THE STATUS OF MARINE BIRDS BREEDING IN THE BARENTS SEA REGION

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Preface

In 1989, the Russian-Norwegian Seabird Expert Group was established as part of the Joint Norwegian-Russian Commission on Environmental Co-operation. The initial aim of the seabird expert group was to establish contacts and initiate collaboration between research and management institutions, as well as to develop and standardise common scientific methodologies and joint databases. From 1993, funds were provided rendering possible the initiation of several such projects. The need for a status report on marine birds breeding in the Barents Sea Region had long been on the list of tasks to be addressed, and in 1995, the Norwegian Directorate for Nature Management provided the necessary funds for the production and printing of this report.

Vidar Bakken led the project and has prepared all the maps. Hallvard Strøm has been the project secretary and has had the main responsibility for updating the species descriptions. The editorial team would like to thank Rob Barrett, Bjørn Frantzen, Maria Gavrilo, John Atle Kålås, Øystein Størkersen, Per Gustav Thingstad and Wim Vader for reviewing earlier drafts of the species descriptions. We also sincerely thank Richard Binns and Rob Barrett for proof-reading the entire manuscript of the report, and Alexander Koryakin for providing comments on the recommendation tables. Odd Willy Brude is gratefully acknowledged for his GIS assistance when preparing the maps and Kjell Isaksen for his help with the reference list and for seeking out and correcting inconsistencies in the text. The recovery data of ringed birds in the Barents Sea Region were prepared by Kandalaksha State Nature Reserve, Russia and the Norwegian ringing centre at Stavanger Museum, Norway. All the drawings were made specially for this report by Eugeny A. Koblik, Moscow.

The production of the report has taken far too long, for which we apologise. The overall task of standardising and editing the text, maps, figures, tables and references proved far more time-consuming than we ever expected. We are grateful to the Directorate for Nature Management, and especially to Morten Ekker, for allowing us to complete the work, and to the authors for their patience as the successive deadlines for publication were passed.

This is the second status report on marine birds breeding in the Barents Sea Region. In the first, "*Barentshavets sjøfuglressurser*" [*The seabird resources in the Barents Sea*] (Norderhaug *et al.* 1977), the Norwegian authors had an extremely limited access to translations of papers from the Russian part of the Barents Sea. Since the late 1980s, however, the political changes in Russia have enabled Russian and Norwegian scientists to collaborate more closely and, in this process, also to improve the international access to the huge amounts of literature and previously unpublished data on seabirds in north-west Russia.

In many ways, this report summarises the first ten years of co-operation between seabird scientists in Russia and Norway, and we sincerely hope that it will serve as a useful reference and inspiration for research and management for many years to come!

Tycho Anker-Nilssen *Vidar Bakken* *Hallvard Strøm*

Alexander N. Golovkin *Vitali V. Bianki* *Ivetta P. Tatarinkova*

Contents

1. Introduction

Marine birds are important elements of the marine ecosystem. Most marine bird species are true marine animals, i.e. they spend most of the year at sea, visit land only to breed and find all their food in the marine environment. Many of them are specialised top predators and changes in their behaviour or population dynamics may therefore reflect changes in the lower trophic levels at an early stage. This position makes them suitable as indicators of changes in the marine environment. Compared to most terrestrial birds, marine birds are generally long-lived, have a high adult survival rate, lay small clutches and have delayed maturity. This life history strategy implies that factors affecting the survival of adults are more important for the long-term population trend than those affecting breeding success or the survival of immature birds.

A very rich biological production supports the many marine birds in the Barents Sea Region, and some areas have populations that are among the densest in the world. Historically, marine birds in the Barents Sea Region have been an important food resource for humans (egging, hunting and trapping) and their feathers, down and skins were used for bedding and clothes. For many fishermen and hunters, marine birds were also important as additional food during long expeditions. In former times, fishermen also depended on marine birds to locate the best fishing grounds offshore and to indicate the way home in fog by observing the flight direction of birds to and from the breeding colonies. Although recent management regulations and the much reduced dependence on marine birds as a food resource have reduced the seabird harvest considerably, the threats to the marine birds of the Barents Sea are more numerous and serious than ever before. Industrial fisheries, environmental contaminants, oil exploration, tourism and disturbance are new real and potential threats to the marine bird populations in this region.

The last general, comprehensive description of the marine bird populations in the Barents Sea was published in 1977 by Magnar Norderhaug, Einar Brun and Gunstein U. Møllen (Norderhaug *et al.* 1977). Their report "*Barentshavets Sjøfuglressurser*" [*The seabird resources in the Barents Sea*] put forward many recommendations that have still not been implemented and several are repeated here. However, as the present report describes, a great deal of additional scientific work has been done on marine birds in the Barents Sea Region over the last two decades. Furthermore, a lot of the information is now incorporated into databases and Geographic Information Systems (GIS), making it easily available for future management and research. Nevertheless, there are still wide gaps in our understanding of the population dynamics, migration patterns and importance of different human threats to the marine bird populations inhabiting these waters.

This report aims to present the current status of the marine birds breeding in the Barents Sea Region. Its main objectives are to:

- Present up-to-date information on all the marine bird species breeding in the Barents Sea Region, including descriptions of their breeding distribution and habitat preferences, population sizes and trends, migration patterns and feeding ecology.
- Identify the most important gaps in our knowledge relating to this information.
- Identify current and potential threats to the populations and, on this basis, propose research, mapping and monitoring activities that should be given special priority in the near future.

The report is divided into six chapters:

- Chapter 2 describes the ecosystem of the Barents Sea Region.
- Chapter 3 describes 41 marine bird species in relation to their distribution, movements, population status, feeding ecology, threats, special studies and recommendations concerning future mapping, research and monitoring.
- Chapter 4 discusses the current and potential threats to the marine birds in the Barents Sea Region.
- Chapter 5 presents recommendations in relation to the identified threats and international environmental strategies concerning future mapping, research and monitoring.
- Chapter 6 lists the references cited in the report. More references of marine birds in the northwest region of Russia and in Finnmark county in Norway can be found in Golovkin & Bakken (1997) and Frantzen & Bakken (1996), respectively.

Six appendices are included:

- Appendix 1 is a systematic list of the names of the bird species described in Chapter 3.
- Appendix 2 summaries the conservation status of the same 41 species.
- Appendix 3 lists and maps the geographical names used in this report.
- Appendix 4 describes the current status of the monitoring of marine birds in the Barents Sea Region.
- Appendix 5 describes the important international environmental strategies most relevant to the marine birds in Arctic countries.
- Appendix 6 lists brief summaries of the marine bird projects which have been conducted as a part of the Norwegian-Russian seabird cooperation in 1990-1999.

Nomenclature

Wherever possible, English names of species are given according to "*The Bird List 2000*" prepared by the British Ornithologists' Union Records Committee (BOU 1999), also to be found on the BOU web-site. Species not included on that list are named as in the relevant volumes of "*Handbook of the Birds of the World*" (*HBW*) (del Hoyo *et al.* 1992, 1996). For nineteen species the name recommended by

BOU is different from that used in *HBW* or in the other standard reference "*The birds of the Western Palearctic*" (*BWP*) (Cramp & Simmons 1977, 1983, Cramp 1985). To avoid any possible confusion in such cases, we have indicated (in parenthesis) the species name in BWP or HBW as part of the key information in the species description in Chapter 3. The common guillemot *Uria aalge* is the only species referred to by a different name in all three sources. Additionally, *HBW* used names that differ from those on the BOU-list for velvet scoter *Melanitta fusca*, grey phalarope *Phalaropus fulicarius*, black-headed gull *Larus ridibundus*, Brünnich's guillemot *Uria lomvia* and little auk *Alle alle*, while the names in *BWP* differ for 13 other species. In accordance with all three sources, and contrary to most Russian literature (e.g. Yudin & Firsova 1988e), we have treated the gull taxon *heuglini* as a sub-species of the lesser black-backed gull *Larus fuscus* and not as a sub-species of herring gull *L. argentatus*. A complete list of the English, scientific, Norwegian and Russian names of the marine bird species breeding within the Barents Sea Region and their conservation status are given in Appendix 1 and Appendix 2, respectively.

The term "marine bird" has no universal definition and is thus subjective. This report covers most of the species that depend on the marine environment when breeding within the Barents Sea Region. For a few species, mainly among the larids, ducks and geese, this description does not necessarily apply to every breeding individual but is typical for the major part of the population. Although it could easily be argued that the definition also holds for the white-tailed eagle *Haliaeetus albicilla*, we did not include this species as it belongs to a group of birds (Accipitriformes) that is not intuitively associated with the marine environment.

2. The Barents Sea Region Ecosystem

In this report the Barents Sea Region is defined as the Norwegian Sea north of the Arctic Circle (66°33'N), the eastern part of the Greenland Sea bordering Svalbard, the Barents Sea and the White Sea (Fig. 2.1). This area is for practical reasons divided into seven sub-regions: the Norwegian coast, the Murman coast, the White Sea, the Nenetski district, Novaya Zemlya (western coast), Franz Josef Land and Svalbard (Fig. 2.1). The three main seas in the region, the Norwegian Sea, the Barents Sea and the White Sea, constitute quite different marine ecosystems and are presented in the following sections.

The Norwegian Sea

The northern part of the Norwegian Sea (Fig. 2.1) is a diverse physical environment (for general descriptions see e.g. Pickard & Emery 1982, Breen 1986, Blindheim 1989). The deepest parts, the Norwegian and Lofoten Basins, have mean depths of more than 3000 m (Fig. 2.2). They are separated from the coastline by an extensive continental shelf, which is more than 200 km wide at the Arctic Circle and narrows rapidly northwards. The edge of the continental shelf is closest to land off Andøya in Vesterålen, where depths of more than 500 m are reached only 10 km offshore. The slope continues northwards, forming the western border of the Barents Sea, until it meets the Arctic and Greenland Seas north and west of Spitsbergen. The circulation of water masses is closely linked to the sea floor bathymetry. Among the most important currents is the Norwegian Coastal Current which runs parallel to and landward of the Norwegian Atlantic Current, the northern branch of the North Atlantic Drift (Fig. 2.2). The Norwegian Atlantic Current transports warm saline water from the south-west northwards along the continental edge. On the coast, the water temperature is highest in September and lowest in March (typically about 10-12°C and 3-5°C, respectively, in the outer Lofoten Islands), with a marked north-south gradient spanning more than three degrees from the Arctic Circle to the south-western border of the Barents Sea.

For seabirds breeding on the Norwegian coast, the most important parts of the Norwegian Sea are, of course, those that are within the normal feeding ranges from the colonies. To sustain their young, even the most pelagic species probably need to find an adequate food supply less than 100 km from their nesting site. This limited range - plus the fact that the highest biological production in spring and summer is found in the convergence zone between the Norwegian Coastal and North Atlantic Currents - probably explains why colonies of auks (Alcidae) and black-legged kittiwakes *Rissa tridactyla* are generally smaller south of the Lofoten Islands than farther north, where the convergence is much closer to land. The relatively large colony of Atlantic puffins *Fratercula arctica* at Lovunden, immediately south of the Arctic Circle, is situated close to a deep channel (Trænadjupet) which cuts into the shelf.

First-year (0-group) herring *Clupea harengus* of the Norwegian spring-spawning stock probably constitute an important food supply for seabirds breeding along the Norwegian Sea north of the Arctic Circle (Fig. 2.3). On the way to their main nursery areas in the southern Barents Sea, the young herring drift passively with the Norwegian Coastal Current from the spawning grounds off western Norway. When biological production en route is sufficient to secure adequate larval and post-larval survival, enormous amounts of 4-7 cm long herring fry (amounting to hundreds of billion individuals) reach the coasts of northern Nordland

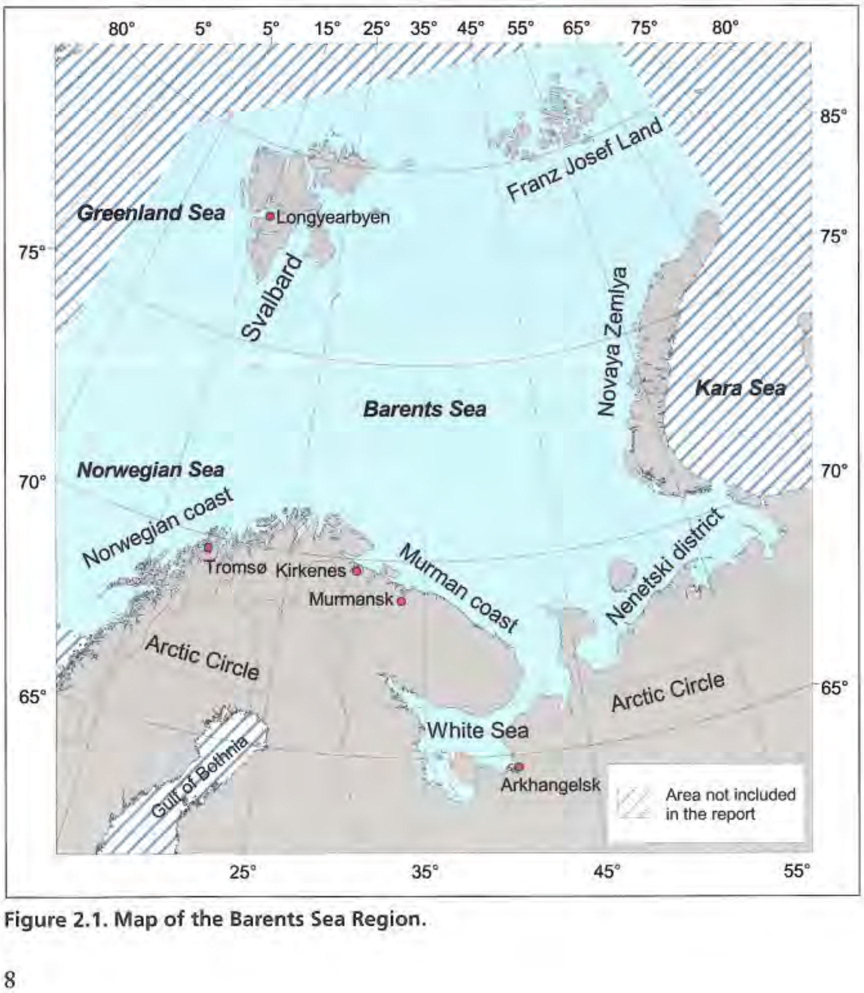


Figure 2.1. Map of the Barents Sea Region.

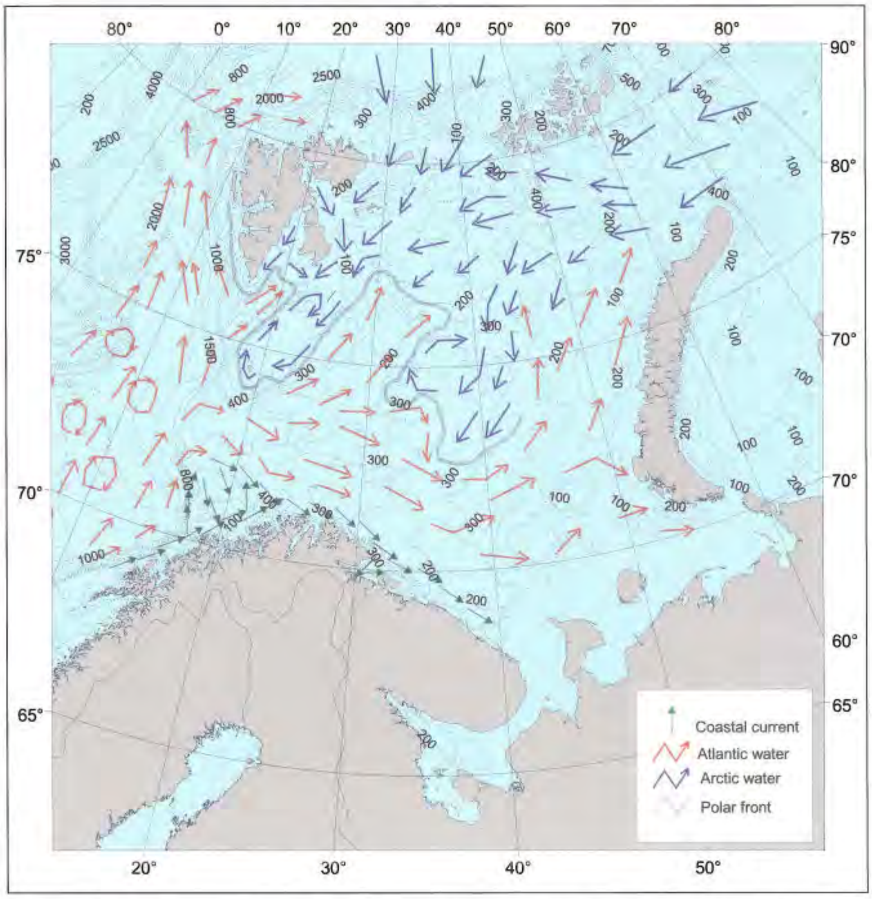
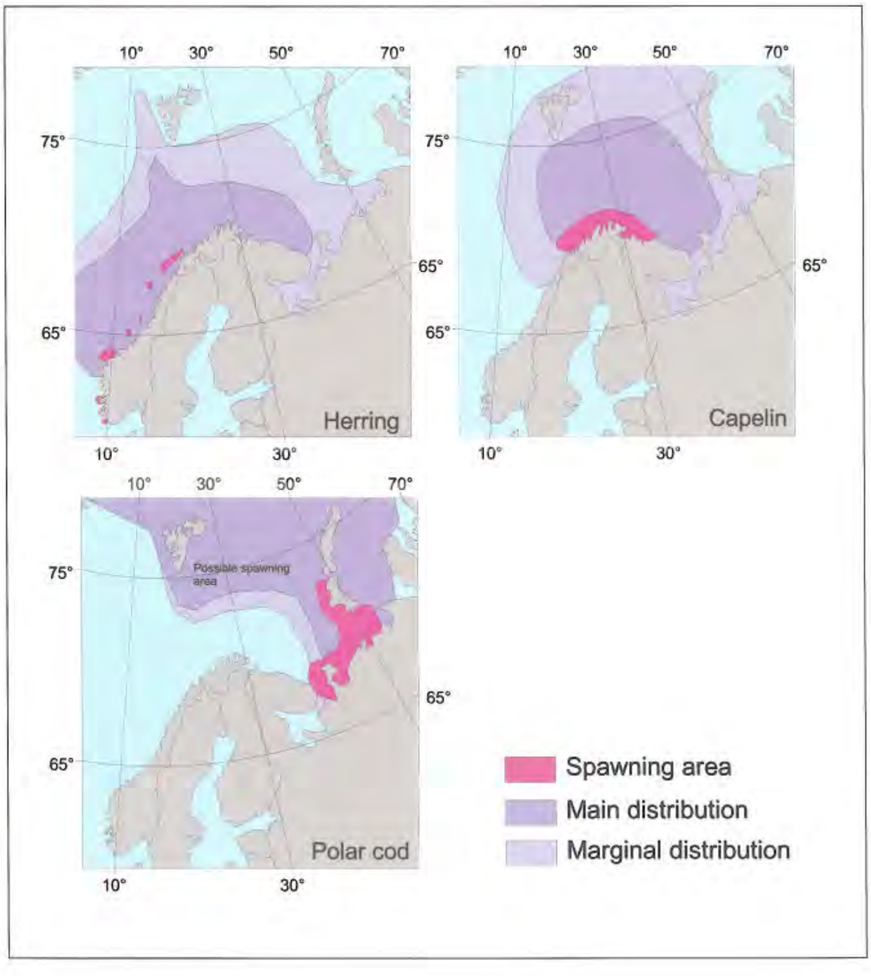


Figure 2.2. Ocean currents and bathymetry of the Barents Sea Region (after Sakshaug *et al.* 1994).



and Troms in summer, where they are a staple food for a number of seabird species (e.g. Atlantic puffins, razorbills *Alca torda*, black-legged kittiwakes and arctic terns *Sterna paradisaea*). The bathymetric features outside of Vestfjorden produce local circulation of coastal water, which increase the retention time for planctonic organisms, such as 0-group herring drifting with the coastal current. Those that reach the Barents Sea grow and mature there for 3-4 years before recruiting to the spawning stock. As they are an important prey for cod *Gadus morhua* and a substantial predator on capelin *Mallotus villosus*, young herring are a key element in the Barents Sea ecosystem (see below).

Compared to the relative smooth coastline of the southern and eastern Barents Sea the coast of the Norwegian Sea is more fractured and characterised by deep fjords and numerous islands and skerries. The complex coastal topography also secure a high production of stationary organisms and provides suitable breeding habitats for most Atlantic seabird species breeding at these latitudes.

The Barents Sea

The information presented here is mainly from Anon (1988), Loeng (1991), Sakshaug *et al.* (1994) and Barr (1995).

The Barents Sea is relatively shallow (average depth 230 m) and covers an area of 1 400 000 km^2 (Fig. 2.1). The maximum depth of 500 m is found in the western part of the trench Bjørnøyrenna. Depths of less than 50 m are found on Spitsbergenbanken and in the south-east around Kolguev Island. The Barents Sea consists of three main water masses: coastal water, Atlantic water and Arctic water, each of which is linked to one of the main current systems (Fig. 2.2). The coastal water flows close to the southern coasts, Atlantic water in western and central parts, and Arctic water in northern and eastern parts of the Barents Sea.

Figure 2.3. The approximate distribution and spawning areas of herring *Clupea harengus*, capelin *Mallotus villosus* and polar cod *Boreogadus saida* in the Kara Sea, the Barents Sea Region and further south along the Norwegian coast (after Sætre *et al.* in prep., Bernes 1996 and Hansen *et al.* 1996).

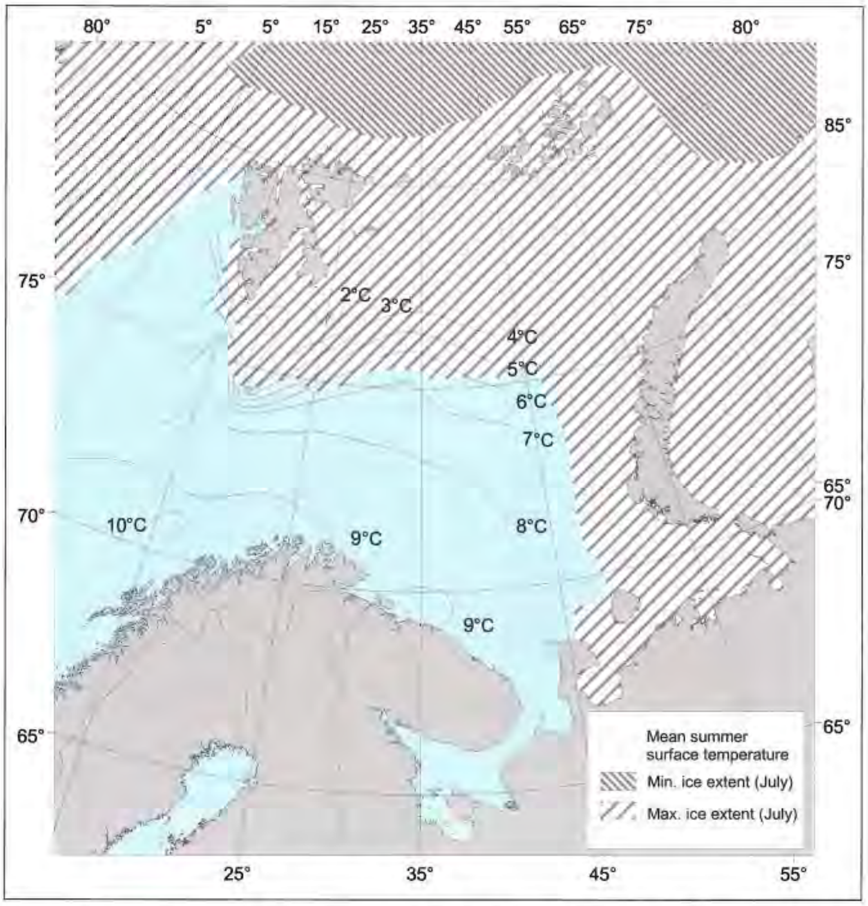


Figure 2.4. Mean summer surface temperature and the minimum and maximum extent of sea ice in July in the Barents Sea Region (after Johnsen 1989 and Midttun 1990).

