels in October. On the western side of the North Sea, the Humber, Wash and Thames Basin each support from four to eight species in internationally important numbers. The Wash is particularly important for wintering knot, with up to 40% of the east-Atlantic flyway population present from the end of October.

Offshore species

The southern North Sea becomes much more important for guillemots and razorbills in October, although inshore areas off Scotland and northern England still hold the highest densities. Guillemots are found at moderate densities across much of the southern half of the North Sea and the Skagerrak. Razorbills disperse south and east to similar areas and the Skagerrak holds significant numbers for the first time since March. Survey effort is poor in the central and north-eastern North Sea but some areas of importance to guillemots have been found. Some guillemots, and a few razorbills, visit their nest sites and nearby waters during October. This behaviour occurs most frequently in more southerly colonies such as the Isle of May and Fowlsheugh. Puffins have largely dispersed away from inshore areas by October and only low densities remain off the east coast of northern England and southern Scotland. Low numbers are seen offshore in parts of the central North Sea where survey effort is poor and off the north and west of Denmark. Little auks move south from the northern breeding colonies during October and moderate numbers occur in the Skagerrak and eastern-central North Sea.

Large numbers of kittiwakes are found in the Skagerrak, over the Dogger Bank and off eastern Scotland and north-east England in October. More are found in the southern North Sea than in the last few months. Common gulls become much more numerous in the southern North Sea in this month. The



majority occur close to land and waters off the Netherlands support the highest densities. Highest densities of herring gulls are found off Belgium, the Netherlands and in coastal waters west of Denmark. Great black-backed gulls are found in similar areas with proportionately fewer in the southern North Sea and Skagerrak, and higher numbers east of Britain. The Moray Firth remains important for both herring and great black-backed gulls. Highest densities of lesser black-backed gulls are found off the Netherlands Delta and a few remain in the Kattegat, Skagerrak, south-eastern North Sea and off the east coast of Britain. Little gulls are found in coastal waters of the southern North Sea and off parts of eastern Britain; concentrations are present off the Firth of Tay in eastern Scotland and off the Netherlands Delta region.

Great skuas remain widespread in low numbers with a higher proportion of birds in the southern half of the North Sea than earlier in the year.

Waters close to large gannet colonies become less important for this species by October as young and adults disperse. Offshore areas in the southern half of the North Sea hold higher numbers than at any other time of year.

Fulmars remain common throughout most of the northern and central North Sea.

November

Inshore and coastal species

November is the first of the winter months when periods of freezing weather are likely and the distribution of birds using coastal sites around the North Sea is influenced by the severity of the weather. Cold weather usually leads to a reduction in the importance of sites in the east as waders and wildfowl move south and west to avoid the conditions. In particularly severe weather large numbers of birds leave the Wadden Sea for estuaries around Britain and Ireland.

The numbers of barnacle geese present in the German and Danish Wadden Sea increase as birds move away from the Dutch sector. The Dutch sector remains the most important area however, with over 40,000 birds. Numbers of wigeon, teal, mallard and pintail remain in large numbers with highest counts in the Dutch Wadden Sea. Around 120,000 wigeon are present in this sector in most years.

There is an influx of long-tailed duck into the North Sea and Baltic in November and December as birds that have moulted on breeding grounds return to wintering areas. The Kattegat and western Baltic support large flocks and there are moderate numbers in the southern Moray Firth. Large numbers of scaup arrive in the western Baltic during the month and important concentrations occur in the western Kattegat, Baltic Straits and off the Baltic coast of Germany. Peak numbers of red-breasted merganser are found in Danish waters in November with up to 7500 in the Baltic Straits. In the western Baltic goosander move from inland lakes to the coast from mid-October to November, the exact timing dependent on the severity of the weather. Flocks of goosander build up in the Dutch Wadden Sea, Limfjorden, around the Danish islands and along the Baltic coast of Germany. Large numbers of wintering seaduck are now present in the southern North Sea and Baltic - see January and February.