The currents in the southern part of the Barents Sea flow generally north and eastwards, while those in the northern part flow west or south-westwards (Fig. 2.2). The Norwegian Coastal Current runs along the entire coast of Norway from the Skagerrak to the Barents Sea. In the Russian part of the Barents Sea, it is called the Murman Coastal Current. Running parallel to, and seaward of, the coastal current, the North Atlantic Current enters the Barents Sea along Bjørnøyrenna, where it is called the Nordkapp Current. In the Barents Sea, it divides into two main branches. One flows eastwards parallel to the Coastal Current, becoming the Murman Current when it enters Russian waters. The other turns north along the Hopen trench and divides into smaller branches. The North Atlantic Current also continues northwards along the west coast of Spitsbergen until it meets cold Arctic water in the north-west.

The transition zone between the Atlantic and Arctic water masses is called the polar front (Fig. 2.2). The mean position of the front mainly follows the bathymetry. From the west, it goes from Svalbardbanken south of Bjørnøya, turns northwards towards Storbanken and finally heads south-east from Sentralbanken. The polar front is clearly defined in the western Barents Sea, where its position is relatively stable. In contrast, in the eastern part of the Barents Sea, it forms a broader transition zone between the warm and cold water masses, and its position changes a lot during the year.

An important oceanographic feature of the Barents Sea is sea ice, and this has a major impact on the distribution of seabirds. Most of the ice is less than one year old and is formed locally. There is some multi-year ice which either originates from the Arctic Ocean or is a remnant of earlier year ice formed in the Barents Sea. The sea ice varies considerably in extent during the year and from one year to the next. The maximum extent is in March-May and the minimum in September or early October. The ice situation and the mean surface temperature in July are shown in Fig. 2.4. As for the polar front, the largest variation in ice distribution is in the eastern part of the Barents Sea. In spring, the ice edge mainly follows the polar front. There are always some open temporary leads inside the ice covered waters that can be used by seabirds. In some areas, as off the fast ice in the Pechora Sea, in the Novaya Zemlya straits, north of Novaya Zemlya and around Franz Josef Land, there are more or less stable recurring polynyas.

The large numbers of seabirds in the Barents Sea are sustained mainly by the relatively high biological production in the area. Productivity is at the maximum in spring when the amount of light increases and the ice begins to melt. For more detailed information, see Sakshaug *et al.* (1992). High, but very varied, densities of seabirds are frequently found along the ice margin in spring (Hunt *et al.* 1996). The mechanisms regulating these numbers are unknown.

The southern coasts of the Barents Sea are characterised by deep fjords in the western part, where the shores are mostly rocky. The number of islands decreases towards the east. The eastern part, from the White Sea to the Kara Gate, has a low coastline without rocky shores. Novaya Zemlya consists of two islands, the Northern Island and the Southern Island, with a total length of approximately 1000 km. The western coast of Novaya Zemlya, which is the eastern border of the Barents Sea, is characterised by many low but steep cliffs which are suitable for cliff-breeding seabirds. Franz Josef Land, located in the north-eastern corner of the Barents Sea, is an archipelago consisting of 191 islands with a total area of 16 135 km^2 and 4425 km of coastline. Its coasts consist mainly of rocky shores and glaciers. Svalbard, situated in the north-western corner of the Barents Sea, consists of fewer but larger islands covering a total land area of 16 135 km^2. Its coastline also consists mainly of rocky shores and glaciers. In most parts of the Svalbard archipelago, as in other land areas in the Barents Sea, cliff-nesting seabirds often find suitable breeding habitats close to the sea.

Foraging areas for seabirds are often closely related to oceanographic or bathymetric features. In the Barents Sea, the polar front is of great importance as a foraging habitat for guillemots (Mehlum, Nordlund *et al.* 1998) and other seabirds. In the northern part of the Barents Sea, ice-edge areas, glacier faces and river outlets from glaciers are also important foraging areas for seabirds (Hartley & Fisher 1936, Mehlum 1984, Hunt *et al.* 1996). The main reason is believed to be the concentration of prey in low salinity surface waters as a consequence of upwelling.

Seabirds in the Barents Sea consume food items of many different taxa. However, amphipods, capelin (Fig. 2.3), polar cod *Boreogadus saida* (Fig. 2.3), herring (Fig. 2.3) and sandeel *Ammodytes* spp. seem to dominate the diet of many species.

As mentioned above, first-year Norwegian spring-spawning herring drift northwards into the Barents Sea where they grow and mature for 3-4 years before recruiting into the spawning stock. The immature herring (0- and I-group) are important as food to seabirds, whereas the II-group fish (third year) can only be taken by the largest species (gannets, cormorants, etc.). The young herring are also major predators of capelin larvae. In the 1960s and 1970s, the young herring were absent in the Barents Sea due to an overfishing and collapse of the spawning stock and, in their absence, the capelin stocks were able to increase (Hamre 1991). Because capelin rarely grow longer than 14-15 cm, they are available as food for seabirds throughout their life cycle. The increase in capelin may have resulted in more food to seabirds, and hence to the increases in numbers of guillemots and black-legged kittiwake in the 1960s, 1970s and 1980s in the south-eastern Barents Sea (Krasnov & Barrett 1995).

In the 1980s and 1990s, the capelin stock collapsed twice. The first collapse in 1985/1986 can be attributed partly to overfishing but also recruitment failure through competition with the increasing herring stock and a high adult mortality due to predation by herring (Gjøsæter 1998). This collapse had a dramatic effect on the common guillemot population in the southern part of the Barents Sea (Vader *et al.* 1990, Anker-Nilssen & Barrett 1991, Mehlum & Bakken 1994, Krasnov & Barrett 1995). The second collapse in 1994/1995 had no apparent effect on seabird numbers, probably because of the presence of young herring in the Barents Sea providing alternative food at the time.

In the northern part of the Barents Sea, the capelin are partly replaced by the polar cod (Fig. 2.3), which primarily live in the cold arctic water and are important food items of the marine birds in these areas. The polar cod stock has also varied in size in the 1980s and 1990s, but the effect of seabirds has been small (Krasnov & Barrett 1995). Sandeels are also important prey to seabirds in the southern part of the Barents Sea, but their biology and population status are, unfortunately poorly known.

The White Sea

Compared to the Barents Sea, the White Sea (Fig. 2.1) is small and covers 90 000 km^2. Its oceanographic features are also quite different from those of the Barents Sea. The combination of a large amount of freshwater runoff and a narrow, shallow strait connecting it to the Barents Sea results in a generally low salinity (10-30‰). In summer, the sea temperature may reach 12-15°C, but drops below zero in winter (Dobrovolski & Zalogin 1982).

In winter, there is land-fast ice in bays and along the shores, and drift ice form in the open sea. In sheltered bays, the sea is ice-covered from October-November until May. There are polynyas in Onega Bay throughout the winter, and this area is an important winter habitat for eiders.

The west coast of the mouth of the White Sea consists mainly of steep cliffs. The coastline south of Ponoy is low except in the inner part of Kandalaksha Bay. The east coast is high in the north and south and low around Mezinsky Bay.

Kandalaksha Bay and Onega Bay contain numerous islands. Many, especially the large ones, are covered with taiga forest. About one third of the White Sea is shallow with depths of about 30 m (Bek 1990). The shallowest areas are in the mouth and in Mezinsky Bay. The shallows in Onega Bay stretch far out from the coast, and the tidal zone is several kilometres wide both there and in Mezinsky Bay.

The coastal zone is the most important area for marine birds in the White Sea. The blue mussel *Mytilus edulis* is very common and is found in concentrations of 30-50 kg/m^2 (Naumov & Fedyakov 1987). It is a very important prey item for the common eider *Somateria mollissima*, black scoter *Melanitta nigra*, goldeneye *Bucephala clangula*, Eurasian oystercatcher *Haematopus ostralegus* and gulls. The gastropods most frequently eaten by common eider chicks and many shorebirds are *Hydrobia ulvae* and *Littorina* spp. Molluscs, other than the blue mussel, and other invertebrates do not form large biomasses, but are important prey items for the velvet scoter *Melanitta fusca* and scaup *Aythya marila*. Thirty-three fish species live and spawn in the White Sea (Andriashev 1951, Paraketsov 1966). Sedentary bullfish (Triglidae), arctic blennies (Stichaeidae) and butterfish *Pholis gunnellus* are the most numerous and widespread species in the coastal zone (Paraketsov 1966) and constitute much of the diet of the goosander *Mergus merganser*, red-breasted merganser *M. serrator* and black guillemot *Cepphus grylle*.

3. Species descriptions

GUIDE

Species descriptions
In this chapter, the distribution, movements, population status and feeding ecology of 41 marine bird species (Appendix 1) breeding in the Barents Sea Region are described, followed by a discussion of current and potential threats to the population and references to special studies that have been made of each species. In addition, recommendations for future mapping, research and monitoring are put forward. Each description is divided under the following headings:

Key information

- The English, scientific, Norwegian and Russian (transliterated) names of the species.
- The size of the population within the Barents Sea Region.
- The proportion it constitutes of the world population.
- The population trend of the species within the Barents Sea Region during the last 10 years indicated by: "Large increase/decrease" = change of at least 50%, "Small increase/ decrease" = change of 20-49%, "Reasonably stable" = stable or change of less than 20%, and "Fluctuating" = fluctuating with changes of at least 20%, but with no clear trend. A question mark indicates a very uncertain assessment.

General description
The introductory section briefly describes the general appearance of the species and its overall distribution, population size(s) and sub-species taxonomy.

Breeding distribution and habitat preferences in the Barents Sea Region
This is a detailed description of the historical and current distribution and the habitat preferences of the species within the Barents Sea Region. It includes an up-to-date distribution map, which indicates all known breeding colonies (red circles) or breeding areas (green coastline), as well as other areas in the region where breeding possibly occurs (yellow coastline). Unless otherwise stated, the colony symbols (red circles) are sized gradually in five logarithmic intervals according to the number of breeding pairs they represent: 0-100, 101-1000, 1001-10 000, 10 001-100 000 and 100 001-1 000 000 pairs. Colonies that have not yet been censused are plotted using green circles. For non-colonial birds, only confirmed and possible breeding areas near the coast are shown. Hence, parts of the populations of several geese, ducks, waders, skuas and gulls may also breed in areas further inland.

Movements
Here, the winter areas and migration patterns of the population are described. Ring recovery data were supplied by the Kandalaksha State Nature Reserve (Russian data) and the Norwegian Ringing Centre at Stavanger Museum (Norwegian data). All recovery sites of individuals ringed within the Barents Sea Region and recovered in September-March are shown on maps. Recoveries of birds ringed in the Norwegian and Russian part of the Barents Sea Region are indicated by red and blue symbols, respectively.

Population status and historical trends
The population status and historical trends in each sub-region within the Barents Sea Region are described and summarised in a table. Both long-term (before 1986) and short-term (1986-1998) trends are considered: +/-2 = change of at least 50%, +/-1 = change of 20-49%, 0 = stable or change of less than 20%, and F = fluctuating with changes of at least 20%, but with no clear trend. Parenthesis indicate a very uncertain assessment. Sub-regions are: NC = Norwegian coast, MC = Murman coast, WS = White Sea, ND = Nenetski district, NZ = Novaya Zemlya, FJL = Franz Josef Land, SV = Svalbard.

Feeding ecology
In this section, general and area-specific elements of the species' feeding ecology in the Barents Sea Region are discussed. For most species, a table is included to summarise the existing information on food choice during the breeding season in each sub-region. The table specifies the localities, observation years, age of birds studied and the composition of their diet divided by main prey species or groups of prey. See above for definitions of sub-regions.

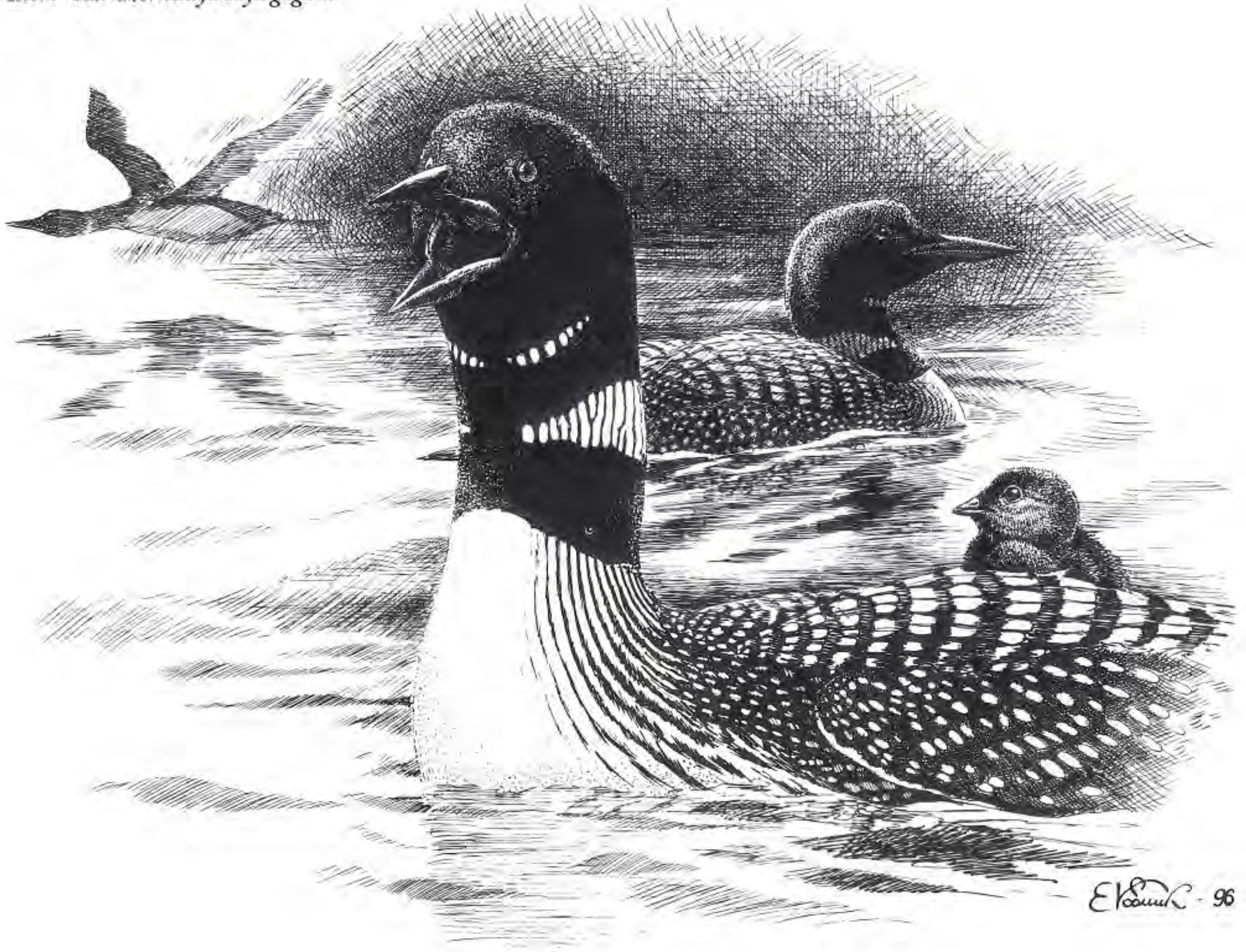
Threats
This part focuses on factors that are regarded to represent current or potential (on a 2-5 year perspective) threats to the species at an any time of the year. In Chapter 4 the threats are categorised into nine groups and evaluated for each species. The results are summarised and discussed across the species.

Special studies
A simple overview of studies conducted on the species in the Barents Sea Region is given. As for any other section, all references are included in the reference list in Chapter 6.

Recommendations
Finally, important species-specific recommendations relating to the need for further mapping, research and monitoring in the Barents Sea Region are stated. They are also summarised in Chapter 5 together with many more recommendations put forward and discussed in general terms by the editors.

Great northern diver *Gavia immer*

No: Islom Ru: Chernoklyuvaya gagara



Population size: 0-3 pairs
Percent of world population: <0.1%
Population trend: Reasonably stable?

General description

The great northern diver is monotypic and is, on average, smaller than the yellow-billed diver *Gavia adamsii* and overlaps in size with the black-throated diver *Gavia arctica* (Cramp & Simmons 1977). It breeds in North America, Greenland, Iceland and Scotland. In the Barents Sea Region, it has only been found breeding on Bjørnøya (Svalbard). The world population is estimated to be a few hundred thousand pairs. The Palaearctic breeding population is essentially limited to 100-300 pairs in Iceland (del Hoyo *et al.* 1992). The species breeds from the northern coniferous forest zone to the tundra in suitable areas of water in open, treeless regions (Cramp & Simmons 1977).

Population sizes and trends of the great northern diver *Gavia immer* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	0						
MC	0						
WS	0						
ND	0						
NZ	0						
FJL	0						
SV	0-3	-	(0)	1986-98	(0)	1932-98	1, 2, 3, 4
All	0-3	-	-	-	-	-	

1. Johnsen 1934, 2. Løvenskiold 1964, 3. Strann 1998, 4. Jerstad & Bakken 1999

Breeding distribution and habitat preferences in the Barents Sea Region

The great northern diver has been observed on lakes on the Norwegian coast (in Finnmark and Troms) in summer, but there are no confirmed records of it having bred there (H. Dransfeld, pers. comm.). No breeding is reported from Russia.

In the Barents Sea Region, the great northern diver has only been found breeding on Bjørnøya (Svalbard), and was first observed there in 1882 (Løvenskiold 1964). It nests on lakes in the northern part of the island. The first confirmed breeding on the island was in

1923 (Hanssen 1923) on Lomvatnet (Johnsen 1934), where a nest with two eggs was found. Bertram & Lack (1933) found two breeding pairs in 1932. Duffey & Sergeant (1950) observed three pairs in breeding plumage, but no signs of breeding. The last confirmed breeding was reported in 1965, on Holmevatnet (Lütken 1969), but adult birds are observed almost annually on Bjørnøya (Strann 1998, V. Bakken, pers. obs., O. Kindberg, pers. comm. and others). A careful survey of the possible breeding area of the great northern diver on the north-eastern part of the island was made in 1997, but no nests were found (Jerstad & Bakken 1999). Two adult birds were observed, but they showed no signs of breeding behaviour. It is not known whether the species breeds annually on Bjørnøya.

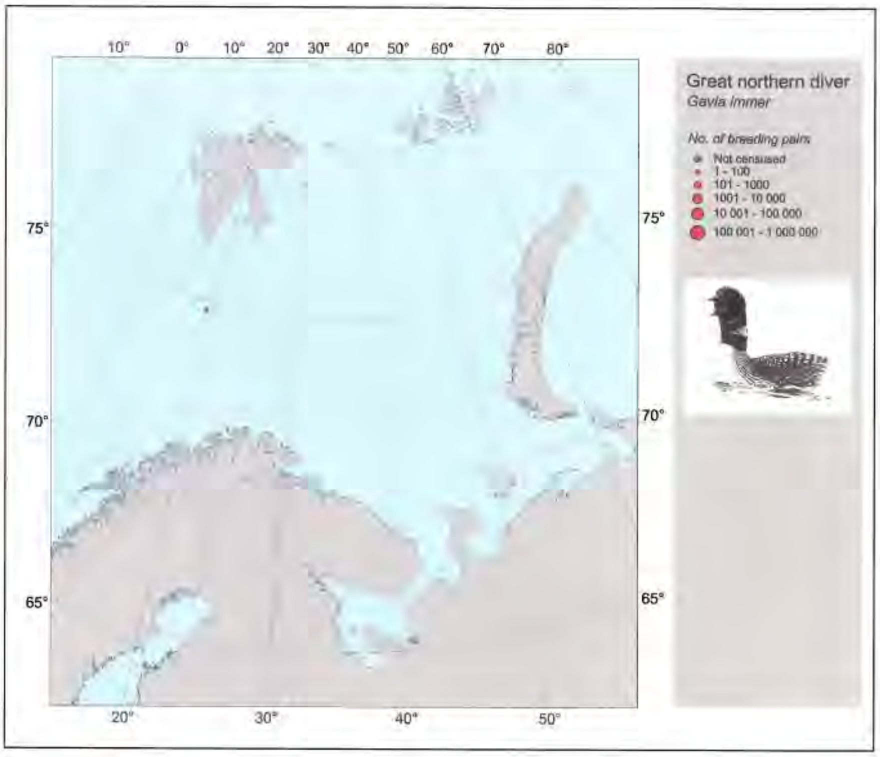
In 1958, Løvenskiold (1964) found a pair of divers consisting of one black-throated diver and one great northern diver building a nest on Laksvatnet. One egg was laid, but it was eaten by an arctic fox *Alopex lagopus*. The same year, a pair of great northern divers was observed on Holmevatnet, but no nesting was confirmed (Løvenskiold 1964).

The great northern diver has never been found breeding elsewhere in Svalbard, or in other parts of the Barents Sea Region (Løvenskiold 1964), but it has been observed several times on Spitsbergen (Longstaff 1924, Kristoffersen 1926, Løvenskiold 1964).

Movements

The great northern diver generally moves southwards and seawards after breeding, and several thousand birds, presumably originating from Iceland, Greenland and Canada, winter along the western coasts of Europe (del Hoyo *et al.* 1992).

No data on the migration of the birds breeding on Bjørnøya exist, but they probably spend the winter along the Norwegian coast or in the North Sea. Fewer than 100 birds winter on the north Norwegian coast, north of Salten, and the total number of birds wintering in Norwegian waters is estimated at 1000-1100 (Strann & Østnes, unpubl. ms.).



Population status and historical trends

The population of the great northern diver in the Barents Sea Region is small, and Bjørnøya is the easternmost breeding locality known. The Barents Sea Region is probably marginal for the species, and it is not certain that the species breeds annually. The historical data are too scarce to indicate any population trends, but no data indicate that the species was ever a numerous breeder in the region.

Feeding ecology

The great northern diver primarily takes fish up to 28 cm long, but also crustaceans, molluscs, annelids, insects and amphibia (Cramp & Simmons 1977). On Bjørnøya in 1932, Bertram & Lack (1933) found a beak-marked arctic char *Salvelinus alpinus* close to the nest. Summerhayes & Elton (1923) wrote that the great northern diver presumably fishes for arctic char in lakes on Spitsbergen. On the northern part of Bjørnøya, adult birds have been seen at sea in the breeding season and probably fed there (V. Bakken, pers. obs.)

Threats

The great northern divers breeding on Bjørnøya are vulnerable to disturbance in the breeding period. If the adults are scared from the nest, glaucous gulls or great skuas easily take the eggs. Nets set for arctic char may also catch adults and chicks. However, according to the Environmental Regulations for Svalbard, fishing with nets is not permitted in Svalbard lakes.

Special studies

Apart from the breeding investigation on Bjørnøya in 1997, no special studies have been undertaken in the Barents Sea Region.