Although many species of wader that use North Sea estuaries during migration are now only present in low numbers, large numbers of some species remain for the winter. The Dutch Wadden Sea for example may support around 130,000 oystercatcher, 30,000 knot, 100,000 dunlin and 35,000 curlew. Other

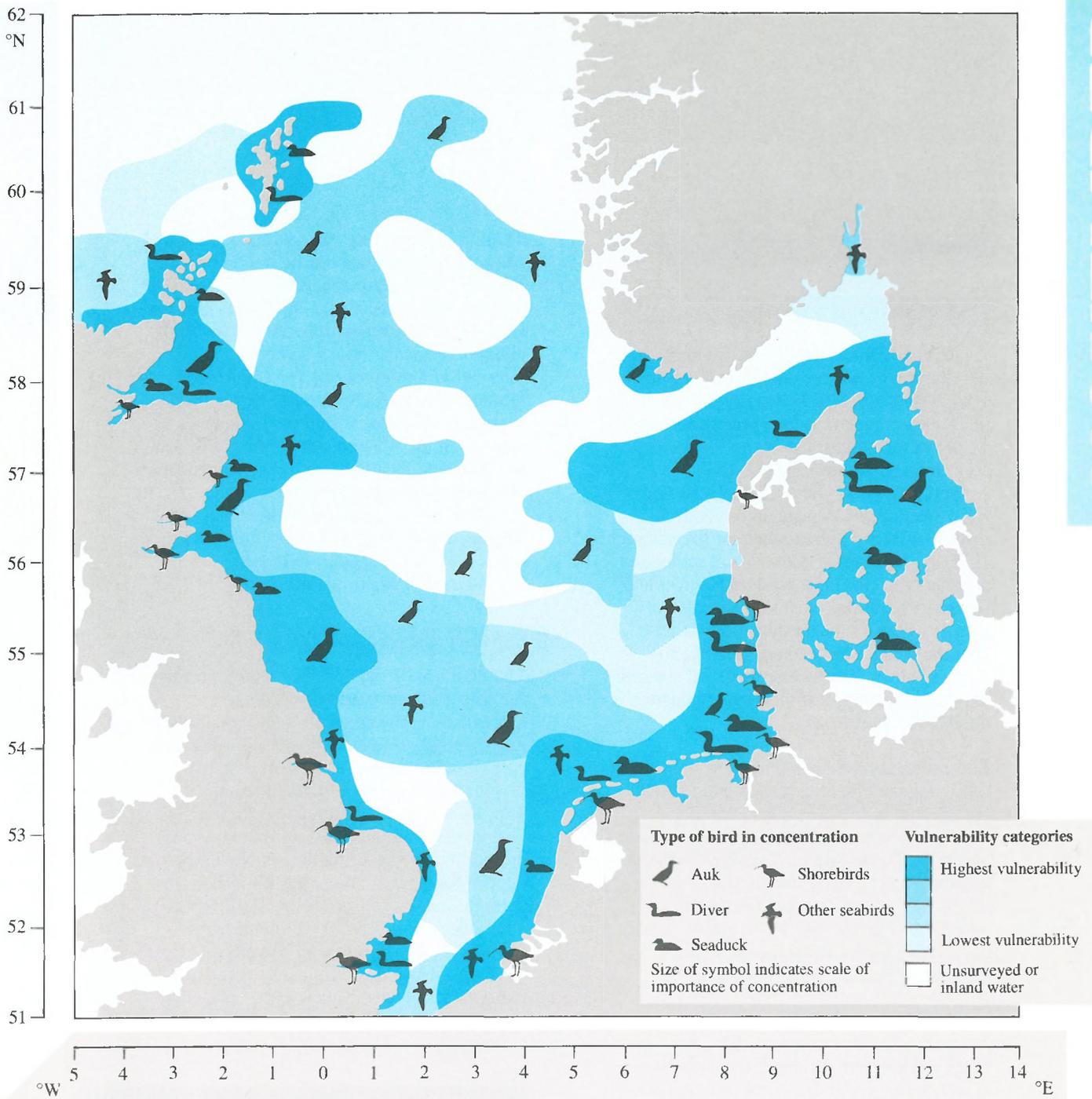
sectors of the Wadden Sea hold the same species in smaller but still internationally important numbers. Numbers of knot increase on British east coast estuaries as birds move west from the Wadden Sea. The Wash and Thames Basin complex are internationally important for seven species of wader. Purple sandpipers arrive on rocky coasts of southern Norway and north-east Britain in large numbers. Significant numbers of turnstone also winter on rocky shores in these areas, as well as on major estuaries.