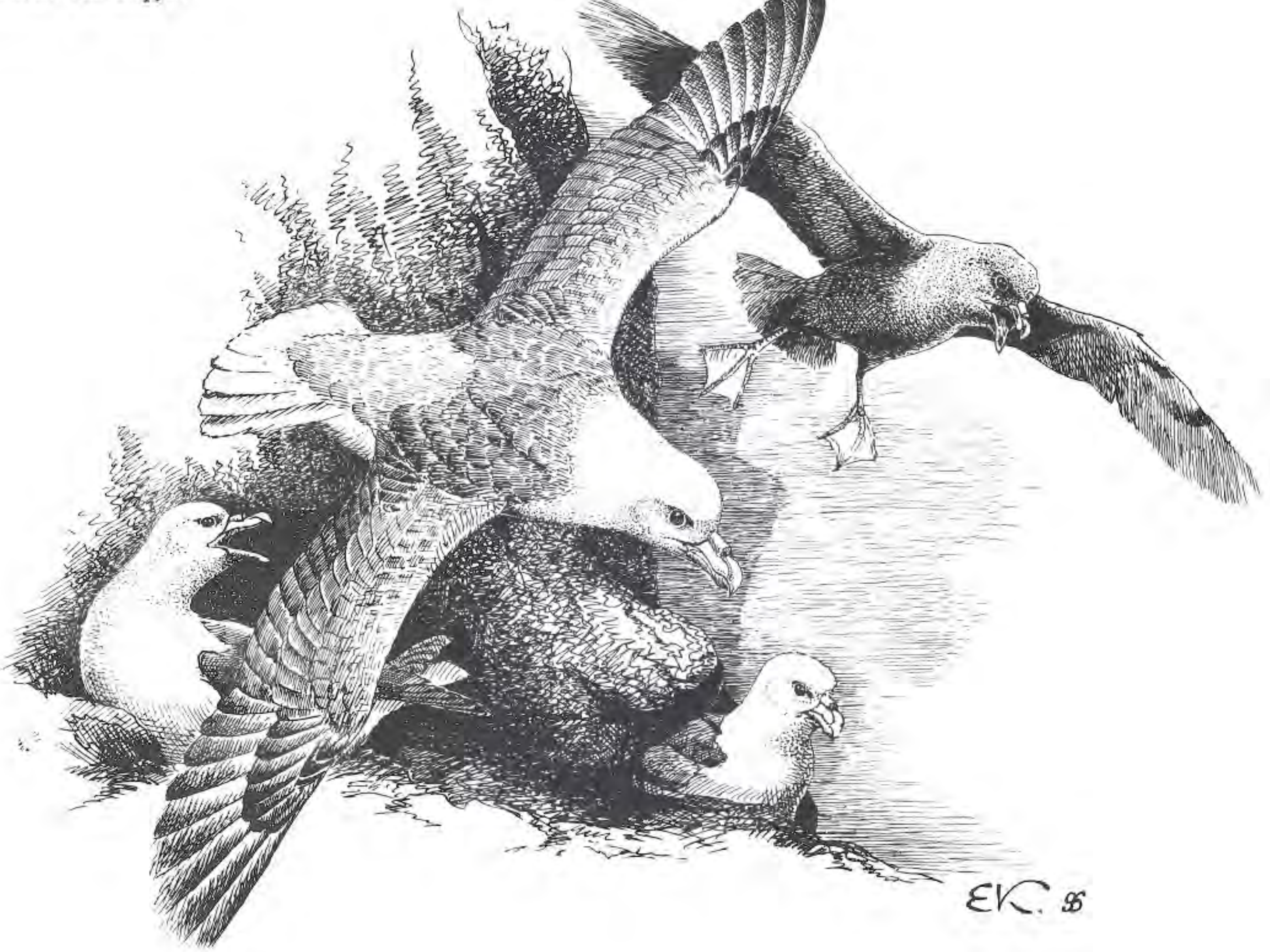
Recommendations

Supplementary mapping should be carried out in the breeding area of the great northern diver on Bjørnøya.

Vidar Bakken

Northern fulmar *Fulmarus glacialis*

No: Havhest Ru: Glupysh



Population size: 100 000-1 000 000 pairs
Percent of world population: 0.5-25%
Population trend: Fluctuating

General description

The northern fulmar is the largest of the three species in the order Procellariifomes breeding in the Barents Sea Region. It is noticeably larger than the black-legged kittiwake *Rissa tridactyla* and sexes are alike.

In the North Atlantic, the northern fulmar breeds in northern Canada, Greenland, Iceland, the Faeroes, Britain and Ireland, northern France, Germany, Norway, Svalbard, Franz Josef Land and Novaya Zemlya (Cramp & Simmons 1977). Two sub-species are recognised in the Atlantic region, *F. g. glacialis* in the high-Arctic and *F. g. auduboni* in boreal and low-Arctic areas, but they are often difficult to distinguish on size and colour phase criteria (van Franeker & Wattel 1982). A third sub-species *F. g. rodgersii* breeds in the northern Pacific (del Hoyo *et al.* 1992).

The boreal and low-Arctic population of the eastern North Atlantic has been spreading and increasing for over 200 years (Cramp & Simmons 1977). The world population is estimated at 4 000 000-16 000 000 pairs (del Hoyo *et al.* 1992).

Breeding distribution and habitat preferences in the Barents Sea Region

About 145 northern fulmar colonies have been registered in the Barents Sea Region (SCRIB 1998). The total population is poorly known as few of the colonies have been censused, breeding is

Population sizes and trends of the northern fulmar *Fulmarus glacialis* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	360-585	1990	(0)	-	(0)	-	1
MC	0						
WS	0						
ND	0						
NZ	2500	1950	(0)	-	(0)	-	2, 3
FJL	2000-3000	1992	(0)	-	(0)	-	4
SV	100 000-1 000 000	1994	(0)	1989	(0)	-	5
All	100 000-1 000 000	-	-	-	-	-	

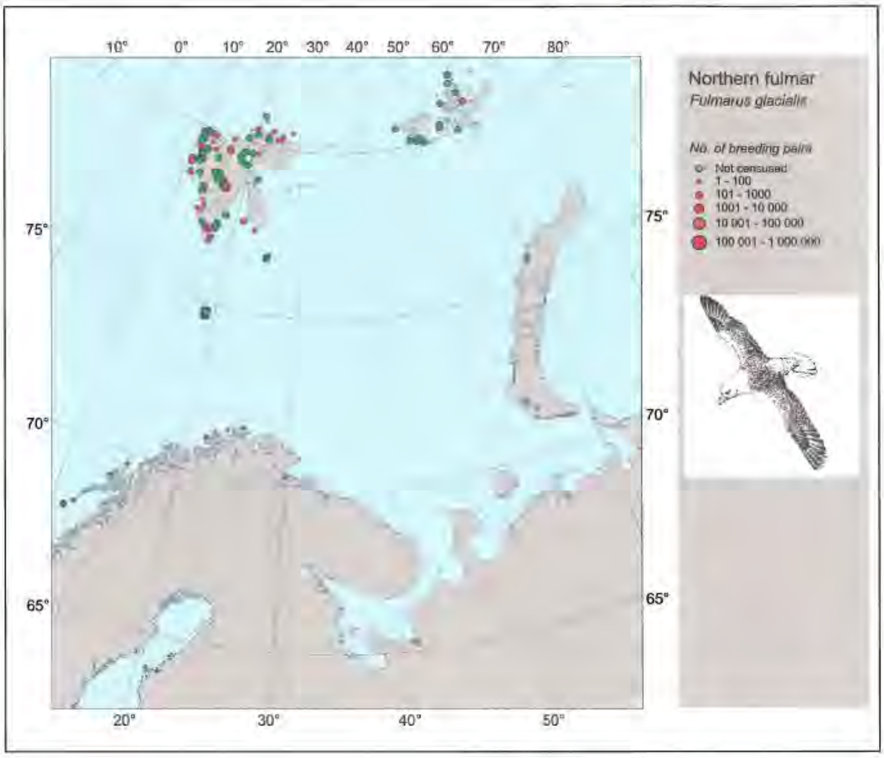
1. Størkersen 1994, 2. Uspenski 1959a, 3. Golovkin 1984, 4. Gavrilo *et al.* 1993. 5. Mehlum & Bakken 1994

scattered and the nest sites are often hidden. Northern fulmars generally breed on steep cliffs, but on Bjørnøya they also breed on flat ground (V. Bakken, pers. obs.).

Five colonies have been recorded on the Norwegian coast north of the Arctic Circle, and the population is estimated at 360-585 pairs, the total population in Norway being approximately 7000 pairs (Størkersen 1994). Northern fulmars were first found breeding in Norway in 1920. The population has since increased substantially and northern fulmars now breed along most of the coast (Størkersen 1994). Most of them belong to the light morph, *F. g. audoboni*. The increase in this population is probably a result of massive emigration from other colonies in the low-Arctic and boreal parts of the Atlantic (Størkersen 1994).

In the Russian part of the Barents Sea, northern fulmars breed on Novaya Zemlya and Franz Josef Land, but not on the mainland. Because only a few censuses are available, the population estimates for these areas are very rough. On Novaya Zemlya, northern fulmar colonies are only found in Krivosheina Bay (Sosnovski 1911) and perhaps near the Petersen glacier (Dubrovski 1933, cited after Demme 1946). The Franz Josef Land population is estimated at 2000-3000 breeding pairs, but colonies do not normally exceed several hundred pairs. The largest is probably on Cape Fischer with about 1000 pairs (Gavrilo *et al.* 1993). No censuses have been made on Novaya Zemlya, but Golovkin (1984) estimated the total population at 2500 pairs. This corresponds well with the 5000 individuals roughly estimated by Uspenski (1959a). The colonies in Franz Josef Land are distributed over most of the archipelago, but there are none on the eastern and western islands, probably due to lack of suitable nesting habitats (Gavrilo *et al.* 1993). All the known colonies are situated on steep cliffs close to the sea. The northern fulmars breed on narrow ledges, mostly on the upper part of the cliffs. The colonies are always mixed with other species, and northern fulmars never dominate.

In the Barents Sea Region, most northern fulmars breed in Svalbard where about 125 colonies have been registered and the total population is estimated at 100 000-1 000 000 pairs (Mehlum & Bakken 1994). The population on Bjørnøya is estimated at 50 000-60 000



breeding pairs (van Franeker & Luttik 1981).

Movements

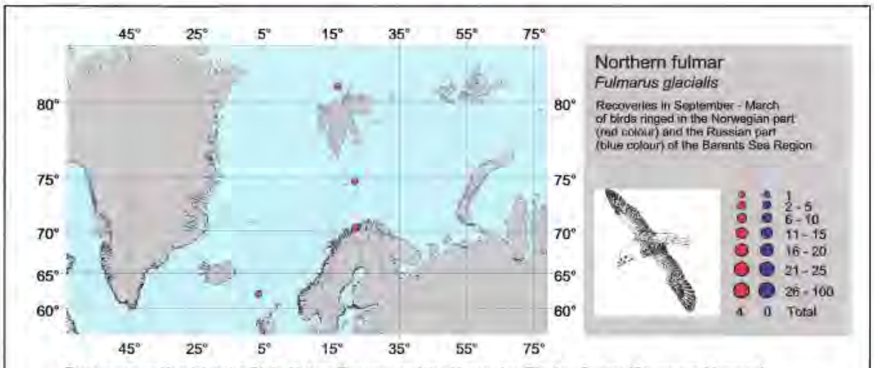
Of northern fulmars ringed in Norway, Svalbard and at sea in Norwegian waters, 68 have been recovered (data from the Norwegian Ringing Centre). Twelve ringed on the Norwegian coast north of the Arctic Circle were recovered at sea in the North Atlantic (6), in Norway (2), the Faeroes (1), the Netherlands (1), Britain (1) and Iceland (1). The results show that northern fulmars can migrate long distances, but no clear pattern has been detected. No northern fulmars have been ringed in the Russian part of the Barents Sea Region.

Preliminary results from satellite tracking of northern fulmars breeding in the fjord regions of western Spitsbergen show that they fly long distances during the chick-rearing period (F. Mehlum, pers. comm.). Some birds travelled to the waters west of Novaya Zemlya, some to the Bjørnøya area and some westwards to the ice margin in the Greenland Sea. Whether attaching transmitters to the back of the birds affects them is not known, but the behaviour of these birds may have been affected. High chick mortality in the experimental group indicates that the nest attendance pattern was altered, and the results may thus not be representative for the population.

Population status and historical trends

The northern fulmar population on the Norwegian coast has increased substantially since the species first bred here in 1920 (Folkedal *et al.* 1989). The colonies in the southern part of Norway are still increasing (Lorentsen 1998). In Finnmark, the number of birds in the study plots have been variable and there is no obvious trend (Lorentsen 1998).

Little is known about the present status and population trend of the northern fulmar in the Russian zone of the Barents Sea Region. The nest sites high up on inaccessible cliffs are difficult to count. The northern fulmar's nomadic way of life, with large numbers of non-breeding birds occurring near the colonies, is also a problem when interpreting the data.
The only colony where several counts have been made is on Rubini Rock in Franz Josef Land, but large differences in numbers (a few pairs in 1929 and 1930 (Gorbunov 1932), 3000 birds in 1931 (Demme 1934), 1000 in 1981 (Belikov & Randla 1984), 20 pairs (Krasnov 1995) and 200 birds in 1993 (L. Stempniewich, pers. comm.), indicate that the methods used do not permit comparison. The size of the breeding population is probably closer to the lower estimates. The estimates in excess of 1000 birds probably include birds flying near the colony. Even though northern fulmar colonies are



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

characterised by large population fluctuations, such large differences seem unrealistic.

In Svalbard, the northern fulmar population has been monitored on Bjørnøya and in one colony on Spitsbergen since 1989 and 1988, respectively. The number of birds in the plots counted as having apparently occupied nesting sites varies a lot, often by more than 100%, and there are no obvious trends (Norwegian Polar Institute, unpubl. data).

Feeding ecology

Northern fulmars consume a great variety of food, including crustaceans, cephalopods, fish, offal, discards and carrion (Cramp & Simmons 1977). The extensive fishery in the Barents Sea produces much offal that is important for the northern fulmars. It is common to observe thousands of northern fulmars around fishing vessels (V. Bakken, pers. obs.).

No information exists from the Norwegian coast and little information is available concerning the diet of the northern fulmar in the Russian area of the Barents Sea. Observations of northern fulmars feeding on invertebrates concentrated on the surface of the sea have been reported by Belopolski (1933) who recorded birds feeding on *Clyone lymacina* and *Lymacina lymacina* on the open sea (74°30'N, 33°30'E, August 1927; 73°00'N, 38°00'E, June 1928).

During the intensive whaling that took place in the Svalbard region in the early 19th century, there were many observations of northern fulmars assembled around the dead whales (Løvenskiold 1964). Today, it is possible that modern fisheries play as equally an important role for the northern fulmars as the whaling did. In July-September 1933, Hartley & Fisher (1936) analysed the stomach contents of 39 northern fulmars from Billefjorden (Spitsbergen). The main food items found were various species of crustaceans (*Thysanoessa inermis*, *Mysis oculata*, *Pseudalibrotus littoralis*, *Parathemisto libellula)*, *Sagitta elegans arctica*, *Cyanea capillata*, cephalopods, along with unidentified fish and offal. On Bjørnøya in July-August 1948, Duffey & Sergeant (1950) found cephalopod beaks, polychaete jaws, fish remains, fish offal and grit (based on 26 stomachs). de Korte (1972) analysed the stomach contents of 20 northern fulmars in Storfjorden during May-August 1968-69. The main prey items found were cephalopod beaks, crustaceans, polychaete jaws, fish and offal. In Hornsund (Spitsbergen) in September/October 1984, Lydersen *et al.* (1989) found mainly indigestible remains such as squid *Gonatus fabricii* beaks, jaws from the polychaete *Nereis irrorata* and pieces of plastic. Camphuysen & van Franeker (1997) investigated the northern fulmar diet in summer on Bjørnøya in 1980. Regurgitated food revealed an entirely different diet composition than did the examination of proventriculus and gizzard contents. Only fish flesh and crustaceans were frequently regurgitated, whereas hard parts such as fish eye lenses, squid eye lenses and beaks, jaws of nereid worms, and plastic numerically dominated the contents of the intestines that were collected. Northern fulmars shot around Svalbard in August-September 1982 had eaten the polychaete *Nereis irrorata*, *Parathemisto libellula*, fish and squid (Mehlum & Gjertz 1984). Polar cod *Boreogadus saida* were the only distinguishable fish present. Rubber, plastic and cotton were also found in some of the stomachs. Camphuysen (1993) found mainly zooplankton and fish in northern fulmars from Svalbard. Important prey in the summers of 1988-90 were crustaceans (*Parathemisto libellula*, *P. abyssorum*, *Gammarus* spp., *Thysanoessa*, Euphausiacea, Decapoda), pteropods (*Limacina* spp.), annelids (*Nereis* spp.), chaetognathes (*Sagitta elegans*), squid and fish *(Mallotus villosus*, *Sebastes* spp., *Benthosema glaciale*). In addition, plastic was frequently recorded (Camphuysen 1993).

Threats

Relatively high concentrations of organochlorines have been found in northern fulmars (Mehlum & Bakken 1994), but no effects on the population have been documented. Plastic has been found frequently in stomachs of northern fulmars (van Franeker 1985, Camphuysen 1993, Camphuysen & van Franeker 1997), but it is not known whether this can affect the survival of the birds (van Franeker 1985). Northern fulmars are commonly caught in the long-line fisheries in the Norwegian and Barents Seas (Løkkeborg 1990, Birdlife International 1999). The total Norwegian long-line fleet (including the inshore fleet of smaller vessels) is estimated conservatively to take ca. 20 000 northern fulmars annually, but the actual total may be as high as 50 000-100 000. The estimated annual mortality is not thought to be status-threatening given that the north-east Atlantic breeding population is ca. 2-4 million pairs (Birdlife International 1999).

Northern fulmars are classified as being vulnerable to oil spills in the Barents Sea Region (Anker-Nilssen, Bakken *et al.* 1988, Fjeld & Bakken 1993). They often concentrate around ships or drilling platforms and this behaviour makes them specially vulnerable to oil spills in such areas. Lorentsen & Anker-Nilssen (1993) studied the behaviour of the northern fulmar in connection with an experimental oil spill in the Norwegian Sea. Evidence strongly suggested that they deliberately avoided settling on the area that was polluted with heavy oil. About 5% of the northern fulmars in the area were, however, slightly oiled, probably because they had been attracted to the "blueshine" areas surrounding the slick by food remains thrown overboard from the research vessel.

When evaluating the threats, the two sub-species should be considered independently, but this is difficult at present.

Diet of the northern fulmar *Fulmarus glacialis* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
SV	Svalbard	Early 19th century	Dead whales	Adults	1
-	Spitsbergen	1933	*Thysanoessa inermis* (59%) *Parathemisto libellula* (13%) *Sagitta elegans arctica* (10%) *Cyanea capillata* (10%) Fish (10%)	Adults	2
-	Bjørnøya	1948	Cephalopods (52%) Polychaete (47%) Fish (35%)	Adults	3
-	Storfjorden	1968-69	Cephalopods (80%) Crustaceans (30%) Polychaete (20%) Fish (20%)	Adults	4
-	Bjørnøya	1980	Stomachs: Fish (91%) Nereid worms (82%) Plastic (82%) Grit (59%) Cephalopods (41%) Regurg: Fish (77%) Crustaceans (46%) Plastic (8%)	Adults	5
-	Svalbard	1982	Polychaete (57%) *Parathemisto libellula* (29%) Pisches, undet. (29%) Polar cod (21%) Cephalopoda/Decapoda (14%)	Adults	6
-	Hornsund	1984	Polychaete (82%) Cephalopods (41%) Polar cod (12%)	Adults	7
-	Svalbard	1988-90	Crustaceans Pteropods Annelida Chaetognatha Squid and fish	Adults	8

1. Løvenskiold 1964, 2. Hartley & Fisher 1936, 3. Duffey & Sergeant 1950, 4. de Korte 1972, 5. Camphuysen & van Franeker 1997, 6. Mehlum & Gjertz 1984, 7. Lydersen *et al.* 1985, 8. Camphuysen 1993

Both occur in the Barents Sea, but the population of the southern sub-species is much smaller than that of the northern one. Their breeding areas are relatively well separated, but both breed on Bjørnøya (van Franeker & Wattel 1982).

Special studies

Only a few special studies of the northern fulmar have been carried out in the Barents Sea Region. On Bjørnøya, van Franeker & Luttik (1981) and Camphuysen & van Franeker (1997) studied breeding numbers, colour phases, interbreeding between light and dark individuals, diet and other aspects of their biology. The chemical contamination of northern fulmars has been investigated by Bourne & Bogan (1972) and Bourne (1976) in 1972 (Bjørnøya), Norheim & Kjos-Hanssen (1984) in 1980 (west coast of Spitsbergen) and Carlberg & Böhler (1985) in 1984 (Hornsund, Spitsbergen). More recent studies indicated relatively high levels of organochlorines in northern fulmars (Mehlum & Bakken 1994). The behaviour of northern fulmars in relation to an oil spill at sea was studied by Lorentsen & Anker-Nilssen (1993). Løkkeborg (1998) looked into alternative setting methods for long- lines to reduce the by-catch of northern fulmars. A study of seabird by-catch in long-lines in North-Norway conducted by Birdlife International and the Norwegian Ornithological Societey in 1997 and 1998, showed that mainly fulmars (>99%) were hooked (Birdlife International 1999).

Ship-based and aerial censuses of northern fulmars at sea in the Barents Sea have been made by Belopolski (1933) and Borkin *et al.* (1992), respectively. Belopolski (1933) gave a semi-quantitative description of northern fulmar and kittiwake distributions and discussed the number of birds in relation to water masses and prey availability. Borkin *et al.* (1992) surveyed the entire Barents Sea in late August 1991, estimated northern fulmar and kittiwake densities, and discussed the spatial correlation between fish and bird distributions.

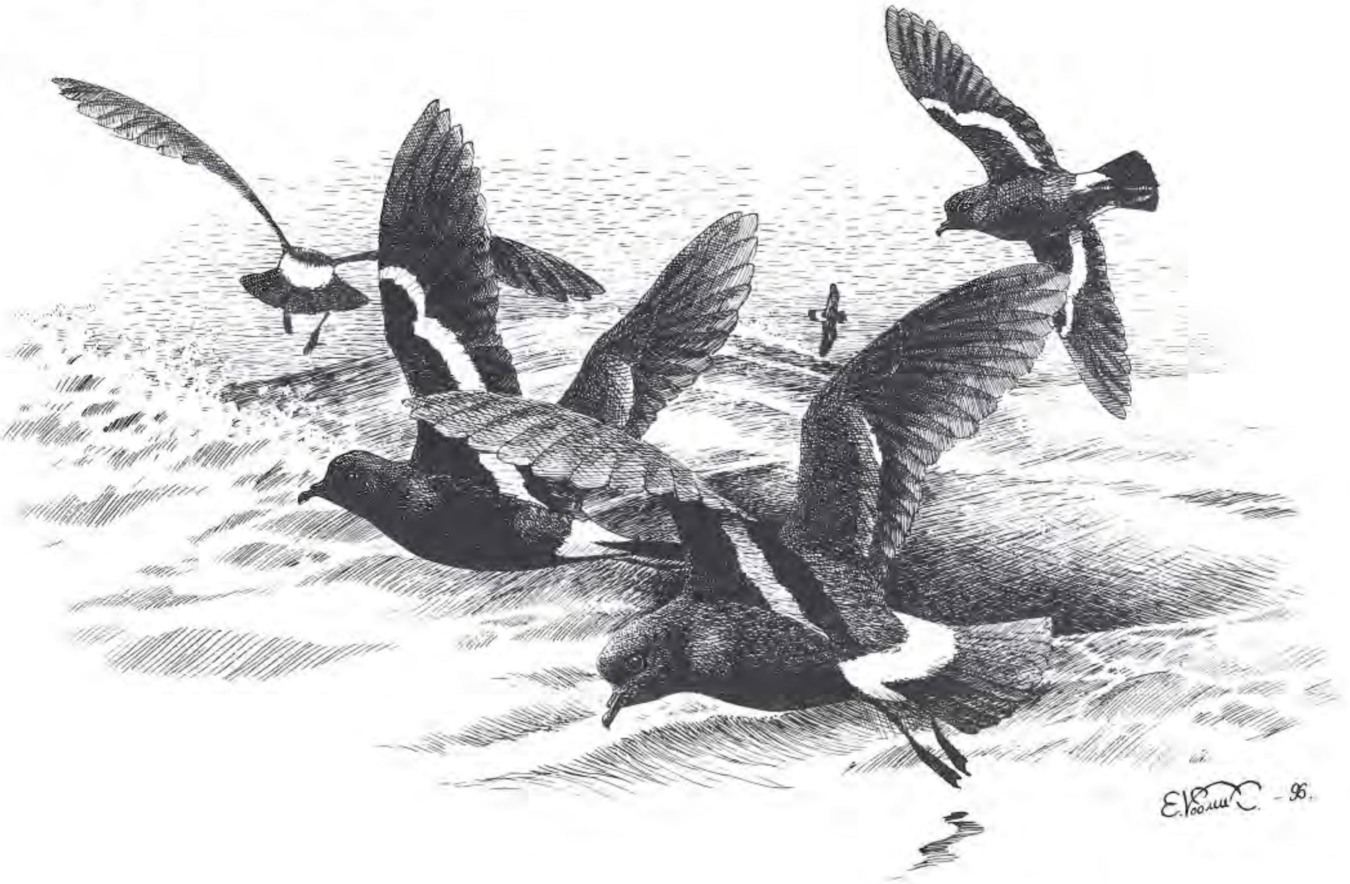
Recommendations

The effect of fisheries on the survival of northern fulmars should be investigated. The amount of by-catches in the long-line fisheries and the possible effects of high levels of organochlorines on survival and reproduction also deserve special attention.

Vidar Bakken & Maria V. Gavrilo

European storm-petrel *Hydrobates pelagicus*

No: Havsvale Ru: Pryamokhvostaya kachurka



Population size: 1000-10 000 pairs
Percent of world population: <10%
Population trend: ?

General description

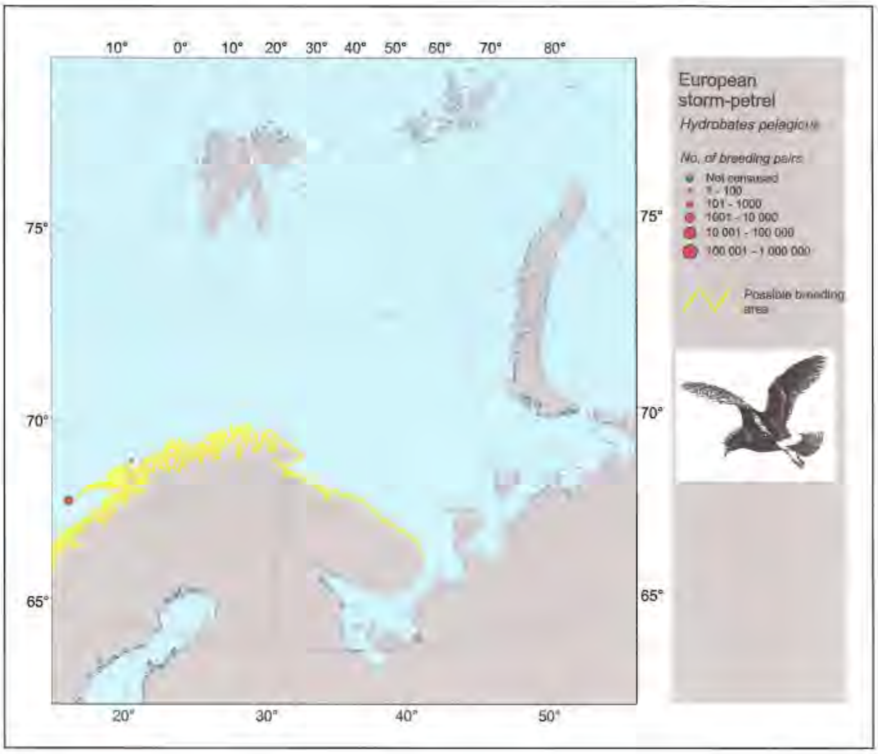
With a body weight of about 25 g, the European storm-petrel is the smallest seabird in the Atlantic Ocean. The distinct white underwing bars distinguish it from all other western Palearctic storm-petrels. It is much smaller than the Leach's storm-petrel, its plumage is darker and its tail is not forked. It is only known to breed in the north-eastern Atlantic, but as its appearance at the breeding grounds is solely nocturnal, its breeding distribution is not known in detail. The breeding range includes most of Europe's Atlantic coast and the Mediterranean east to Turkey, and continues northwards along the Norwegian Sea into the south-western part of the Barents Sea. The total population has been estimated to be between 135 000 and 380 000 pairs (Evans 1984a, Lloyd *et al.* 1991). More than 90% of these breed in north-west Britain (mainly Shetland and Orkney), western Ireland and the Faeroe Islands, which may have roughly equal populations. However, Bloch *et al.* (1996) have recently suggested that the Faeroese population, alone, numbers 250 000 pairs. In these three main areas, the continental shelf is narrow and strong frontal systems between the Atlantic Current and coastal water masses are relatively close to the shore. Breeding has been proved or is very likely at a minimum of eight Norwegian sites, and all are in similar areas.

A few thousand pairs breed on the Vestmanna Islands in Iceland. Malta has at least 10 000 pairs, but populations elsewhere in southern Europe are small. The southernmost colonies are on the Canary Islands, where there are about 1000 pairs. European storm-petrels are regularly recorded in the North Sea and the Skagerrak, but have not been found breeding there. Occasionally, they are observed as far north as Spitsbergen, and strong winds may carry birds far inland in western Europe. A substantial proportion of birds attending colonies are non-breeders or are breeding elsewhere. The

Population sizes and trends of the European storm-petrel *Hydrobates pelagicus* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	1000-10 000	1994	No data	-	No data	-	1
MC	0?						
WS	0						
ND	0						
NZ	0						
FJL	0						
SV	0						
All	1000-10 000	1994	-	-	-	-	

1. Anker-Nilssen 1994a



species is monotypic, but the Mediterranean population may form a distinct sub-species *H. p. melitensis* (del Hoyo *et al.* 1992).

European storm-petrels breed in colonies on grassy islands furthest out on the coast, occasionally on the mainland where there are no islands. As is typical for tube-noses (Procellariiformes), the species has a very low reproduction rate. It does not start to breed before the age of four or five years and lays only one egg. This is counterbalanced by low adult mortality (12-13% per year) (Scott 1970). So far, the oldest individual on record was ringed as a full-grown bird in Shetland in 1962 and controlled in the Faeroes 32 years later (Jensen 1995). The oldest Norwegian bird was last recaptured in Røst in 1996, 29 years after it was ringed there as a full-grown individual (Anker-Nilssen 1997).

The egg weighs about 25% of the bird's body mass. It is generally placed directly on the ground in a deep crevice under stones, among boulders or in a soil burrow dug by puffins, shearwaters or rabbits, but European storm-petrels are able to dig in soft soil. The egg is incubated for about 40 days, and the chick stays in the nest for another 60-70 (50-80) days. In Britain, egg laying starts in May-June and most birds finish breeding before the end of October (Cramp & Simmons 1977).

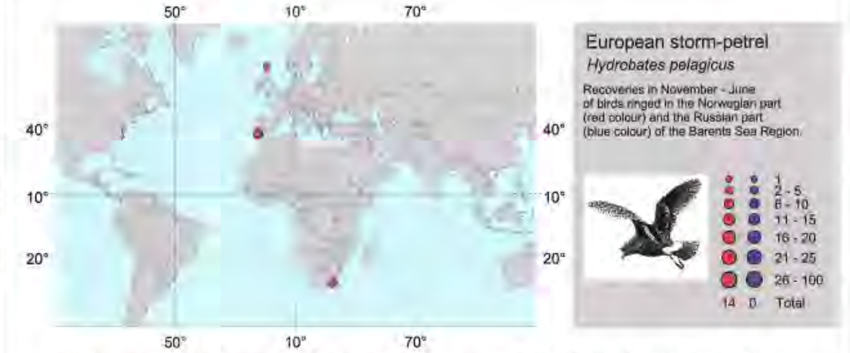
Breeding distribution and habitat preferences in the Barents Sea Region

The distribution of European storm-petrels in Norway is probably determined mainly by the frontal system between the coastal and Atlantic currents, where their main prey, small crustaceans and other planktonic organisms (Cramp & Simmons 1977), is particularly abundant. Thus, with a relatively short distance to such areas over the outermost part of the continental shelf, the coast from the Lofoten Islands to western Finnmark would seem to be the most promising breeding grounds.

Bianki *et al.* (1993) described the European storm-petrel as a vagrant species recorded over the entire White Sea. However, they did not mention any other records from north-west Russia and reported only one observation, made in Kandalaksha Bay on 7 September 1989. Thus, the occurrence of the species in the Russian part of the Barents Sea, e.g. along the Kola Peninsula, is unknown. Only two colonies are known within the Barents Sea Region, both situated in the south-west. The largest is in Røst, farthest out in the Lofoten Islands, where the first Norwegian breeding record was made in 1961 (Helling 1962). The species has been known to occur in Røst since the 1920s (Myrberget *et al.* 1969), and even though relatively few nests have been found, there are probably several thousand breeding pairs scattered over a number of islands and islets in the Røst archipelago. This assumption is supported by a much higher recapture rate of ringed birds in Røst than at other localities in Norway (Anker-Nilssen 1990, 1996, Anker-Nilssen & Anker-Nilssen 1993). Besides Røst, such high recapture rates have only been registered at Erkna near Ålesund, which triggered the recent discovery of a small storm-petrel colony on that island, the first confirmed breeding of the species in southern Norway (Olsen 1996). During 1964-98, approximately 12 000 European storm-petrels have been captured in Røst, with an annual average of 1568 individuals in the peak years 1994-96 (Anker-Nilssen 1997, 1999).

The other colony is on Bleiksøy off Andøya in Vesterålen, where an incubating adult was captured on the nest in 1986 (Barrett & Strann 1987). In addition to Røst, more than 1300 European storm-petrels have been successfully tape-lured for ringing purposes at 27 localities scattered along the Norwegian coast north of the Arctic Circle, the highest numbers being on or close to the island of Frugga, 73 km south of Bleiksøy (Anker-Nilssen 1998a, 1999, unpubl. data). It is, thus, quite possible that the species is breeding there and at several other places within the Barents Sea Region. The most promising observations, such as capturing adults on land without using tape-lures or employing play-back calls to provoke birds to display underground, have been made on Kalsholmen, Fuglenyken and Frugga in Nordland, Sør-Fugløy in Troms, and Gjesvær and Hornøya in Finnmark (Nygård & Einvik 1991, Anker-Nilssen 1994a, 1999, K.-B. Strann, pers. comm.). The possibility that colonies exist along the Kola Peninsula has not yet been explored.

In Røst, European storm-petrels breed mainly in boulder screes or crevices underneath or between large rocks protruding from the grassy slopes. It is, occasionally, possible to see birds on the nest from the outside. Puffin burrows are also used. Some birds breed only a few metres above and away from the sea, while others breed higher up, at least up to 40-50 m above sea level (Anker-Nilssen & Anker-Nilssen 1993). The nest on Bleiksøy was placed in the entrance of a puffin burrow dug in a grassy slope (Barrett & Strann 1987).



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Probably to avoid predation, European storm-petrels arrive and leave the colony in the dark. Consequently, the continuous daylight in Arctic regions in midsummer probably explains why egg laying in north Norway is postponed until August (Anker-Nilssen 1990). Considering the long incubation and fledging periods, it implies that some northern chicks do not leave the colony until early December. This was corroborated on 3 December 1997 when a newly fledged, downy juvenile was captured at Andenes (Aune 1997), only 10 km north-east of Bleiksøy.

Movements

European storm-petrels spend the winter in the south-eastern Atlantic, particularly high numbers being seen off South Africa (Cramp & Simmons 1977). Thanks to a considerable ringing effort over the past three decades, 3053 movements of individual birds between different sites including at least one Norwegian locality, have been recorded up to 1998 (Anker-Nilssen 1999). Of these, 1492 (49%) involve sites in north Norway. Only two Norwegian birds, both ringed in Røst, have been recovered in South Africa (both found dead), while 12 birds from Røst, one from Eggum, three from Hovden and one from Frugga have been captured in Algarve, Portugal, when returning north in June. Also, 24 birds captured in Algarve have later been controlled in north Norway; 23 in Røst, one at Eggum, three at Hovden, and one on Frugga. As indicated by the mismatch in these numbers, some individuals were controlled in several years and on several Norwegian ringing sites, which explains the total of 49 recoveries registered between north Norway and Portugal (either way). Up to 1998, 54 recoveries have been made between north Norway and Great Britain, and 12 between north Norway and the Faeroe Islands, while two birds ringed in Iceland, one in Ireland and one in Holland have been controlled in Røst (Anker-Nilssen 1999).

The disproportionately high rate of recoveries between north Norway and Portugal, compared to Great Britain, where the annual catch is 10-20 times higher than in Portugal, is striking. It strongly suggests that most birds breeding in north Norway pass the British breeding areas at a considerable distance. Likewise, ringing results indicate that the exchange of birds between north Norway and the north-western breeding grounds of the species in Iceland and the Faeroes, is equally insignificant. Also, Norwegian birds are over-represented at Algarve in June, where one out of three foreign ringed birds stem from Norway, and they occur slightly later than British birds (Wallis 1996). This is most likely connected with the much later onset of breeding in north Norway. In Britain, most birds lay in June (Scott 1970) and probably arrive at the breeding sites no later than May, but the catching success in Algarve is very low prior to early June (Harris *et al.* 1993).

European storm-petrels may travel very long distances in a short time. The Norwegian speed records (minimum of 15 km per hour) are held by a bird that covered the 819 km from Frugga to the island of Runde near Ålesund in western Norway in less than 54 hours, one that travelled at least 630 km from Røst to Runde in less than 42 hours, and one that was captured near Eigersund in southern Norway 72 hours after it was ringed in Røst 1044 km farther north (Anker-Nilssen 1999). Another 13 birds are known to have flown hundreds of kilometres at speeds faster than 10 km per hour. Even ovid females and birds attending a chick are known to have travelled many hundreds of kilometres in just a few days (e.g. Anker-Nilssen 1991a, Mork 1994). Consequently, an analysis of migration patterns in Norwegian waters is complicated, to say the least.

Population status and historical trends

There is no information on population trends in Røst, nor is there any easy way to assess and monitor the population size with reasonable accuracy (but see e.g. Wood 1997). The population breeding in north Norway may be between 1000-10 000 pairs, but there are few facts to substantiate this very rough guesstimate. Although the Røst population alone may well hold that many birds, the great exchange of birds between different catching localities (Anker-Nilssen 1999) may indicate that the population is not much larger, even though there are probably several undiscovered colonies.

There is no information on population trends in the Barents Sea Region, but declines have been demonstrated in southern England and the Mediterranean (Lloyd *et al.* 1991).

Feeding ecology

The European storm-petrel is an offshore surface feeder (Cramp & Simmons 1977), but is also able to dive several metres (Jensen 1993). It feeds mainly on small fish, squid and crustaceans, also medusae and offal (del Hoyo *et al.* 1992). There is, however, no information on its diet in the Norwegian and Barents Seas. In Britain, small herring *Clupea harengus* and sprat *Sprattus sprattus* may constitute a large proportion of the food regurgitated to the chick (Scott 1970).

Threats

In the colony, birds are highly vulnerable to predation from gulls and mammals. In the Barents Sea Region, potential predators would include most gull species, brown rats *Rattus norvegicus* and several musteline species *Mustela* spp., as well as arctic foxes *Alopex lagopus* on high-Arctic islands. As most colonies are found on islands where these mammals are absent, the local introduction of such species, or of cats, could easily have a devastating effect. In Røst, there are rats on at least one of the islands where the species probably breeds, and a probably increasing population of great black-backed gulls *Larus marinus* may also have an effect on population numbers. Farther south in Europe, rat and cat predation has been responsible for some local extinctions and shifting of colonies, and extensive building for tourism along the coast is considered a threat for the Mediterranean population (del Hoyo *et al.* 1992).

There are relatively few reports of European storm-petrels being killed by oil spills, but their extremely offshore feeding habit makes it unlikely that many oiled birds will reach land. Also, owing to their small size and dark colour, beached birds will be easily overlooked. Following the Exxon Valdez incident in Alaska in 1989, more than 400 storm-petrels (Hydrobatidae) were found dead and oiled, most of them belonging to the very abundant species, the fork-tailed storm-petrel *Oceanodroma furcata* (Piatt *et al.* 1990).

Special studies

The extensive Norwegian ringing work commented on above has also produced valuable data on body measurements and capture-recapture rates. The latter applies in particular to the studies made in Røst, where, among other things, the calculation of annual survival rates for presumed breeders (i.e. those captured several years) is now feasible. Also, the late onset of breeding in the north has been confirmed in Røst by the weight changes of adults caught repeatedly during the same season and the occasional laying of an egg while adults are kept briefly for ringing (T. Anker-Nilssen, unpubl. data). Otherwise, there are no past or ongoing studies of European storm-petrels north of the Arctic Circle.

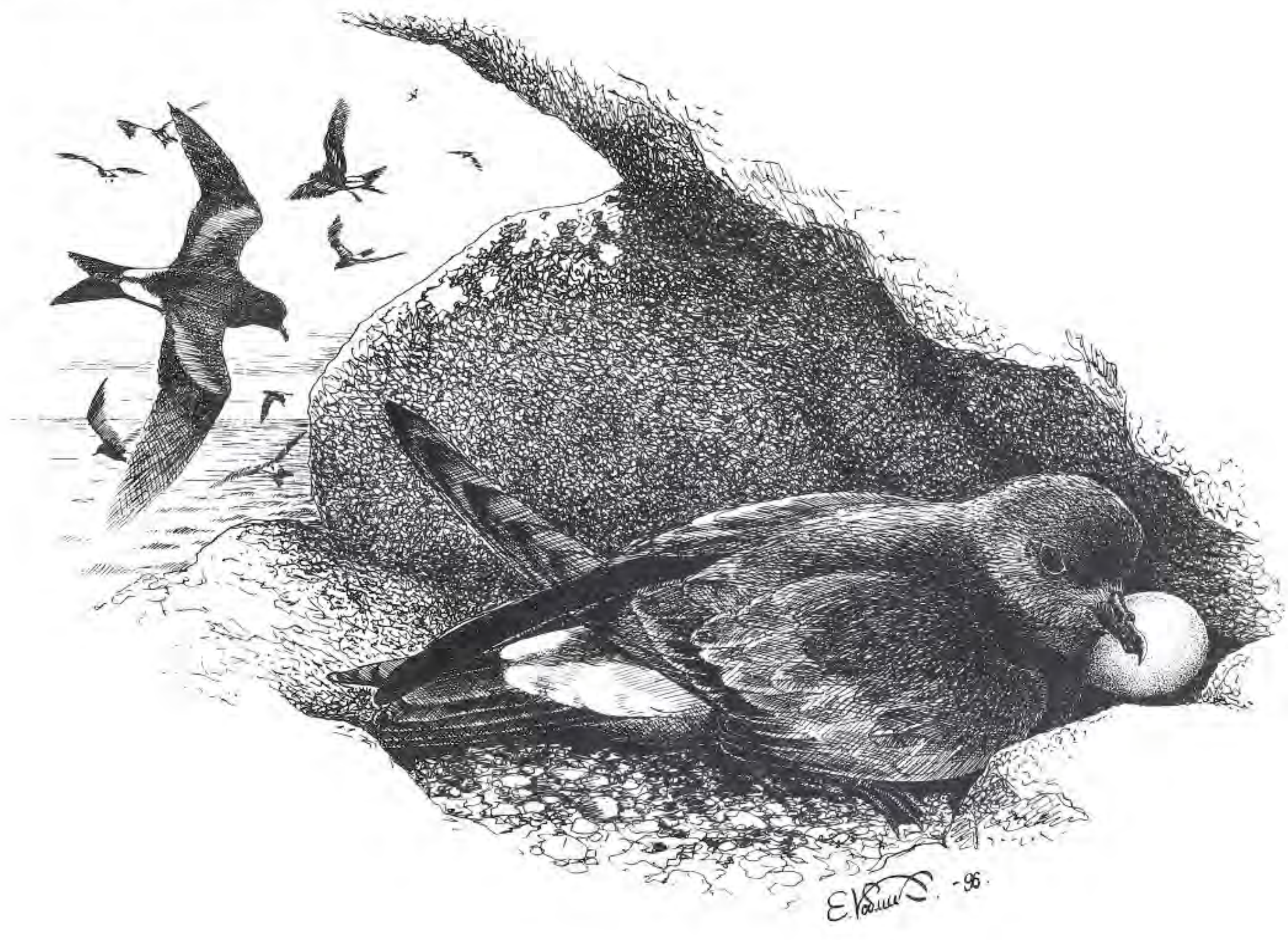
Recommendations

The possibility that European storm-petrels regularly visit Russian waters and may even breed along the Kola Peninsula should be explored both with and without the use of tape-lures on coastal islands on dark nights in August and September.

Tycho Anker-Nilssen

Leach's storm-petrel *Oceanodroma leucorhoa*

No: Stormsvale Ru: Severnaya kachurka



Population size: 100-1000 pairs
Percent of world population: <0.1%
Population trend: ?

General description

The Leach's storm-petrel is a very abundant member of the storm-petrel family and is widely distributed in the northern hemisphere. Compared with the storm-petrel itself, it is much larger (ca. 45 g), its plumage is browner, and its tail is forked. Its underwings are uniformly dark, but the upper side of the inner wings has a conspicuous, broad, pale, diagonal band. Its main breeding areas are in the North Pacific and north-western Atlantic (Croxall *et al.* 1984, Lloyd *et al.* 1991). The world population is estimated at 10-15 million pairs, of which more than 3 million pairs breed in the colony on Baccalieu Island, Newfoundland (Sklepkovych & Montevecchi 1989). Alaska has 5-7 million pairs. The only known colony in Japan is the second largest in the world with around 1 million breeding pairs.