Offshore species

The Fisher Banks, Skagerrak and Kattegat are important for wintering guillemots and razorbills; the inner Kattegat holds especially high numbers of razorbills. Large numbers of guillemots remain in the northern North Sea, especially off eastern Britain. Razorbills become less common in the north although some are still found in the Moray Firth and off north-east England. Puffins occur at low densities in many offshore areas north of a line from the Wash to northern Jutland, with very few south of this line; the western-central North Sea supports the highest numbers. Little auks continue to enter the northern North Sea during November. High numbers are found off Norway with lesser concentrations off north-east Britain and over the Fisher Banks.

Kittiwakes are common over much of the southern North Sea and large concentrations occur in the Skagerrak and Kattegat. High densities are still found off north-east Britain and offshore in the northern North Sea. Common and black-headed gulls remain concentrated in coastal waters in the southern North Sea and around Denmark. The coastal areas with high numbers of herring and great black-backed gulls in October continue to be important in November and there is a large increase of both species in offshore areas of the North Sea. These are mainly breeding birds from northern Norway returning to winter in the North Sea. Lesser black-backed gulls have mostly left the region to winter inland or south of the North Sea. A few stragglers are still present in the south and a small concentration remains off the Netherlands Delta.

Most great skuas have left the North Sea by November. Many of those still present stay for the winter and are mainly seen around fishing vessels.



Gannets are widespread in western and central areas as many adults remain in the North Sea for the winter. Immatures tend to disperse further than adults and few remain in the North Sea.

Fewer fulmars are seen in the North Sea in November than in previous months. Densities drop in the south and increase in the north-west, suggesting that birds move to the north-west before leaving the North Sea. Recoveries of ringed birds indicate that non-breeding and immature birds are most likely to be involved in this movement.

December

Inshore and coastal species

As in other winter months, the numbers and distribution of inshore and coastal species around the North Sea is heavily influenced by the weather. In severe weather, waders and wildfowl move west out of the Wadden Sea, concentrating in areas such as the Netherlands Delta and on British estuaries. Most seaduck are dependent on ice-free inshore waters. High numbers of species such as scaup, long-tailed duck, velvet scoter and goosander occur in the western Baltic when freezing conditions exist to the north and east. If waters in the western Baltic freeze then the North Sea becomes a refuge for many seaduck. Freshwater wildfowl species may utilise estuaries if their usual inland habitat becomes frozen.

Red-necked grebes arrive in the Kattegat following the breeding season and up to 3500 are present during the winter. Smaller numbers winter off the Danish Wadden Sea and in the Baltic Straits. Variable numbers of great crested grebes winter at sea in the region, depending to a large extent on the severity of the weather. Up to 20,000 may be present in Dutch coastal waters if the IJsselmeer freezes, with fewer in mild winters; flocks totalling about 5000 birds may be present in the Baltic Straits.

Large numbers of shelduck remain in the Wadden Sea where the Dutch sector is the most important, holding around 50,000 birds. Several estuaries on the east coast of Britain are internationally important for shelduck in December, including the Thames Basin complex and the Firth of Forth.

Long-tailed duck continue to arrive on wintering grounds in the North Sea and Baltic during December. In some winters large flocks are present in the western Kattegat and Baltic Straits; there is also an important flock in the Moray Firth. The Moray Firth supports internationally important numbers of red-breasted merganser in December. Tufted duck often winter in sheltered coastal waters in the western Baltic. Up to 110,000 are present in the Baltic Straits and high numbers occur along the Baltic coast of Germany. Other species of seaduck are found mainly in the same areas as in November.