The eastern Atlantic population is very small, probably numbering between 10 000 and 100 000 pairs (Lloyd *et al.* 1991). As colony attendance is strictly nocturnal, the breeding distribution is not known in detail. Seven colonies are situated on the outermost, most isolated islands in north-western Britain, where the birds forage over or beyond the edge of the continental shelf (Webb *et al.* 1990). The largest European colony is found on Boreray in the St Kilda archipelago, west of the Hebrides, and has 3200-6400 occupied nest burrows. The Vestmanna Islands in Iceland probably

Population sizes and trends of the Leach's storm-petrel *Oceanodroma leucorhoa* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	100-1000	1994	no data	-	no data	-	1
MC	0?						
WS	0						
ND	0						
NZ	0						
FJL	0						
SV	0						
All	100-1000	1994	-	-	-	-	

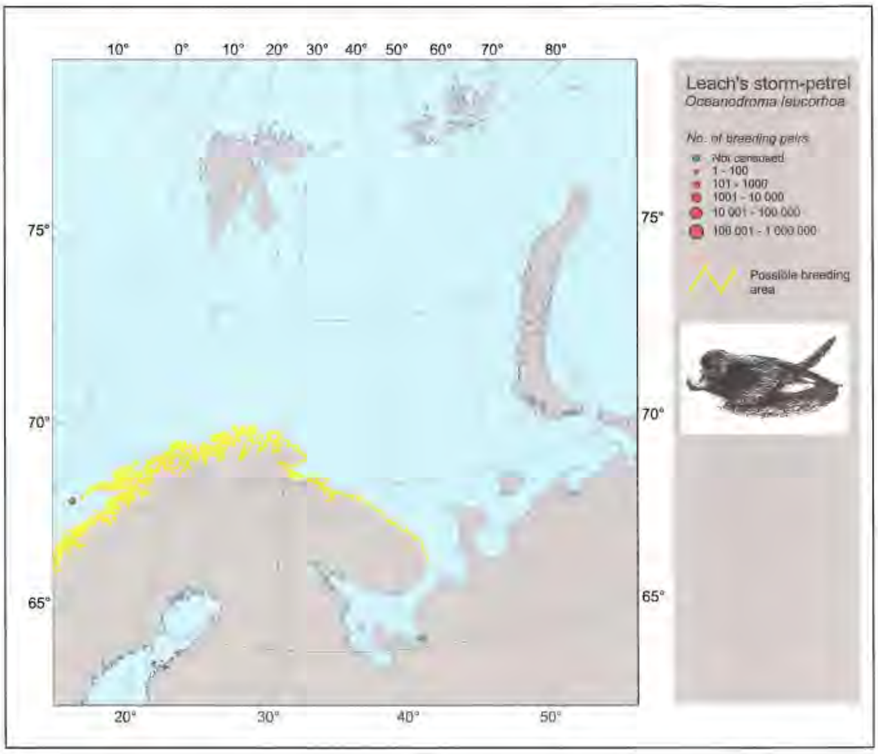
1. Anker-Nilssen 1994b

also have more than 1000 pairs, the Faeroe Islands about 1000 pairs (Bloch *et al.* 1996) and Ireland has one known colony with at least 200 pairs.

Leach's storm-petrels are occasionally seen in the Barents Sea, the North Sea, the Baltic Sea and the Mediterranean, but there are no breeding records from those areas. Individual birds may be forced far inland by strong winds, as illustrated by accidental reports from Switzerland and Austria (Cramp & Simmons 1977).

Like all storm-petrels, the Leach's storm-petrel has a very low reproduction rate. It lays only one egg and does not commence breeding before it is four or five years old. This must be compensated for by high adult survival, but reliable estimates of survival rates are lacking. One ringed bird is known to have been at least 24 years old.

The male builds the nest in a natural cavity in the ground, for instance in screes, puffin burrows or beneath roots of trees, or it digs out a burrow itself in soft soil. The nest is generally only a layer of dry straws, but the amount of nest material used varies considerably. The egg is incubated for about seven weeks and the chick stays in the nest for another 60-70 days. In Britain, egg laying starts in June, and most birds finish breeding before the end of October (Cramp & Simmons 1977).



Breeding distribution and habitat preferences in the Barents Sea Region

The species is only known to breed in colonies on oceanic islands, usually at a considerable distance from the nearest mainland. Until recently, breeding in Norway had only been confirmed in Røst in the outer Lofoten Islands. Although this colony has been known since the early 1960s (Helling 1962), the first confirmed breeding record was made in late August 1989 when a nest with two birds and one egg was found in an Atlantic puffin *Fratercula arctica* burrow. Other information indicates that the total population of Leach's storm-petrels in the Røst archipelago probably amounts to at least some hundreds of pairs, and that they prefer to breed on the upper slopes of the highest islands (Anker-Nilssen & Anker-Nilssen 1993). Røst is still the only known colony north of the Arctic Circle. Farther south, however, the second Norwegian breeding site was confirmed on 13 August 1996, when a nest containing a relatively newly hatched chick was found on Erkna, a low, 0.5 km^2 grassy island in Møre & Romsdal, western Norway (Olsen 1996). This pair bred in a self-dug, earthen burrow on a low hillside. At the same time, a bird was calling from another potential nest site, and display flights were observed at six or seven places on the island (O. Olsen, pers. comm.).

Although only two colonies are known, the species has been captured in mist-nets at 34 sites spread along the entire Norwegian coastline (Anker-Nilssen 1999), usually by using tape-lures that easily attract wandering, non-breeding individuals. Without using play-back calls, Leach's storm-petrels have only been captured on Erkna, Sklinna, Mosken and four islands in Røst (Anker-Nilssen 1994b, Olsen 1996). On Hornøya in eastern Finnmark, one individual was heard calling from below the ground, but tape-lures were used at the same time elsewhere on the island (K.-B. Strann, pers. comm.). Of the 698 Leach's storm-petrels ringed in Norway during 1964-98, 589 (84%) were ringed in Røst, 7 on Hornøy and 10 more at six other sites in north Norway. Farther south, more than ten individuals have only been ringed at Sklinna (20) and Runde (13) (Anker-Nilssen 1999). Erkna, which has been visited much less frequently, is situated only 22 km north-east of Runde.

Probably to avoid predation, Leach's storm-petrels arrive and leave the colony in the dark. However, besides being the northernmost colony yet discovered, Røst is situated one degree (111 km) north of the Arctic Circle. It is therefore very likely that the continuous daylight in Røst in midsummer explains why the Leach's storm-petrels breeding there postpone egg laying until August, some birds probably not laying before early September (Anker-Nilssen & Anker-Nilssen 1993). Considering the long incubation and fledging periods, this implies that the chicks do not leave the colony until November or early December. However, the breeding on Erkna (Olsen 1996), which is four degrees south of the Arctic Circle and only two degrees north of Shetland, seems to coincide with the timing of breeding in British colonies.

Movements

Most European Leach's storm-petrels winter in tropical regions of the Atlantic Ocean. Some birds breeding in the north-west Atlantic probably migrate east to Europe before turning south. Significant numbers (probably mostly second-year birds) stay in the tropics in summer, but it has been shown that two-year-old birds may visit the colonies (Cramp & Simmons 1977).

There is very little information on the dispersion of Norwegian Leach's storm-petrels. Except for local recaptures, which have only been made in Røst (repeatedly) and Hovden (once), there are just eight recoveries of birds ringed in Norway (Anker-Nilssen 1998a, 1999). Two were between Røst and Runde (one each way), one of the birds travelling the distance (630 km) northwards in less than 143 hours. One bird from Sklinna was controlled in the colony on Sule Skerry, Orkney, the next year, and one from Flø was also controlled in the Orkneys one year later. The other recoveries are between ringing sites in southern Norway, including one ringed at Lista and controlled twice in the same year and three times the next year on Jomfruland on the Skagerrak coast (Cleve 1991, Anker-Nilssen 1993b). The only Leach's storm-petrel from abroad recovered in Norway was ringed in Shetland and controlled in Røst three years later.

Population status and historical trends

There is no information on population trends in Røst, nor is there any easy way to assess and monitor the population size with reasonable accuracy. Likewise, no data exist which can throw light on the population development in other European colonies. In north-eastern USA, the number of colonies has been reduced as a consequence of predation from dogs, cats and rats, disturbance from tourism and other human activities, and habitat destruction due to sheep grazing (del Hoyo *et al.* 1992). Moreover, its habit of ingesting small plastic debris floating at sea may also have increased Leach's storm-petrel mortality. In California and Mexico, the population trend is also negative.

Feeding ecology

The Leach's storm-petrel is an offshore surface feeder (Cramp & Simmons 1977). There are no data on food choice in Norwegian waters, but the diet generally consists of small fish, squid, planktonic crustaceans and offal. The birds may also follow marine mammals and feed on leftovers and faeces (del Hoyo *et al.* 1992).

Threats

Breeding birds are highly vulnerable to predation from gulls and mammals (cf. examples from the USA commented above). In the Barents Sea Region, potential predators would include most gull species, brown rats *Rattus norvegicus* and several musteline species *Mustela* spp., as well as arctic foxes *Alopex lagopus* on high-Arctic islands. As most colonies are found on islands where these mammals are absent, the local introduction of such species, or of cats, could easily have a devastating effect. in Røst, rats inhabit at least one of the islands where the Leach's storm-petrels probably breed, and the increasing population of great black-backed gulls *Larus marinus* may also have a detrimental effect on population numbers.

There are relatively few reports of Leach's storm-petrels being killed by oil spills, but their extremely offshore feeding habit makes it unlikely that many oiled birds will reach land. Also, owing to their small size and dark colour, beached birds will more easily be overlooked than, for example, auks and fulmars. Following the *Exxon Valdez* incident in Alaska in 1989, more than 400 storm-petrels (Hydrobatidae) were found dead and oiled, most of which belonged to the very abundant species, the fork-tailed storm-petrel *Oceanodroma furcata* (Piatt *et al.* 1990).

Special studies

The ringing work has also produced valuable data on body measurements and the timing of breeding in Røst commented above (Anker-Nilssen & Anker-Nilssen 1993). Apart from this, there are no past or ongoing studies of Leach's storm-petrels north of the Arctic Circle. A few Swinhoe's storm-petrels *Oceanodroma monorhis* have been captured during mist-netting in south-east Britain (e.g. Cubitt 1995), and two birds captured in south-western Norway in 1996 and 1997 probably also belonged to this species (Jæren Ringing Group, pers. comm.).

Recommendations

The possibility that Leach's storm-petrels regularly visit Russian waters and may even breed along the Kola Peninsula should be explored both with and without the use of tape-lures on coastal islands on dark nights in August and September.

Tycho Anker-Nilssen

Northern gannet *Morus bassanus*

No: Havsule Ru: Severnaya olusha

Population size: ca. 2200 pairs
Percent of world population: 1%
Population trend: Reasonably stable

General description

The northern gannet is the largest of the seabirds breeding in the Barents Sea Region. At least 330 000 pairs of northern gannets bred in the North Atlantic in 1994/95 (Murray & Wanless 1997, D. Nettleship & G. Chapdelaine, pers. comm.), the main centre of distribution being Britain. The population is increasing, and has done so at a rate of 2-3% p.a. since the beginning of this century (Nelson 1978, Wanless 1987). New colonies have been established in Iceland, Germany, Britain, Ireland, France, the Channel Islands and Norway.

The northern gannet first nested in Norway (on Runde) in 1946 and the first north Norwegian colony was established at Syltefjord in 1961. The first confirmed record of a northern gannet laying an egg in Russia (Murman) was made in 1996. The conspicuousness of the northern gannet and its habit of building large, open nests has enabled a detailed monitoring of its population expansion.

Population sizes and trends of the northern gannet *Morus bassanus* within the Barents Sea Region.

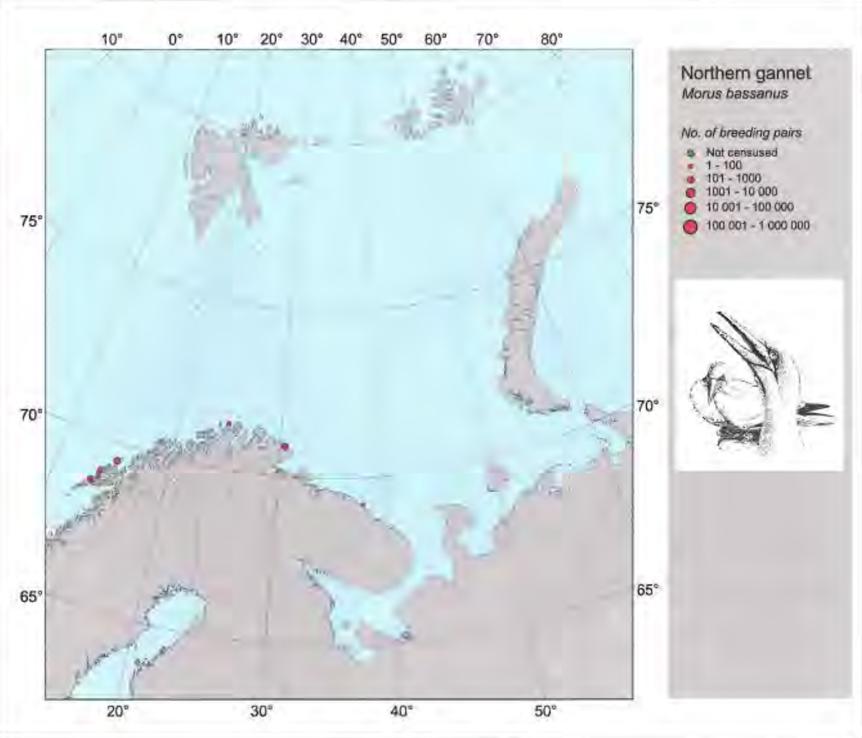
Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	2200	1995	0	1991-95	+2	1961-1995	1
MC	1	1995	-	-	-	-	1
WS	0						
ND	0						
NZ	0						
FJL	0						
SV	0						
All	2200	-	-	-	-	-	

1. Barrett & Folkstad 1996

Breeding distribution and habitat preferences in the Barents Sea Region

In 1995, the northern gannet bred in four colonies only in north Norway and the regional population totalled about 2200 pairs (Barrett & Folkestad 1996). The first nest to be built in Russia was found on Kharlov Island in 1995, and the first egg was laid there in 1996 (Krasnov & Barrett 1997a, b).

Two of the colonies, Hovsflesa and Skarvklakken, are on low skerries, 2-4 km offshore, where the northern gannets established themselves in association with European shags *Phalacrocorax aristotelis* and great cormorants *P. carbo*. The



colony on Storstappen is on a steep, grassy slope on the side of a large stack, and the northern gannets in Syltefjord breed among black-legged kittiwakes *Rissa tridactyla* and common guillemots *Uria aalge* on the top and sides of a high stack. The nest on Kharlov Island was built on a ledge on a steep cliff, among guillemots and black-legged kittiwakes.

Movements

North Norwegian northern gannets have the same dispersal and migration patterns as British northern gannets (Barrett 1988). During their first autumn, they move south to the North Sea and on to the waters off north-west Africa or to the Mediterranean (R.T. Barrett, unpubl. data) where they probably remain until their second summer or winter. Older birds tend not to move so far south (Barrett 1988). Several recoveries of northern gannets ringed in Britain, Iceland and the Channel Islands have been made along the Norwegian coast, including birds breeding in north Norwegian colonies, thus documenting a continuing immigration of "foreign" birds to the region (Barrett & Folkestad 1996).

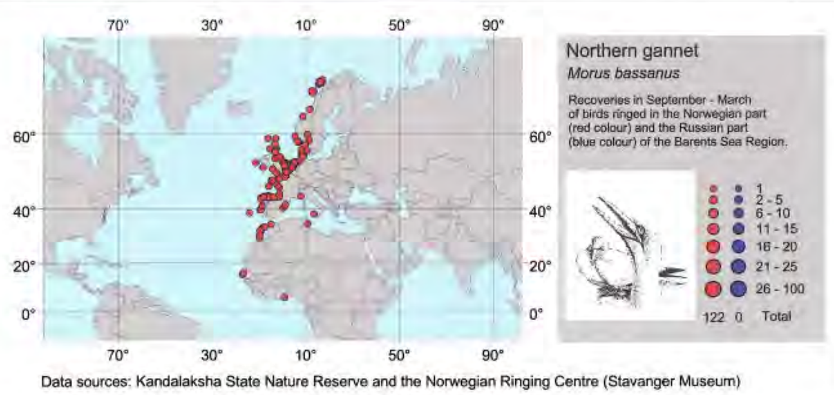
Population status and historical trends

The first Norwegian northern gannet colony was established on Runde, western Norway, in 1946. In 1961, a colony was established in east Finnmark (Syltefjord) and since then four other colonies were established in 1964 (Skittenskarvholmen, Lofoten), 1967 (Skarvklakken, Vesterålen), 1975 (Hovsflesa, Lofoten) and 1987 (Storstappen, west Finnmark). The 1995 population in Norway was about 3700 pairs. After an initial population increase at a rate of 20-25% p.a. (1945-1965), the rate of growth of the Norwegian population has slowed (7.5% in 1975-1985) to near zero in 1991-1995 (Barrett & Folkestad 1996). Between 1991 and 1999, the populations on Skarvklakken and Hovsflesa have declined from ca. 1500 pairs to ca. 500 pairs. During this period of decline, northern gannets have bred in small numbers (totalling ca. 130 pairs in 1998) on three cormorant colonies situated between the two islands. The Syltefjord colony has remained stable at a little under 500 pairs since 1992 (R.T. Barrett, unpubl.), while that at Storstappen has continued to increase rapidly (at a rate of 78% p.a. in 1987-1995, Barrett & Folkestad 1996). Northern gannets have otherwise been seen on land, sometimes on newly built nests, in several other locations in north Norway, but have always subsequently abandoned the sites (Barrett & Folkestad 1996).

In Russia, the first adult northern gannets were seen at sea off Kharlov Island in 1977, and the first immatures appeared in 1985. In 1993, one pair occupied a territory on the cliffs throughout the summer. Three pairs occupied territories on the same site in 1995 and one nest was built. The first egg was laid in 1996 (Krasnov & Barrett 1997a, b). Ca. 35 nests and sites were occupied in 1998 (J.V. Krasnov, unpubl.).

Feeding ecology

Mackerel *Scomber scombrus*, saithe *Pollachius virens* and herring *Clupea harengus* have been recorded as common prey, along with some salmon *Salmo salar*, sandeel *Ammodytes* spp. and capelin *Mallotus villosus* on Skarvklakken and Hovsflesa (Brun 1972, 1974, Barrett 1981, Montevecchi & Barrett 1987). Herring made up all the food samples recorded on Storstappen in 1991, 1993 and 1995 (R.T. Barrett, unpubl. data), and capelin are thought to be the main diet of northern gannets breeding in Syltefjord (Brun 1967, 1972). Sandeels, capelin and herring constitute the diet of northern gannets in Murman (Krasnov & Barrett 1997a, b).



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Threats

The colony on Skittenskarvholmen was found abandoned in 1978, possibly as a result of disturbance during the breeding season (Barrett 1979a). The four main colonies surviving today are all within legally protected areas (reserves) and access to them is thus strictly limited. It is possible that the recent declines on Hovsflesa and Skarvklakken are due to predation pressure from white-tailed eagles *Haliaëtus albicilla* (R.T. Barrett, pers. obs.). It is not thought that the northern gannets in north Norway are directly threatened by man in any way. The further establishment and growth of the colony on Kharlov Island is, however, threatened by uncontrolled harvesting of eggs and birds through a lack of funds to warden the island reserve.

Special studies

After northern gannets became established in the Barents Sea Region in 1961, the increase in their population and their spread have been subjects of frequent studies and reviews (Brun 1967, 1970a, 1971e, 1972, 1974, Barrett 1979a, 1981, Montevecchi *et al.* 1987, Barrett & Folkestad 1996, Krasnov & Barrett 1997a, b). Attempts are now made to survey all the colonies at regular (1-3 year) intervals. Since the appearance of northern gannets in Murman, their presence has been documented regularly and detailed observations are being made of the colony on Kharlov Island (Shklyarevich & Kokhanov 1980, Krasnov *et al.* 1995, Tatarinkova & Chemyakin 1995, Krasnov & Barrett 1997a, b).

Northern gannet prey selection was studied in Lofoten and Vesterålen in the early 1980s (Montevecchi & Barrett 1987), and their migration and intercolony movements were described by Barrett (1988) and Barrett & Folkestad (1996). Montevecchi & Hufthammer (1990) have analysed the possible prehistoric distribution of northern gannets in Norway. Monitoring of organochlorine and mercury contents in northern gannet eggs has shown a general decrease in levels since 1972 (Fimreite *et al.* 1974, 1977, 1980, Barrett, Skaare *et al.* 1985, 1996).

Diet of the northern gannet *Morus bassanus* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Skarvkl./ Hovsflesa	1986-86	Herring 57% Saithe 41% Sandeel 2%	Pull.	1
-	Skarvkl./ Hovsflesa	1997-99	Mackerel, herring, sandeel, saithe	Pull.	2
-	Gjesvær	1991-99	Herring, capelin, saithe	Pull.	2

1. Montevecchi & Barrett 1987, 2. Barrett pers. obs.

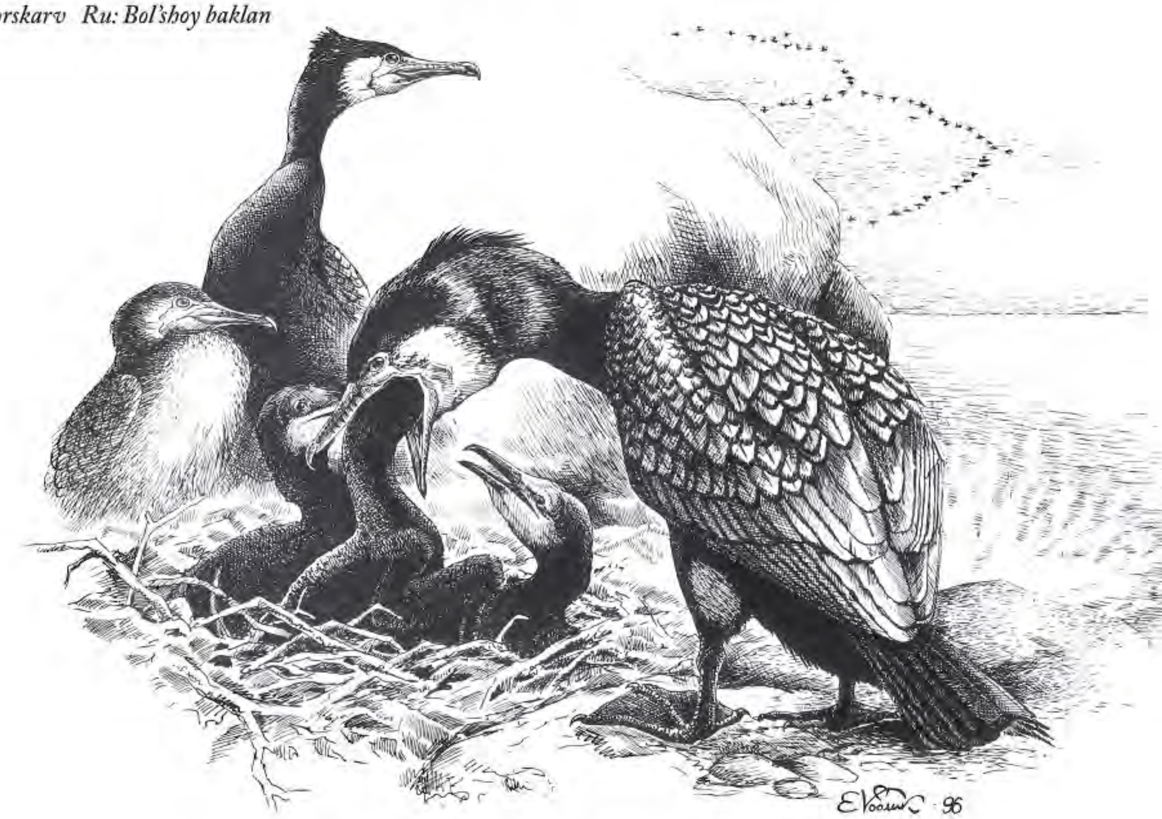
Recommendations

Surveys of northern gannets in the region should continue and the establishment of new colonies should be carefully documented. The possible role played by white-tailed eagles in the recent declines in Lofoten and Vesterålen should also be studied closely. More information on the food choice of northern gannets is needed to help explain changes in numbers and distribution, and to document the northern gannets' role as a top predator in the Barents Sea Region.

Robert T. Barrett & Juri V. Krasnov

Great cormorant *Phalacrocorax carbo*

No: Storskarv Ru: Bol'shoy baklan



Population size: 8000 pairs
Percent of world population:
17% North Atlantic (*P. carbo carbo*) form and 4% of all sub-species
Population trend: Fluctuating

General description

The North Atlantic form of the great cormorant breeds along the North Atlantic coasts of Europe and America. Several other sub-species occur in coastal and inland waters, mainly in Eurasia, Australia and Africa.