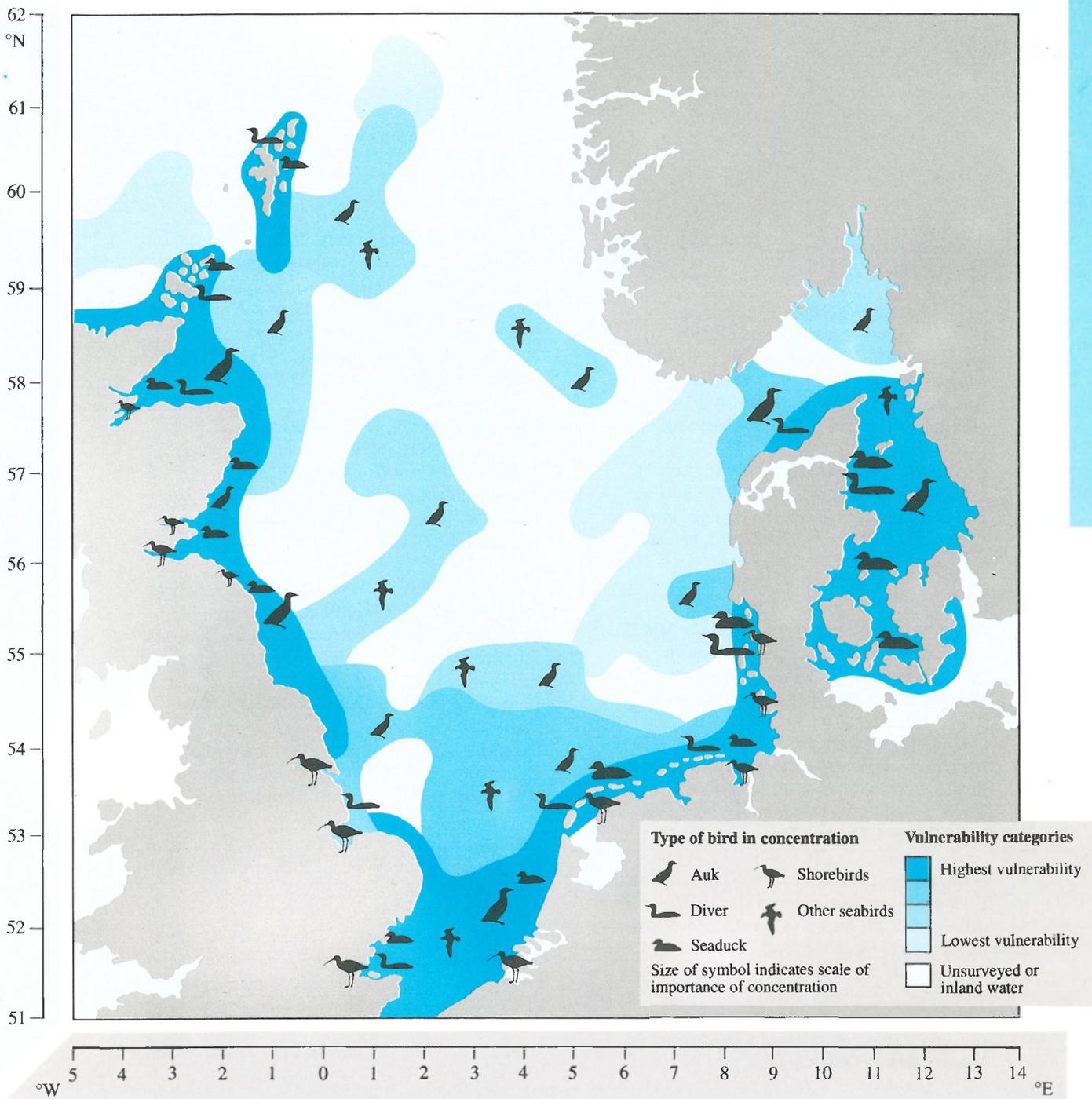
There is a continuing emigration of waders from the Wadden Sea during December, the intensity of which is related to the severity of the weather. In most years the Dutch sector supports the highest number of waders with about nine species above levels of international importance. The Danish and German sectors each support internationally important numbers of four or five species of wader. On the western side of the North Sea numbers and locations are little changed from November, unless cold weather on the continent pushes birds west; the Wash and Thames Basin remain the most important areas, with seven species found in internationally important numbers.

Offshore species

The Southern Bight becomes more important for both guillemots and razorbills in December. These concentrations are probably mainly young birds that disperse further from colonies than adults. Waters off eastern Scotland and northern England remain important as birds continue to occasionally visit nearby colonies. Fewer guillemots are present in the Skagerrak than in November but the Kattegat remains very important for both guillemots and razorbills. Puffins and little auks are mostly present in the same areas of the North Sea as in November, although survey effort in many central and north-eastern areas is poor. Little auks enter the Skagerrak in large numbers during December.