The world population probably does not greatly exceed 50 000 pairs (Debout *et al.* 1995, Veldkamp, in manus., Røv 1997). The main breeding areas are Norway, the British Isles and Iceland.

The great cormorant is a large, black, conspicuous seabird with a goose-like flight. It is one of the largest cormorant species. It has a white patch on each thigh in breeding plumage. Juveniles have more or less white underparts. The North Atlantic form is found along coasts and estuaries, sometimes in freshwater lakes. Great cormorants feed almost exclusively on medium-sized fish which are caught near the bottom in shallow water. Breeding colonies and resting places are found on cliffs and are conspicuous, being covered in white guano.

Five other sub-species are smaller, have more slender bills and varying amounts of white on their necks and underparts. The Eurasian *P. c. sinensis* has a whiter throat than *P. c. carbo* and has silvery white hair plumes over the crown to the back and sides of the neck, when in breeding plumage. Old male *P. c. carbo* often show similar features (Cramp & Simmons 1977, del Hoyo *et al.* 1992).

Population sizes and trends of the great cormorant *Phalacrocorax carbo* within the Barents Sea Region.

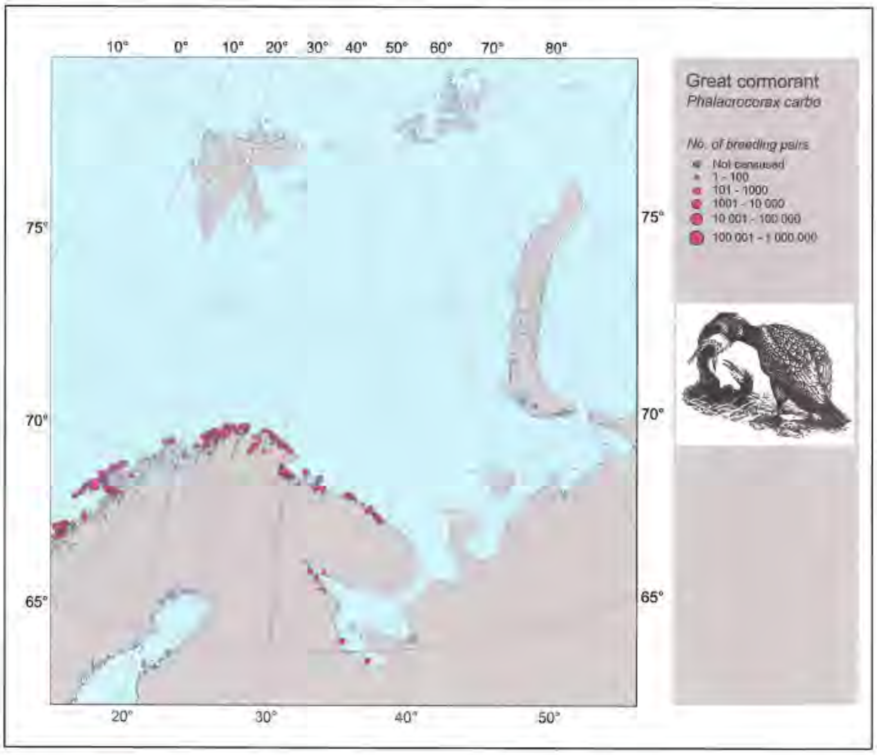
Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	6500	1985-95	F	1985-95	?	-	1-4
MC	1100	1992	+2	1986-95	+1	1978-86	5-7
WS	400	1995	+1	-	+2	1960s	8-12
ND	0						
NZ	0						
FJL	0						
SV	0						
All	8000	-	-	-	-	-	

1. Norwegian Seabird Registry 1998, 2. N. Røv, unpubl., 3. N. Røv & R.T. Barrett, unpubl., 4. Røv & Strann 1987, 5. Gerasimova 1962, 6. Krasnov *et al.* 1995, 7. F.N. Shklyarevich, unpubl., 8. Bianki *et al.* 1993 and unpubl., 9. V.V. Bianki & A.S. Koryakin, unpubl., 10. Kokhanov 1981a and unpubl., 11. A.S. Koryakin, unpubl., 12. V. Semashko & A. Cherenkov, unpubl.

Breeding distribution and habitat preferences in the Barents Sea Region

The great cormorant breeds along the whole coast of Norway and the Barents Sea coast of the Kola Peninsula as far east as eastern Murman; also in Kandalaksha Bay and Onezhski Bay in the White Sea.

Great cormorants nest in colonies, mostly on coastal cliffs, stacks or small islets on the outer coast. In Finnmark, colonies are frequently situated on steep bird cliffs on islands or the mainland, sometimes in fjords. Great cormorants prefer to nest close to their neighbours, also when they breed on ledges which are often inaccessible to fairly large terrestrial predators such as foxes. The nearest-neighbour distance is usually about 1-1.5 m. Breeding great cormorants prefer to have open space around their nests for easy take off and landing, and a good view to the sea. Otherwise, the species is very flexible with regard to nesting habitat. In one colony in Sør-Varanger, nests have been built in the lower branches of birch trees on a steep hillside close to cliffs. This resembles the nesting habit of the *sinensis* sub-species.



Movements

According to an analysis of rings recovered from birds ringed by Stavanger Museum (Mogstad & Røv 1997), great cormorants from northern Nordland usually winter on the coasts of central and western Norway, Skagerrak and Kattegat, having travelled an average distance of 775 km. Most birds from the Finnmark colonies migrate along the coast in August and September to coastal waters in Troms, Nordland and Trøndelag. Some move to western Norway where they winter together with birds from more southerly colonies. However, both ringing recoveries and visual observations of migrating birds indicate that some great cormorants from east Finnmark fly across land to the Gulf of Bothnia to winter in the ice-free waters of the Baltic Sea. The average distance between the breeding colonies and the wintering areas of birds from Finnmark is 900 km, which is significantly further than for birds from more southerly colonies. Some Nordland birds winter as far south as the coasts of the Mediterranean.

On the Murman coast, the birds leave their colonies in September, and a few stay in the coastal zone all winter. Ringing recoveries show that birds from east Murman migrate eastwards to the mouth of the White Sea, where they join the general flow of migrating waterfowl over the White Sea, along the shores of Onezhski Bay and Dvinski Bay, across Lakes Onega and Ladoga to their wintering grounds in the Baltic Sea (Skokova 1978, Bianki 1983, Bianki & Boyko 1989, Bianki, Kokhanov *et al.* 1975, 1993, Tatarinkova *et al.* 1983). The autumn departure of great cormorants in the White Sea begins at the end of August (Bianki, Kokhanov *et al.* 1975, 1993). During their migration across the mainland, great cormorants rest on lakes in Karelia and southern Finland. They return to their breeding colonies on the Murman coast at the end of February to the beginning of March, and at the end of April to the beginning of May in the White Sea (Kokhanov 1981a). An interesting trend is that wintering great cormorants from the Russian colonies do not usually move beyond the Baltic Sea and therefore do not mix with birds from the west coast of Norway.

Population status and historical trends

According to Solberg (1910), remains of great cormorants were found on a Stone Age site on Kjelmøy in Sør-Varanger. Great cormorants were recorded in Finnmark by Lilienskiold around 1700 (in "Speculum boreale" cited by Wessel 1926). Breeding great cormorants were recorded in Vardø, east Finnmark, in 1882 (Schneider 1882) and numerous great cormorants were observed in the Tana estuary in spring 1884 (Chapman 1885). Collett (1894) reported great cormorants breeding in Finnmark during the 1880s. Hagemann (1897) recorded great cormorants breeding in Alta and occasionally observed them along the river. A "new colony" of great cormorants on a cliff in Porsangerfjord was visited in 1887 by Kolthoff (1895); 40 nests were counted.

Recent data indicate that about 6500 pairs now breed on the Norwegian coast north of the Arctic Circle. Important breeding areas are the Træna-Myken area, Vesterålen and west Finnmark. Although little is known about the population development before 1985, breeding numbers probably peaked in 1985. The population crashed in Finnmark in 1986-87, but gradually increased again until the beginning of the 1990s. In Nordland, the population has been increasing or has remained stable over the last ten years (Røv 1988, Debout *et al.* 1995, N. Røv, unpubl. data).

Breeding great cormorants were seen on the Murman coast at the end of last century. On Fiskarhalvøya in Varangerfjord, Hortling & Baker (1932) recorded great cormorants breeding in "large numbers" in 1931. In the White Sea, nesting started in Kandalaksha Bay in the 1960s and in Onezhski Bay in 1980 (Kokhanov 1981a).

In 1991, 353 pairs in 11 colonies were counted along the east Murman coast (east of Kola Bay). In 1992, only seven colonies were recorded in this area, but the number of birds had increased to 526 pairs. That year, all the colonies along the Murman coast were surveyed for the first time, and 1092 breeding pairs were recorded in 14 colonies.

The main nesting area in Kandalaksha Bay is in the Srednie Ludy archipelago in the centre of the bay. The number of nests there rose from 7 in 1967 to 130 in 1992 (Bianki *et al.* 1993). The main

Diet of the great cormorant *Phalacrocorax carbo* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Lofoten	1985-86	Gadidae (59%) Polychaeta (20%)	Adults	1
-	East Finnmark	1989	Cod (29%) Sandeels (23%) Capelin (19%)	Adults	1
MC	Seven Islands	1985-92	Cod, catfish, sandeels, capelin	Adults and chicks	2
WS	-	-	Cod, navaga, herring	Adults and chicks	3

1. Barrett *et al.* 1990, 2. Krasnov *et al.* 1995, 3. Bianki *et al.* 1993

concentration in Onezhski Bay is on the Parusnitsi Islands (two colonies), where 180 pairs were counted in 1994 and 185 in 1995 (V. Semashko & A. Cherenkov, unpubl. data). Even though the number of nests has varied greatly in both these colonies, there has been an apparent increase in the total number of birds since 1980.

Feeding ecology

Great cormorants normally feed near the bottom in shallow water, usually not deeper than 10 m. However, their food choice in the Barents Sea indicates that they may also feed on shoaling fish in open water. They are pursuit divers and usually feed solitarily, but sometimes concentrate in areas where fish are abundant. Breeding great cormorants prefer to feed close to the colonies. When potential feeding habitats are readily available, Norwegian great cormorants do not usually travel more than 8-10 km away from their breeding colonies (cf. Røv *et al.* 1990, Røv 1994). In Seven Islands on the Murman coast, the maximum feeding dispersal of breeding birds is 12 km from the colonies (Krasnov *et al.* 1995).

Barrett *et al.* (1990) analysed pellets from breeding colonies in east Finnmark and Lofoten. The results indicate that small gadoids (Gadidae) and sandeels (Ammodytidae) were important food items. In Sør-Varanger, great cormorants also feed on capelin *Mallotus villosus*. The diets on the Murman coast and in the White Sea have been studied by analysing regurgitations from adults and chicks in breeding colonies. On the Murman coast, the main food items were cod *Gadus morhua*, catfish *Anarhichas* sp., northern sand lance *Ammodytes tobianus* and capelin (Krasnov *et al.* 1995). In the White Sea, the great cormorants mainly fed on cod, Atlantic navaga *Eleginus navaga* and herring *Clupea harengus* (Bianki *et al.* 1993). Studies on winter diet in northern and central Norway (Johansen *et al.* 1999, Barrett *et al.* 1990) show that gadoids (mainly cod and saithe *Pollachius virens*) were important food items outside the breeding season.

Threats

It has been assumed that great cormorant populations are vulnerable to fish stocks being depleted by over-fishing or natural causes (Røv 1988, 1994). Low temperatures in wintering areas (Røv & Nygård 1994) and drowning in fishing nets (ring recovery data from Stavanger Museum) seem to be important mortality factors outside the breeding season. In some years, illegal persecution at salmonid fish farms in Norwegian wintering areas may cause heavy mortality (Røv 1988). Hunting statistics (Directorate for Nature Management, Norway) and ring recoveries (Stavanger Museum) show that approximately 3000 great cormorants were shot during the 1994/95 open season in the main wintering areas for the north Norwegian populations. The Directorate does not consider this mortality to be of particular importance for the population development of the species.

Great cormorants are considered particularly vulnerable to oil pollution (e.g. Anker-Nilssen *et al.* 1994).

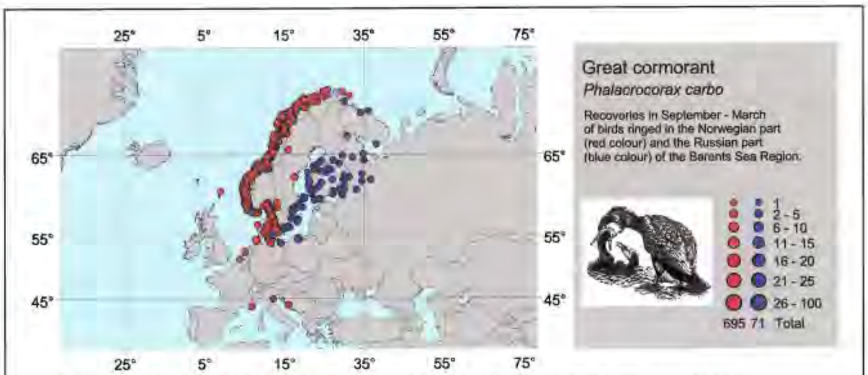
Special studies

The national monitoring programme for breeding seabirds in Norway (Lorentsen 1995) includes yearly counts of selected great cormorant colonies in Nordland and Finnmark. The national monitoring programme for wintering waterfowl in Norway (Nygård 1994) started in 1980 and undertakes yearly counts of great cormorants from the northern colonies in selected wintering areas. It is co-ordinated by the International Wetlands Programme. Great cormorants are also monitored in several colonies in Sør-Varanger (Barrett & Schei 1977, Barrett 1985a, N. Røv & R.T. Barrett, unpubl. data) where bird cliffs have been monitored at varying intervals since Brun's (1971a) first survey in 1966.

Røv (1994) studied the regulation of breeding numbers in Norwegian great cormorant populations, and Barrett *et al.* (1990) analysed the diet of great cormorants in Norway, and possible implications on gadoid stock recruitment. Colonies in Lofoten and east Finnmark were included in this study. Furthermore Johansen *et al.* (1999) carried out a study which addressed the role played by great cormorants as predators in a cod enhancement area in North Norway, and the bird's feeding strategies in winter was studied by Johansen *et al.* (unpubl. ms.).

The migratory and wintering habits of Norwegian great cormorants have been studied by Mogstad & Røv (1997), and mortality rates have been estimated by Fiske & Røv (1997). Both these studies are based on analysis of ring recovery data.

Long-term monitoring of breeding numbers is taking place on Baklan Island (Gavrilovskie Islands) and Veshnyak Island (Seven Islands) on the east Murman coast, and on Gagarkina and Sirotka



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Islands in the Tarasikha Islands in Kandalaksha Bay (Krasnov *et al.* 1995, T.D. Paneva 1986-1995, unpubl. data, A.S. Koryakin 1986-1995, unpubl. data). All four colonies are within the Kandalaksha State Nature Reserve. No more than 20% of the total breeding population in each area breeds on these islands. Long-term studies of feeding are being carried out on the east Murman coast by Krasnov *et al.* (1995) and in Kandalaksha Bay by Bianki *et al.* (1993).

Recommendations

In Norway, the monitoring of the breeding populations in the Træna-Myken area, Vesterålen, west Finnmark and Kongsfjord should continue. The yearly counts of great cormorants wintering in selected areas on the Norwegian coast should also continue as part of the International Wetlands programme. A monitoring programme for populations breeding on the Murman coast and in the White Sea that are not within the Kandalaksha State Nature Reserve, including the main colonies on the Srednie Ludy Islands in Kandalaksha Bay, should also be initiated.

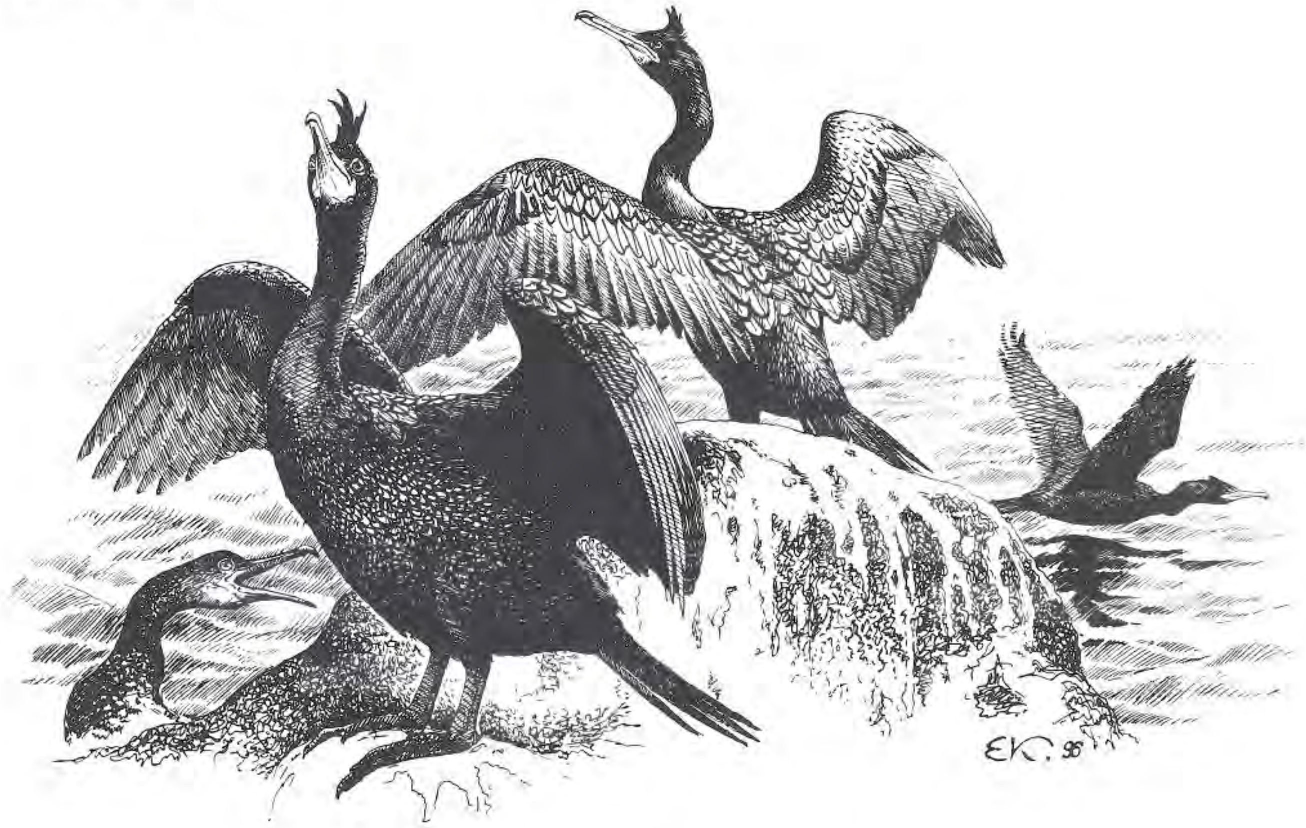
A joint Russian - Norwegian ringing programme for great cormorants should be considered to monitor the survival rates and mortality relating to drowning in fishing gear and shooting. Together with the hunting statistics, the results of such a study would provide an important basis for revising the open season in Norway. At present, these regulations are revised every five years.

It is furthermore important to follow up the recommendations on the conservation and management of great cormorants agreed upon by the parties to the Bonn Convention in June 1994.

Nils Røv & Tat'yana D. Paneva

European shag *Phalacrocorax aristotelis*

No: Toppskarv Ru: Khokhlaty baklan



Population size: 9150 pairs
Percent of world population: 10%
Population trend: Small decrease

General description

European shags breed on the European coasts of the North Atlantic Ocean and the Barents Sea (nominate form), and the coasts of North Africa (*P. a. riggenbachi*), the Mediterranean and the Black Sea (*P. a. desmarestii*). They do not occur elsewhere in the world.

According to the most recent estimates (Røv 1984, Lloyd *et al.* 1991), the world breeding population is approximately 86 000 pairs. At present, the British Isles, Norway and Iceland are the most important breeding areas.

The European shag is a medium-sized, marine cormorant with a slender bill. Adults have black plumage which is glossy when seen at close quarters. They have a yellow base to their lower mandible and a conspicuous crest in spring. The young are mainly dark brown in the nominate form. European shags are marine throughout the year. They prefer areas with cliffs and a rugged topography. They usually feed in deeper water than great cormorants *Phalacrocorax carbo* and catch free-swimming pelagic fish. Estuarine and brackish waters are avoided (Lloyd *et al.* 1991, del Hoyo *et al.* 1992).

Three sub-species are recognised. The nominate form is slightly larger than the other two. It has a black bill and feet, and less bare skin at the base of its lower mandible. There is little morphological variation within the sub-species (Cramp & Simmons 1977).

Population sizes and trends of the European shag *Phalacrocorax aristotelis* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	8800	1982-95	-1	1985-93	?	-	1-9
MC	350	1982-95	+2	1988-95	F	1960-86	10-13
WS	0						
ND	0						
NZ	0						
FJL	0						
SV	0						
All	9150	-	-	-	-	-	

1. Amundsen & Stokland 1985, 2. R.T. Barrett, pers. comm., 3. Lorentsen 1995, 4. Nygård & Røv 1984, 5. Rikardsen & Strann 1983, 6. N. Røv, unpubl. data, 7. K.-B. Strann, pers. comm., 9. Strann & Vader 1986, 10. Krasnov *et al.* 1995, 11. Shklyarevich 1981, 12. Shklyarevich & Tatarinkova 1986, 13. Tatarinkova 1990, unpubl. data

Breeding distribution and habitat preferences in the Barents Sea Region

European shags breed along the outer part of the whole Norwegian coastline, west Finnmark being most densely populated. The colonies are more scattered in east Finnmark and on the Murman coast. Seven breeding localities have been recorded on the Murman coast as far east as Dvorovaya Bay (39°E). The preferred nesting habitats are rocky cliffs and islands. Nests are found scattered on rock shelves, narrow ledges or in crevices among boulders, but always close to the sea. Most colonies are small (20-40 pairs) and often in association with black-legged kittiwakes *Rissa tridactyla*, great cormorants and auks (Alcidae). Mainland colonies are generally not easily accessible from land, obviously to avoid predation by terrestrial mammals.

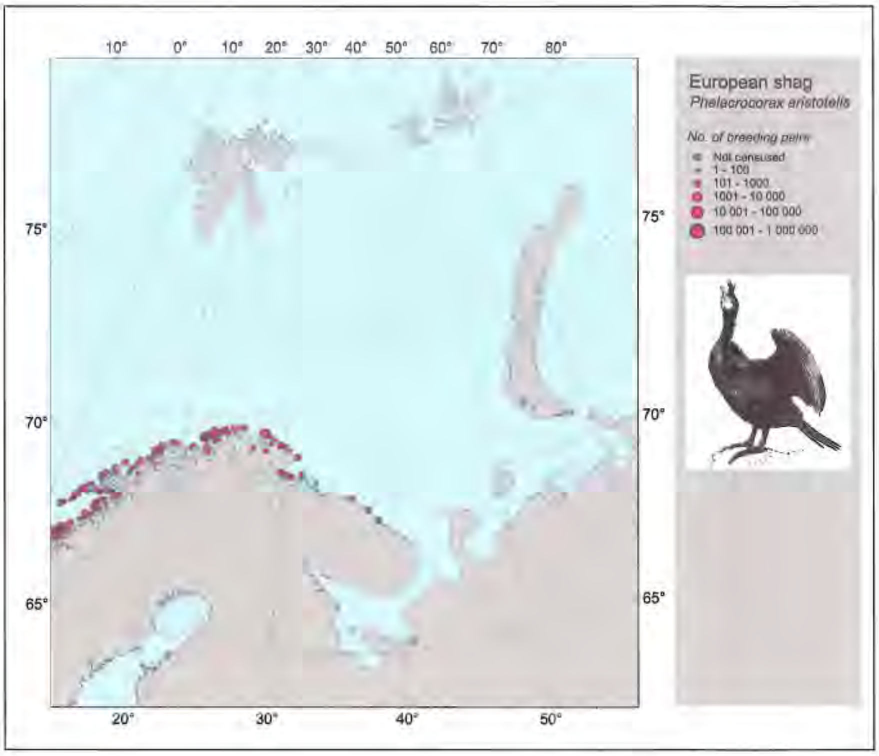
Movements

Ringing recoveries (Myrberget 1973a, Johansen 1975, Galbraith *et al.* 1986) show that post-breeding European shags from North Norway generally move to wintering areas along the coast from Møre & Romsdal to Troms, involving average dispersal distances of over 500 km. This suggests that they may be migratory rather than dispersive, in contrast to other European shag populations in northern Europe (Galbraith *et al.* 1986). Some young European shags may be found as far as 1500 km from their natal colonies as early as in September. Only a few European shags winter in Finnmark. However, in some winters up to a thousand have been recorded as far north as northern Troms (K.-B. Strann, pers. comm.). There are no winter recoveries from the breeding areas on the Murman coast, but single individuals have been sighted there.

Population status and historical trends

The most recent data indicate that approximately 8800 pairs currently breed in 185 colonies on the Norwegian coast north of the Arctic Circle and 350 pairs in 12 colonies on the Murman coast. However, most colonies in Norway have not been surveyed since 1981-85, and large changes in breeding numbers are known to have occurred during the last ten years. Hence, the population figure for Norway must be considered as a rough estimate of the present status of the species.

European shags are known to have occurred on the coast of north Norway during the Stone Age (Solberg 1910, Hesjedal 1993). The species was mentioned by Collett (1894) and Pleske



(1887) on the coasts of Finnmark and Kola, respectively.

There are two European shag colonies on the Russian coast of Varangerfjord, in Bazarnaya Bay and Pechengskaya Bay (30-40 pairs in 1972-82), and 163 pairs bred on the neighbouring Aynov Islands in 1995 and a few on nearby Cape Gorodetski in 1992.

Regular breeding has been recorded on the Kola Peninsula since the 1930s. In eastern Murman, the first nest was found on Kharlov Island in the Seven Islands archipelago in 1932 (Spangenberg 1941). In 1939, 40 pairs nested there (Modestov 1967) and several nests were found on nearby Kuvshin Island (Kartashev 1949a). Breeding stopped during the Second World War, probably because of human disturbance through the collecting of guillemot *Uria* sp. eggs. After the war, small colonies were discovered on Veshnyak Island, beside Kuvshin Island. Since then, the species has bred there annually (20-45 pairs in 1985-95), and there have sometimes been a few pairs on all the other islands in the area (Krasnov *et al.* 1995). European shags have also been recorded breeding at three other localities on the east Murman coast: in Dvorovaya Bay on the mainland (35 nests in 1978, only two in 1992), in the Gavrilovskie Islands Nature Reserve (102 pairs in 1995) and at Cape Shel'pinski on the mainland near the Gavrilovskie Islands (five pairs in 1989-92).

Various long-term studies indicate that European shag populations in the Barents Sea Region have undergone dramatic changes, suffering marked declines in 1966, 1979 and 1986-87. The Lille Kamøy counts are of particular interest. Whereas 2400 pairs bred there in 1985, none were recorded in 1986-87 (Strann & Ludvigsen 1986, 1987). However, in 1988 the same number of birds were back in their former breeding locality (Lorentsen 1997). Ringing recoveries indicated that the European shags spent the season on the coast of North Norway without attempting to breed (Strann & Ludvigsen 1987). Particularly low breeding numbers were simultaneously recorded in great cormorant colonies in northern Norway. This has been related to exceptionally low temperatures and low fish stocks in both the North Atlantic and the Barents Sea during those years (Røv 1994).

Feeding ecology

Barrett *et al.* (1990) analysed large samples of pellets from breeding European shags on Hornøya. Although large shoals of capelin *Mallotus villosus* occurred near the colony, no capelin were recorded in the pellets. The diet consisted almost exclusively of sandeels (Ammodytidae) and 1-year group gadoids (Gadidae). On Bleiksøy in Vesterålen, mostly the same diet was found, but sea scorpions *Myoxocephalus scorpius* and polychaetes were also recorded.

Modestov (1967) found herring *Clupea harengus*, sandeels, cod *Gadus morhua*,

Diet of the European shag *Phalacrocorax aristotelis* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Bleiksøy	1985-86	Gadidae (69%) Sandeel (15%) Polychaetes (8%)	Adults	1
-	Hornøya	1989	Sandeel (56%) Gadidae (40%)	Adults	1
MC	Seven Islands	1985-90	Cod (50%) Sandeel (50%)	Chicks	2

1. Barrett *et al.* 1990, 2. Krasnov *et al.* 1995

bullhead *Cottus gobio* and crabs in stomachs of European shags shot in the late 1930s on the Murman coast, but no figures were given. Belopolskii (unpubl. data cited by Krasnov 1995) analysed the contents of 12 adult European shag stomachs from the Seven Islands Reserve in 1935 and 1941. Ten pellets contained sandeels, one capelin and two cod. Chick pellets collected by Krasnov *et al.* (1995) at the same locality contained cod (two pellets) and sandeels (two pellets).

To conclude, it seems that within the Barents Sea Region, sandeels and young gadoids predominate in the food of European shags.

Threats

Human disturbance on the breeding grounds, especially at the beginning of the nesting period, may cause egg loss by predation (ravens *Corvus corax*, crows *Corvus corone*, gulls *Larus* sp.), nest desertion and even colony movement. This problem is probably not significant at present because the most important colonies have been protected as nature reserves.

Ringing recoveries indicate that drowning in various kinds of fishing gear may be an important mortality factor, particularly in winter.

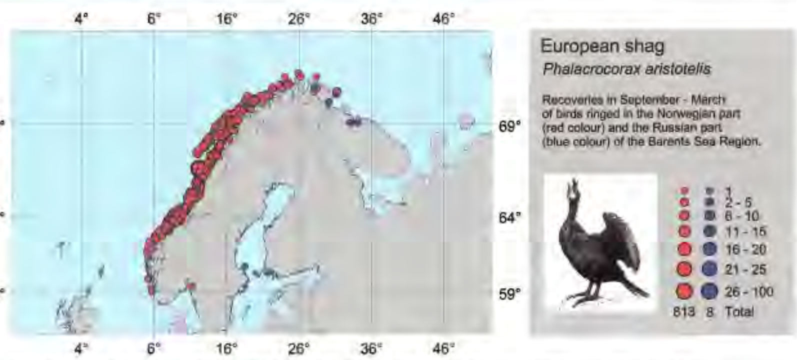
North American mink *Mustela vison* predation was observed in some breeding colonies in Vesterålen and Lofoten in 1982 (N. Røv, pers. obs.). The recorded decline of the species in some areas may therefore partly be explained by mink predation. Furthermore, shooting in the wintering areas may negatively affect European shag populations, particularly in years with reduced stocks of preferred prey.

The large (partly extreme) annual variations in breeding numbers probably reflect variation both in nesting frequency and adult mortality. The short- and long-term population changes indicate that the production of young and their rate of survival are highly dependent on food resources. The occurrence of young gadoids in coastal waters has varied considerably during recent decades. Although this has not been investigated, it may be supposed that sandeel populations are also highly variable. Since the European shag might be considered as a food specialist, the populations in the Barents Sea Region, on the border of the range of the species, are likely to be particularly vulnerable to reduced stocks of their dominant prey, sandeels and young gadoids.

Special studies

In addition to the studies on population status, development and food already mentioned, the feeding ecology of European shags has figured among the extensive seabird studies carried out on Hornøya in east Finnmark (Furness & Barrett 1985, Barrett & Furness 1990, Barrett *et al.* 1990), along with investigations of their breeding biology, morphometry (Barrett *et al.* 1986), and the accumulation of persistent organochlorines and mercury (Barrett, Fieler *et al.* 1985, Thompson *et al.* 1992).

In 1985, Amundsen & Stokland (1986) and Stokland & Amundsen (1988) carried out an experimental study on size hierarchy and brood reduction in Røst, whereas Røv (1990) included some data on the population development and breeding biology of European shags in Røst in 1985-88 in a study of Norwegian European shag populations. Both Johansen (1975) and Galbraith *et al.* (1986) included recoveries of European shags ringed in North Norway in their analyses of European shag movements. Krasnov *et al.* (1995) included information on European shag biology in Seven Islands in their study of colonial seabirds on the Murman coast.



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Recommendations

A complete survey of European shag colonies in northern Norway should be undertaken. The monitoring of breeding populations in Røst, in Troms, on Lille Kamøy, and in the Aynov, Gavrilovskie and Seven Islands should continue and be expanded to include data on clutch size, the collection of food samples and ringing of chicks.

Action should be taken to minimise the risk of oil pollution in connection with shipping and future petroleum activity in the Barents Sea. Restrictions should be imposed on the use of certain types of fishing gear within specified areas to minimise mortality outside the breeding season.

During years with reduced production of young and decreasing populations, shooting should be prohibited or strictly regulated within the wintering areas of European shags.

A sustainable management of the fish resources in the North Atlantic and Barents Sea ecosystems is of great importance for the well-being of the European shag in this area.

Nils Røv, Ivetta P. Tatarinkova and Tat'yana D. Paneva

Greylag goose *Anser anser*

No: Grågås Ru: Sery Gus

Population size: 3000-4000 pairs
Percent of the north-west European population of A. a. anser: 7-10%
Population trend: Large increase

General description

The greylag goose is the largest European goose species, except for the introduced Canada goose *Branta canadensis*. The plumage is grey with numerous black markings on the belly, and in flight it is distinguished from all the other grey geese by its pale grey forewings. The sexes are similar in appearance although the male is slightly larger; it weighs about 4 kg, the weight varying during the year.

The greylag goose breeds widely in boreal and temperate latitudes in the Palaearctic, from Iceland, Scotland and the Netherlands in the west across Europe and Russia to the Pacific in the east (Madsen *et al.* 1999). Two subspecies are recognised, the smaller western *anser* with a pale orange bill and the eastern *rubrirostris* with a pink bill (Cramp & Simmons 1977, Scott & Rose 1996).

It has a disjunctive breeding distribution in the western Palaearctic, where six populations can be identified (Madsen 1987, 1991, Scott & Rose 1996). The Norwegian population, breeding in coastal areas north and east to Gamvik in east Finnmark, belongs to the north-west European breeding population of *anser* that winters in Spain and the Netherlands. This population was estimated at more than 200 000 individuals in September 1991 (Nilsson *et al.* 1999), but the population has since increased (Nilsson pers. comm.). Birds from north-west Russia belong to the central European breeding population of *anser* wintering in North Africa. The boundary between these two populations is not well known (Madsen 1987, Madsen *et al.* 1999) and the few greylags breeding on the Kola and Kanin Peninsulas in Russia may represent an eastern extension of the Norwegian population.

Norwegian, Icelandic and Scottish greylags were earlier thought to belong to a separate sub-species, *sylvestris*, but this is not now accepted due to lack of data (Cramp & Simmons 1977). Recent work (Nordic Greylag Goose Project) has shown that the geese breeding in Norway have migration and staging patterns which differ markedly to those geese breeding around the south-western Baltic, although they overlap extensively in their winter quarters (Andersson *et al.* in manus.). Norwegian and Baltic greylags also differ in their morphology, breeding biology and habitat choice (A. Follestad, unpubl. data). Further work may determine whether at least the main Norwegian breeding population should be treated as a separate population.

Breeding distribution and habitat preferences in the Barents Sea Region

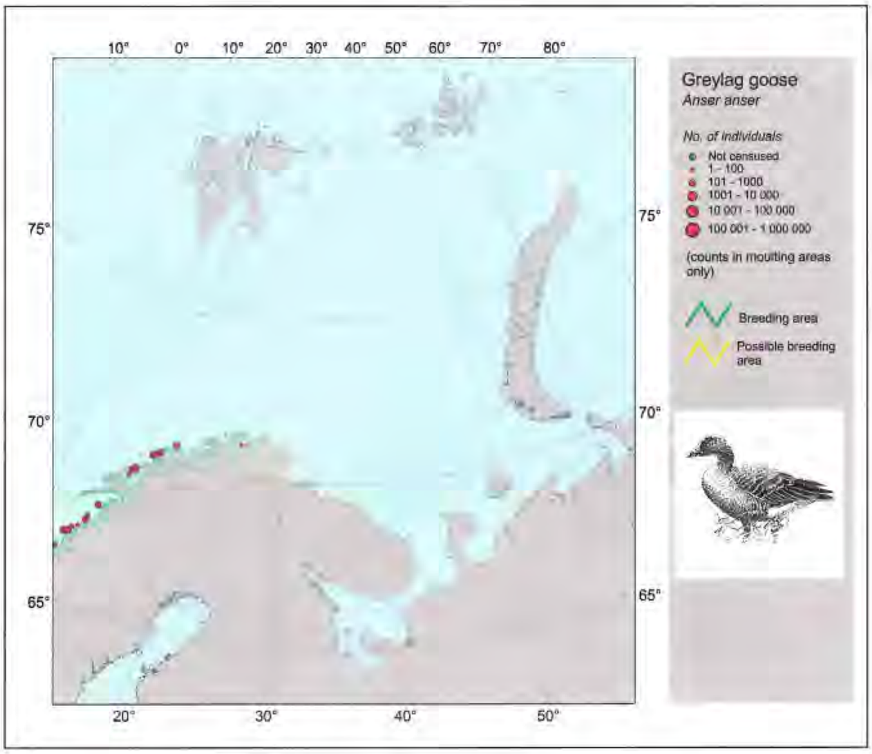
The main population of greylags in the Barents Sea Region breeds in north Norway (Follestad 1994a, 1999b). Porsangerfjord has for a long time been considered as the eastern limit of its distribution in Norway, Store Tamsøy having been known as a breeding locality for a relatively large number of birds (Haftorn 1971, Morset *et al.* 1992). However, some scattered pairs have been found even further east (Henriksen 1989). It is not certain whether the discovery of greylags breeding as far east as Gamvik on the Nordkinn Peninsula (K.-B. Strann, pers. comm.) indicates a recent eastward extension of its breeding area or is just a consequence of better coverage of potential breeding grounds in northern Finnmark, as the greylag also breeds on the Murman coast.

In the south-western part of the Barents Sea Region, the greylag mainly breeds on outlying islands with grass or heather. In northern parts of Troms and

Finnmark, however, much of the population breeds on islands or bogs along the fjords, often several kilometres from the seashore. Some breed in birch woods, and several pairs have been found using old crow nests (K.-B. Strann, pers. comm.), perhaps to avoid predation from red foxes *Vulpes vulpes* or the North American mink *Mustela vison*.

The northern limit of the greylag breeding area in western Russia has been described by several authors. From the Baltic Sea, it approximately follows the 61°N latitude as far as the River Ob where it turns north up to the river mouth at about 67°N (Dementjev & Gladkov 1952, Ivanov & Shtegman 1964, Flint *et al.* 1989, Stepanyan 1990). That greylags breed on the Russian side of Varangerfjord has, however, been known since the 19th century (Menzbier 1895) and has recently been confirmed by the finding of five nests on the Aynov Islands (L. Tatarinkova, pers. comm.). Greylags were found nesting on the eastern Murman coast in June 1932, on coastal tundra near the village of Kharlovka (Spangenberg 1941). None were subsequently observed during faunistic studies in western and eastern Murman (e.g. Gerasimova 1958, Kishchinski 1960), but one bird from a flock of six was shot in early May 1961 near Podpakhta Bay, in eastern Murman (A. Golovkin, unpubl. data). The nesting of greylags on the west coast of the Kanin Peninsula has been known for many years (Buturlin 1935), and a nest was found in June 1957 near Chizha (Spangenberg & Leonovich 1960). Based on a huge number of observations from the Kandalaksha State Nature Reserve over many years, Bianki *et al.* (1993) showed that greylags nest irregularly (1-3 seasons per 10 years) on the mainland tundra along the Murman coast from the Rybachi Peninsula in the west to Cape Svyatoy Nos in the east, and breed almost annually on the west coast of the Kanin Peninsula and adjacent small islands. There are also indications of breeding on the taiga along the east coast of the White Sea. The regularity of nesting here is about 4-7 seasons per 10 years.

In north Norway, greylags breed close to the seashore and moult on some of the outermost archipelagos. In Russia, however, they rarely visit the coast. Their main habitats there are steppe lakes with reed thickets, flood plains and large, inaccessible bogs near wet grassland (Rogacheva 1992).



Movements

Greylags have been marked with neckbands in north Norway to study their migration patterns, staging areas and wintering areas. Since the end of the 1980s, birds from the southern part of the Barents Sea Region have changed their departure time in autumn from September/October to early or mid-August. In northern Norway they still seem to migrate mainly in September and October, and large numbers rest at certain localities in central and southern Norway (Follestad 1992, 1999a, unpubl. data), where they may be heavily hunted. A greylag with a satellite transmitter migrated from Store Tamsøy to Tønsberg in southern Norway in less than three days, possibly via the Baltic. The existence of such a migration route for geese from Tamsøy (and possibly other breeding grounds in north Norway and Russia) is indicated by a greylag tagged with a neck band on Tamsøy in July 1991 which was observed near Stockholm in September the same year. Some northern greylags may follow the same route in reverse in spring, as has been shown for the bean goose *Anser fabalis* (Nilsson 1984) and the lesser white-fronted goose *Anser erythropus* (Norderhaug & Norderhaug 1984).

Several areas along the coast of central Norway are important moulting sites for non-breeding greylags, the southwestern part of the Barents Sea Region being one of the most important (Follestad *et al.* 1988). Counts in 1996 indicate that probably more than 1000 birds also moult in Troms (A. Follestad, unpubl. data).

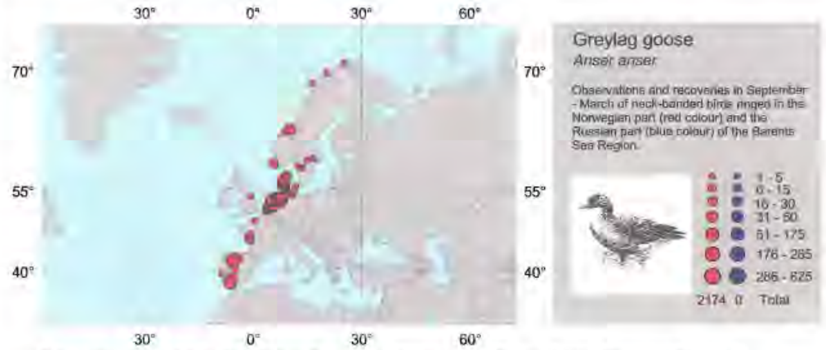
The autumn migration of the greylags was observed on the east coast of the White Sea in 1962 and 1963 (Bianki, Kokhanov *et al.* 1975). Small flocks migrated south-west, crossing the Dvinski and Onezhski Bays at the beginning of October. In spring, greylags arrive on the Kanin Peninsula in April (Zubtsovski & Ryabitsev 1976). Spring and autumn migrations have also been observed along the north coast of the Kola Peninsula (Bianki *et al.* 1993), but the origin of these birds was unknown.

Observations of 28 greylags from the sub-species *rubrirostris* between Vardø and Hamningberg on 7 July 1971 and 25 birds at the same place two days later (Risberg 1972), indicate that birds from the Baltic area may extend their normal movements north of their breeding areas. This may indicate that some Baltic greylags moult in the Barents Sea Region and perhaps mix with the local breeding population (cf. the possible eastern migration route to the Baltic mentioned above).

Population status and historical trends

Very few data exist on the number of pairs breeding in the Barents Sea Region. Based on 166 pairs reported nesting in seabird colonies, ca. 500 pairs were estimated to be breeding in Troms around 1940 (Soot-Ryen 1941a). The breeding population in Troms today is thought to be at least 1000-2000 pairs (K.-B. Strann, pers. comm.). Another 1000-1500 pairs are estimated to be breeding in Nordland north of the Arctic Circle, and 500-1000 pairs in Finnmark. The population on the Kola and Kanin Peninsulas probably numbers some hundreds of birds.

The population in north Norway has increased since the middle of this century (Haftorn 1971, Morset *et al.* 1992), but the trend in the last decade is not clear. On the island of Vega, just south of what we define as the Barents Sea Region, the population has increased from 53 pairs in 1976 to a maximum of 215 pairs in 1994 and 1995, followed by a reduction to about 165 pairs in 1999 (Follestad 1994b, J. Antonsen, pers. comm.).



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Feeding ecology

Like other geese, the greylag is almost a pure terrestrial or freshwater aquatic vegetarian (Owen 1980), but may feed on some marine green algae (A. Follestad, unpubl. data). Hardly anything is known about its feeding ecology in the Barents Sea Region. Greylags are often observed feeding on cultivated areas in spring, in both their staging and breeding areas. When they arrive at the breeding grounds on Store Tamsøy in the middle of May, there is almost no fresh vegetation to graze on (Follestad 1999a), as is the situation for many other goose species breeding in the Arctic. Hatching in the middle of June in Porsangerfjord coincides with the new growth of herbal vegetation (Follestad 1999a).

In southern parts of the region, both breeding and non-breeding greylags have been observed feeding on crowberries *Émpetrum nigrum* from the end of July (Follestad 1999a, unpubl. data). In Troms, greylags used to be accused of eating large quantities of cloudberries *Rubus chamaemórus*, and many land owners therefore killed all the greylags on their land (Soot-Ryen 1941a). However, no evidence of greylags feeding on cloudberries has since been found (Snow & Snow 1988). The breeding in north Norway may thus be well timed to the phenology of vegetation growth in spring and the ripening of crowberries in the southern part of the region and cloudberries in the northern part (e.g. Store Tamsøy) just before the chicks fledge.

Threats

Among the predators on eggs, goslings or adults are white-tailed eagles *Haliaëtus albicilla*, golden eagles *Aquila chrysaëtos*, great black-backed gulls *Larus marinus*, ravens *Corvus corax* and the introduced North American mink, but none of them are considered to be a serious threat in any part of the breeding area. However, the mink may have changed the breeding habits of the greylag from nesting close to the shore to nesting in heather and shrubs inland on the larger islands. Red foxes and arctic foxes *Alopex lagopus* may take eggs and goslings in some areas, but not on islands along the Norwegian coast where there are no foxes.

Earlier this century, people harvested some eggs and goslings on the Norwegian coast, but this is probably a minor problem today.

Increased shooting pressure in Troms and Finnmark may lead to changes in the timing of autumn migration, as has been seen in central Norway, including a large part of Nordland (Follestad 1994b). A further increase in the breeding population may increase crop damage and lead to more extensive shooting or disturbance of the geese. Some of these conflicts may, however, have been solved now through local management plans (see Directorate for Nature Management 1996). In Russia, spring and autumn shooting is allowed throughout the region except in the Kandalaksha State Nature Reserve.

Their marine way of life, especially in the period when the non-breeding geese are moulting, make greylags vulnerable to oil spills as they are very shy in this period and move out to sea at the slightest disturbance (A. Follestad, unpubl. data).

As wind power may become an important mean of raising future energy production in Norway, large windmill parks on the coast may effect the distribution pattern and the available area both for nesting, moulting and resting birds (Follestad *et al.* 1999).