Adult gannet
Photograph by Paul Doherty



The largest concentrations of kittiwakes are found in the Kattegat, Skagerrak and Southern Bight in December. Many birds probably move out of the North Sea through the English Channel at this time of year. Areas close to major colonies in the north and east hold fewer birds in December than at any other time of year. Common and black-headed gulls have a mainly coastal distribution with moderate numbers of both species in the southern North Sea. Coastal waters around Denmark, including the Skagerrak and Kattegat, support moderate numbers of common gulls. Herring and great black-backed gulls are most numerous off the east coast of Britain, and in the southern North Sea and Kattegat.

Gannets reach their lowest levels of the year in December, although they remain

widespread in western and central areas of the North Sea.

The exodus of fulmars from the North Sea continues and fewer are present in December than at any other time of year. Highest numbers are found in the Moray Firth and north-western North Sea, and in the Skagerrak.

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Appendix 1

The offshore vulnerability index

The offshore vulnerability index (ovi) for each species was calculated according to the following formula:

$$\text{ovi} = 2a + 2b + c + d$$

where **a** = the proportion of time spent on the water

b = the size of the biogeographical population

c = the potential rate of population recovery following a reduction in numbers

d = reliance on the marine environment

Each factor was scored between one and five; five indicates the highest level of vulnerability. Factors **a** and **b** were rated as being twice as important as the other two factors as shown by the formula.

Factor **a** was scored using a combination of information from beached bird surveys and an analysis of the North Sea seabird database. The results of beached bird surveys around North Sea coasts provided information on the proportion of birds of each species found oiled. The North Sea database provided information on the proportion of birds of each species recorded sitting on the water and flying. Species found to be frequently oiled and with a high proportion of database records referring to birds on the water were given a high score for factor **a**.

Factor **b** was scored by using the most up to date estimates of the biogeographical population of each species. Species with the smallest biogeographical populations were given the highest score for this factor.

Factor **c** was scored using information on clutch size (average clutch size and maximum clutch size) and age of first breeding for each species. Species that lay one egg and do not breed until several years old were given the highest score for this factor.

Factor **d** was scored by assessing the habitat requirements of each species in the breeding and non-breeding season from the literature.

Species that are completely dependent on the marine environment in the breeding or non-breeding season were given the maximum score for this factor.

Appendix 2

Procedure for producing vulnerability maps of offshore areas of the North Sea

(i) The analysis of the North Sea database was based on rectangles used by the International Council for the Exploration of the Seas (ICES). For all rectangles of 15' latitude by 30' longitude in the North Sea (quarter ICES rectangles), an area vulnerability score was calculated according to the following formula:

$$\text{area vulnerability score} = \sum_{\text{species}} \ln(d + 1) * \text{ovi}$$

where d = the density of each species recorded.

ovi = the offshore vulnerability index score of each species.

The area vulnerability scores are thus dependent on the number of species present in each area and their offshore vulnerability index scores. Natural logarithms were used in order to transform the species densities to a similar range as the offshore vulnerability index scores. The natural logarithm was applied to density plus one to prevent densities of less than one resulting in a negative number.

(ii) Each quarter ICES rectangle was ranked as one of four categories of vulnerability (very high, high, moderate or low) based on its area vulnerability score. These four categories of rectangle were then plotted directly onto a map using UKDMAP, a digital marine atlas developed by the Natural Environment Research Council's British Oceanographic Data Centre.

(iii) The final maps were smoothed to show generalised areas of vulnerability using a combination of the SURFER computer smoothing program and smoothing by hand.

The UK Joint Nature Conservation Committee was established by the Environmental Protection Act 1990 "for the purposes of nature conservation, and fostering the understanding thereof" in Great Britain as a whole and outside Great Britain. It is a committee of the three country councils (English Nature, Scottish Natural Heritage and the Countryside Council for Wales), together with independent members and representatives from Northern Ireland and the Countryside Commission, and is supported by specialist staff. JNCC and the three country councils carry forward duties previously undertaken by the Nature Conservancy Council.

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