Special studies

Studies of migration patterns are being carried out in north Norway, including the island of Vega, by using neck-bands. Research has concentrated on monitoring the size and development of the population (counts of breeding and non-breeding geese during their moult), population dynamics (phenological events such as their arrival in spring, timing of egg laying and hatching, breeding habitat, and sizes of clutches and broods), geographical variations in morphology and moulting strategies of non-breeding geese (feather growth, weight changes during moulting) and the effects of various shooting regimes (see Follestad 1994b, 1999a).

Recommendations

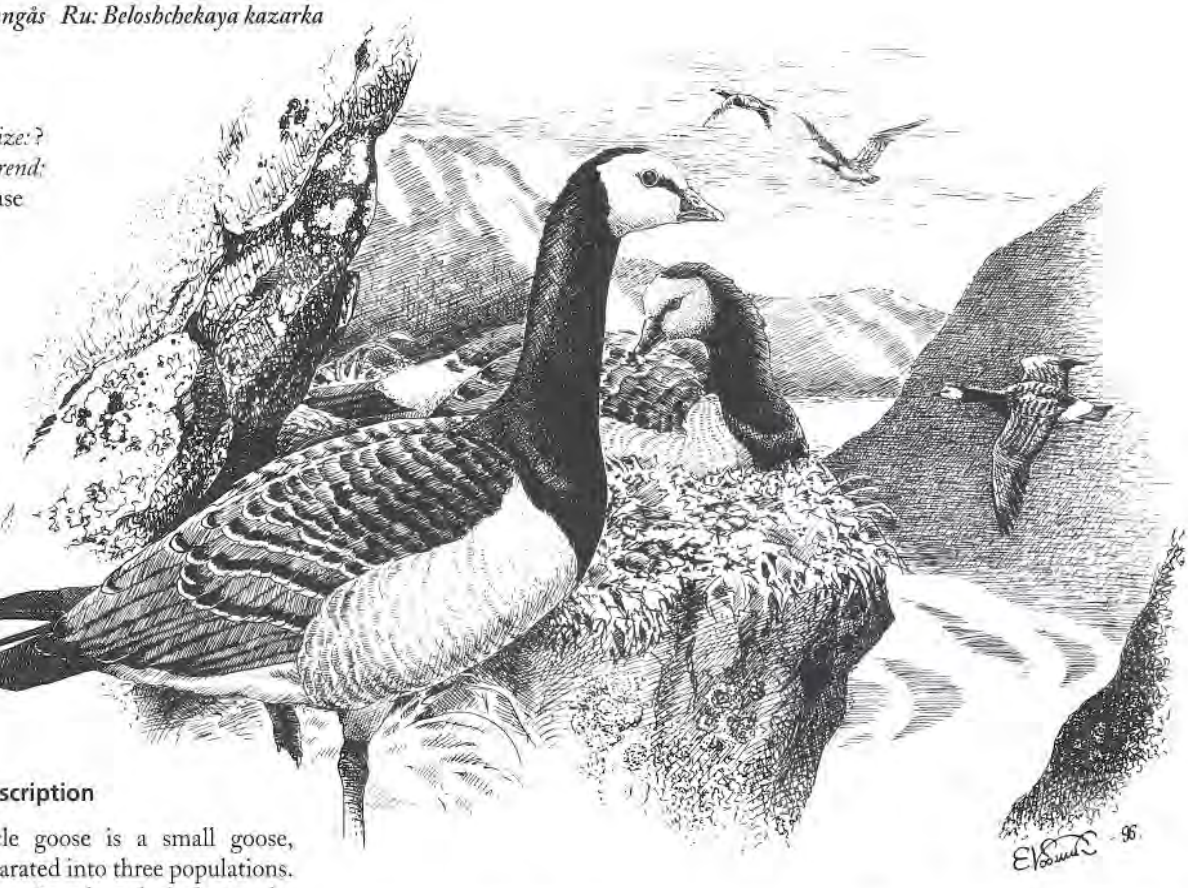
The population studies should continue to improve our knowledge of the size and trend of the greylag population in the Barents Sea Region, its dynamics and migration strategies. A further increase in the population may result in more conflicts with farmers and lead to actions being taken to reduce the greylags, which may influence their future numbers as well as other aspects of their biology, such as changing the timing of their autumn migration. Earlier southward migration may increase conflicts in staging areas in southern and central Norway, and in other countries. The northernmost greylags differ in many respects from birds breeding in central Norway, and studies of their adaptation to breeding in the north may identify environmental limits to their breeding still farther east and north compared with other goose species, and thus form a sounder platform for proper management of the species.

Arne Follestad & Alexander N. Golovkin

Barnacle goose *Branta leucopsis*

No: Hvitkinngås Ru: Beloshchekaya kazarka

Population size: ?
Population trend:
Large increase



General description

The barnacle goose is a small goose, which is separated into three populations. Two of these breed exclusively in the European Arctic, and the third in the Arctic and Baltic regions. The westernmost population breeds in north-eastern Greenland and winters in Ireland and western Scotland. The second population breeds in Svalbard and winters in northern Britain. The third breeds in north-west Russia and the Baltic and winters in Germany and the Netherlands.

The total world population of barnacle geese was, in 1999, ca. 330 000 individuals. The Greenland population numbers about 40 000 (Ogilvie *et al.* 1999), the north-west Russian one (including the Baltic birds) about 267 000 (Ganter *et al.* 1999), and the Svalbard one 23 000 individuals (Black 1997). The species as a whole has increased in numbers and expanded its breeding areas since the 1950s and early 1960s. Kalyakin (1986) considered that its breeding range had been heavily influenced by human activities. He argued that in the past the range included vast areas in the Barents Sea Region, and that the present expansion reflects a re-establishment of this former range.

The three populations show no distinct morphological variations, and hence the species is monotypic (Owen 1980). However, the birds breeding on Gotland, Sweden, differ from the others in behaviour by nesting and moulting one month earlier than other barnacle geese. Recent molecular studies track the origin of the barnacle goose back to an ancestral Canada goose *Branta canadensis* (R. Fleischer, in Black 1997).

Breeding distribution and habitat preferences in the Barents Sea Region

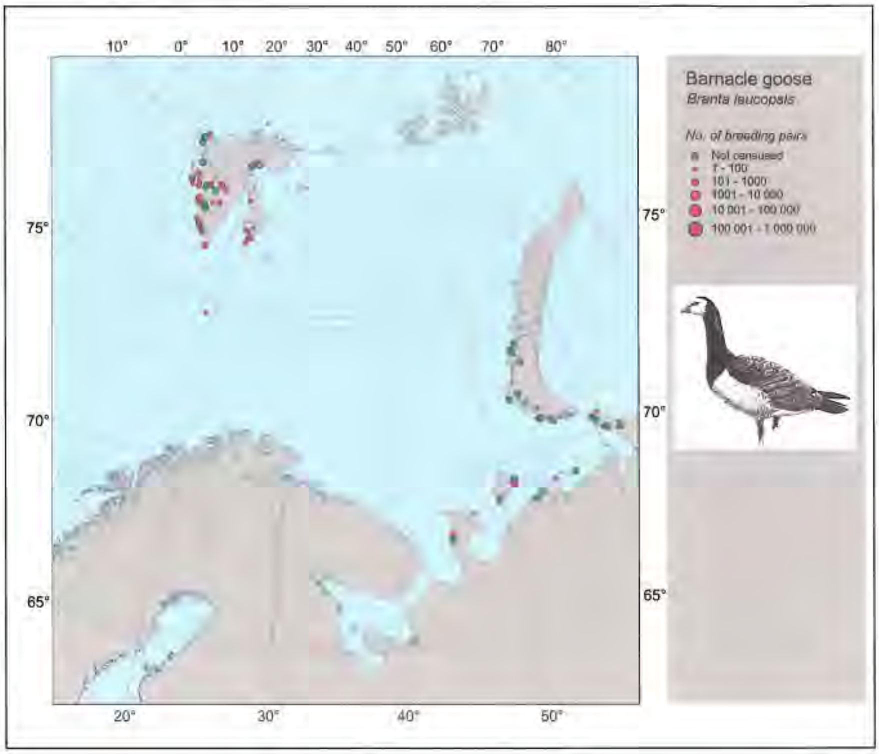
Two of the three barnacle goose populations breed in the Barents Sea Region. The Svalbard population breeds in colonies on small islands throughout the western and south-eastern parts of the archipelago, often together with eiders. A small part of the population breeds on steep cliffs and on islets in small lakes in the interior of Spitsbergen.

The east European population breeds on the southern island of Novaya Zemlya, on Vaygach Island, and along the south-east coast of the Barents Sea where they nest on the Kanin Peninsula (Fil'chagov & Leonovich 1992, Syroechkovski 1995a) and in the coastal zone of the Malozemel'skaya and Bol'shezemel'skaya tundras: in Kolokolkova Bay on the coast, on the Chayach'i Islands and nearby islets, Sengeiski Island, the Russkii Zavorot Peninsula, the Gulyaevskie Koshki Islands and the Medynskil Zavorot Peninsula (Syroechkovski 1995a). Nesting birds and non-breeders have also been recorded on the Yugorski Peninsula (Mineev 1984, Kalyakin 1986, Morozov 1995).

Dispersion to the north has been recorded in recent years. In 1992, barnacle geese bred in Krestovaya Bay and Arkangel'skaya Bay and moulted in Severnaya Sul'meneva Bay on the northern island of Novaya Zemlya (Kalyakin 1993, Pokrovskaya & Tertitsky 1993). In 1994, they were recorded on Hooker Island, which is the first breeding record in Franz Josef Land (Todd 1996, J. de Korte & F. Vulliemier, pers. comm.).

The east European population also shows a tendency to spread further east into the Kara Sea Region. Barnacle geese have recently been observed on the Yamal Peninsula and the islands in Khaypudyrskaya Bay during aerial surveys (Kalyakin 1993), and north of the Gydan Peninsula in the early 1980s during land-based surveys (Lin'kov 1983) and in 1990 (Zhukov 1995).

In north-western Russia, the barnacle goose most frequently nests on cliff ledges, ridges and coastal bluffs. Some nests may be located at high altitudes in mountainous areas. Some recently established colonies in the south-eastern Barents Sea Region are situated in coastal habitats, called "laida", located between sandy beaches and the tundra and consisting of numerous brackish lakes and salt-marshes (Ponomareva 1992, Fil'chagov & Leonovich 1992). In this type of habitat, the density of nests sometimes reaches 1000 per hectare (Ponomareva 1992). Islets on tundra lakes are sometimes used on Vaygach Island (Romanov 1989). On flat islands, barnacle geese often nest in eider colonies. On "laidas", they nest among large gulls which provide protection. They also quite often nest near the nests of peregrine falcons *Falco peregrinus* or rough-legged buzzards *Buteo lagopus* (Kalyakin 1986, Volkov & Chupin 1995).



Movements

After hatching, the families depart from the nesting islands and swim to the mainland to forage on the lush vegetation near tundra ponds and lakes. In Svalbard, 5-25 km generally separate the breeding and brood-rearing sites (Prop *et al.* 1984). The adults moult after nesting, seeking protection from predators on tundra lakes and at sea. After the moult, the families travel to suitable gathering areas, often near bird cliffs, where they feed before starting the migration to the wintering grounds. In Svalbard, such gathering sites are located in the southern part of the archipelago.

The barnacle geese breeding in Svalbard start their autumn migration in September. It is thought that most of the population stops and feeds on Bjørnøya before continuing to the coast of northern Norway or directly to Scotland. Large flocks are present annually on Bjørnøya during a five-week period in September-October (Owen & Gullestad 1984). The whole population winters on the Solway Firth, on the border between England and Scotland, until April, when the spring migration starts. During the migration to Svalbard, the birds stage on islands in the Lånan and Vega archipelagos in Helgeland, north Norway. The last part of the spring migration takes place in May, and the birds arrive in their breeding areas in late May or early June.

The east European population leaves its arctic breeding grounds from late August to mid-September. The birds migrate through the White Sea Region and the Gulf of Finland, and stage along the coasts of northern Estonia and on the Swedish islands of Gotland and Öland. They then continue to southern Denmark, northern Germany or the Netherlands. The main wintering area is in the Netherlands. The spring migration begins in March, and the birds stage in the Baltic during the first half of May before completing their migration and arriving in the breeding areas in the first half of June.

Population status and historical trends

The Svalbard population

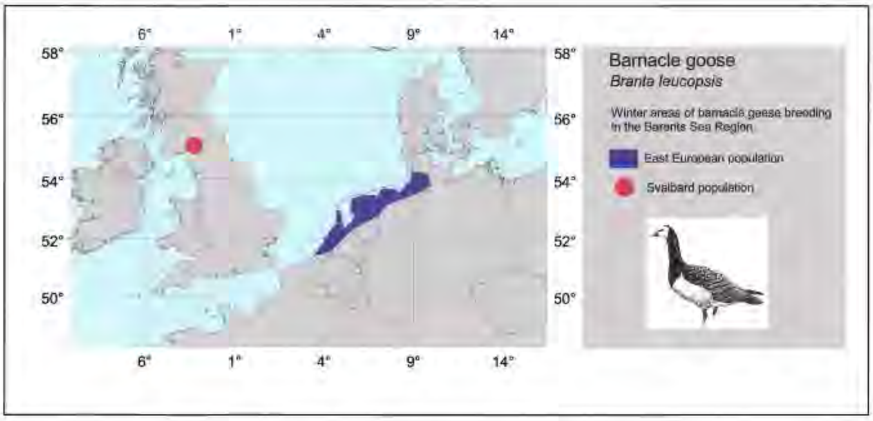
This population has increased rapidly since the end of the 1940s, when it was estimated at about 300 individuals (Owen 1984). The counts in the first half of the 1990s in the wintering quarters have fluctuated between 13 000 and 13 700 birds, but in 1996 there were 23 000 (Black 1997). The increase since the 1940s is the result of several protection measures in Svalbard and at the wintering sites. Most of the known breeding colonies are located in bird sanctuaries or nature reserves. The rapid increase in numbers in the mid-1990s has yet to be explained.

The breeding distribution has also expanded extensively since the 1940s and 1950s, when the barnacle goose was known to breed only at a few localities between Hornsund and Isfjorden on western Spitsbergen (Løvenskiold 1964). At present, it breeds on islands along the west coast of Spitsbergen from the southernmost part (Sørkappøya) to the northernmost islands (Risen and Steggholmen). Breeding recently started in the south-eastern parts of Barentsøya and Edgeøya, the main colonies being on the islands of Tusenøyane. Detailed studies have been made of the establishment and development of colonies in the Kongsfjorden area on north-west Spitsbergen. The area was colonised in the early 1980s, and a total of 329 pairs now breed there (1997) (F. Mehlum & I. Tombre, unpubl. data).

The east European population

According to censuses at the wintering sites, the east European population has increased from ca. 20 000 individuals around 1960 to the present level of ca. 267 000 (Boyd 1961, Ganter *et al.* 1999). Most of the population breeds on the southern island of Novaya Zemlya and on Vaygach Island. Little is known about the population development before 1960, but it is thought to have been severely affected by human exploitation at both the breeding and wintering sites. Total protection from shooting in the wintering quarters, as well as on the staging sites during migration and at the breeding sites has probably been an important factor for the population increase after 1960.

Barnacle geese have recently established colonies in the south-eastern part of the Barents Sea Region. The first colony was discovered on Kolguev Island, where 500 pairs were found breeding in



1989 (Ponomareva 1992). In 1990, a colony of 350 breeding pairs was found on the Kanin Peninsula (Fil'chagov & Leonovich 1992); the authors claimed that this colonisation started in the early 1980s. By 1995, it had grown to more than 1000 breeding pairs (M. Gluchovski & N.S. Morozov, pers. comm.). After surveying the region in 1994, Syroechkovski (1995b) described seven new colonies, most of them with 5 to 200 nests and believed to have been colonised in the late 1980s. He estimated that 3000-4000 pairs now breed on the coastal lowlands and islands in the south-eastern Barents Sea, with about 30% on Kolguev Island.

The current knowledge of the present breeding range of the barnacle goose in Russia corroborates the opinion of Kalyakin (1986) that it marks the reestablishment of the former natural breeding range of the species.

Feeding ecology

The barnacle goose has a varied diet of plants. When it reaches the breeding sites, the Svalbard population forages on snow-free patches, where the birds take roots and moss. Later in the summer, grasses and sedges (*Dupontia* spp., *Poa alpigena* and *Festuca rubra*) dominate the diet, together with a variety of herbs and horsetails (Prop *et al.* 1984, M. Loonen, pers. comm.). During the autumn staging on Bjørnøya, grassy habitats, mainly with *Festuca rubra*, are used (Owen & Gullestad 1984). In the spring staging areas in Helgeland, *Festuca rubra* and *Puccinella maritima* are important food plants. In their wintering areas in north-west Britain, barnacle geese forage on the salt-marshes, but also feed on fields used as pasture.

The east European population often feeds on fields while staging in the Baltic. In the Netherlands, *Salicornia* sp. is an important food item in autumn, and in winter the geese feed on cultivated grasslands, shifting to salt-marshes in early spring (Prins & Ydenberg 1985). Little is known about their feeding habits on the arctic Russian breeding sites, but molluscs and crustaceans have been reported as part of the diet, in addition to vegetable food (Dementjev & Gladkov 1952).

Threats

In spite of a population increase in all three populations, the barnacle goose remains vulnerable to human impact. A main reason for its vulnerability is the spatial structure of the populations throughout the life cycle, i.e. the habit of aggregating in limited areas during breeding, staging and wintering. Protection of the geese in these areas is crucial for the well-being of the species.

Both populations breeding in the Barents Sea Region are protected throughout their range. The increasing size of the population in the wintering area in Scotland has recently created conflict with farmers when the geese feed on agricultural land. Licences have been issued to farmers to shoot a limited number of barnacle geese. This measure probably does not have a significantly negative effect on the population development. Conflicts between agriculture and foraging barnacle geese are also present in Estonia (Leito *et al.* 1991, Leito 1996).

Special studies

The population breeding in Svalbard has been studied intensively by British, Dutch and Norwegian groups. Much of the research is based on colour ringing of the birds. About 25% of the birds (3500) are currently individually ringed, and 95% of these are re-sighted annually and form the basis for estimates of survival and reproductive performance. Because the families stay together during the winter, it is possible to track the breeding performance of individual parents. Studies have been made of factors that influence reproductive output and survival, migration physiology, energetic breeding investment, demography, population dynamics, life-history strategies, mating systems, bi-parental care, social evolution, foraging ecology and competition, and goose - plant interactions.

In Russia, the phenology and other features of the breeding biology of barnacle geese were investigated on the Yugorski Peninsula and Vaygach Island in the 1980s (Kalyakin 1986, Romanov 1989, Mineev 1994), and on the Kanin Peninsula in the early 1990s (Fil'chagov & Leonivich 1992). A comparative study of the ecology of arctic geese (including the barnacle goose) is currently taking place (1994-1997) on Novaya Zemlya, Vaygach Island and the Yugorski Peninsula (Syroechkovski 1995a).

In Estonia, extensive studies of spring staging and feeding ecology were conducted in the 1980s and 1990s (Leito & Renno 1983, Leito *et al.* 1986, 1991).

Recommendations

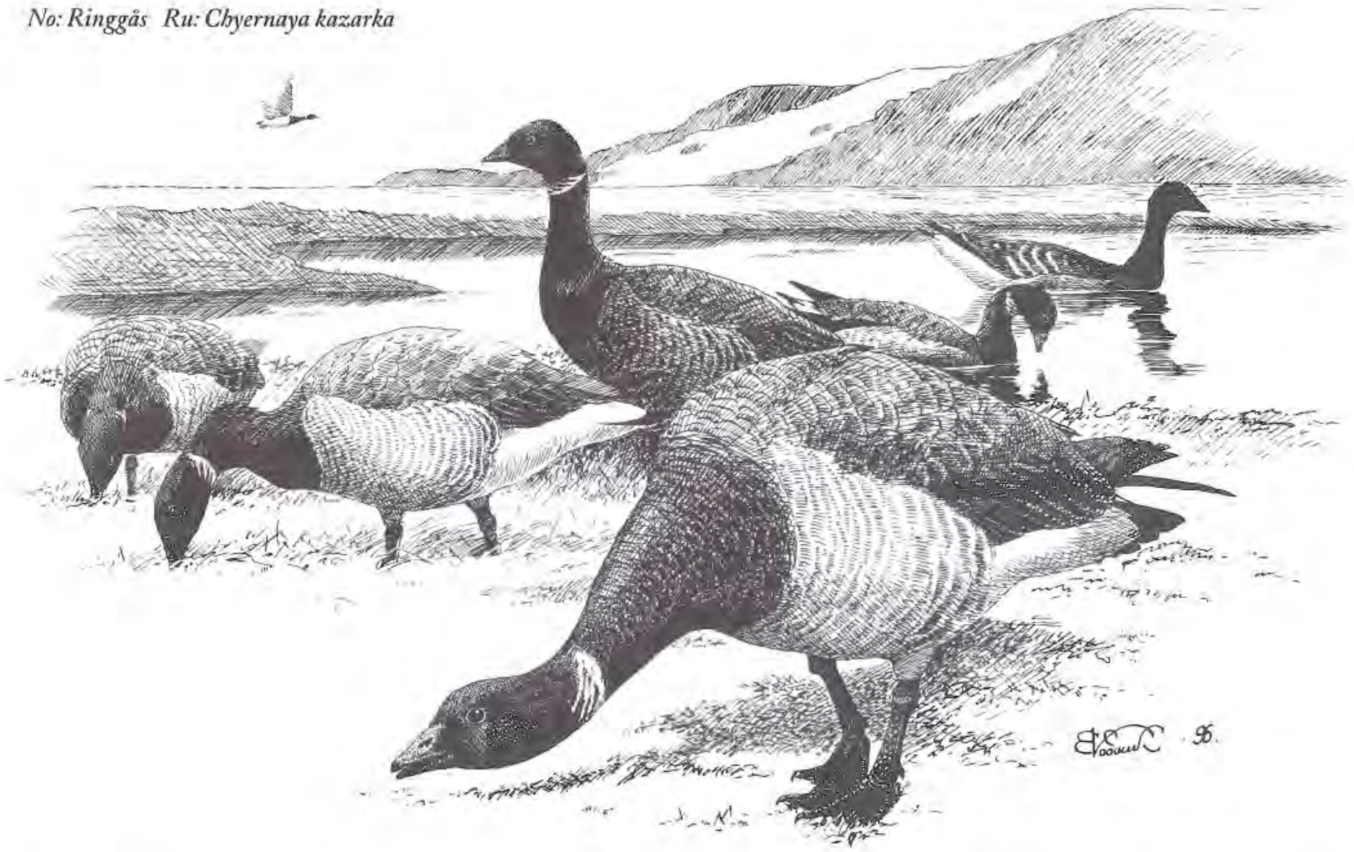
Under the terms of the recent Agreement on the Conservation of African-Eurasian Migratory Waterbirds (1995), under the Bonn Convention for migratory species, the range states are encouraged to co-ordinate efforts to enhance populations of waterbird populations that are of great concern for conservation. The Svalbard barnacle goose population is regarded as one such population, and the range states (in this case Norway and the United Kingdom) have agreed to prepare a "Flyway Conservation and Management Plan" to ensure the well-being and favourable conservation status of the population at a defined population size. Such a Flyway Plan is currently being prepared by the governments of Norway and the United Kingdom. Along with other measures that are necessary to ensure a satisfactory population development, such a plan should be adopted by the range states.

Little is known concerning the breeding distribution of the east European population, the largest of the three populations. Human activities are increasing in northern Russia, and there is an urgent need to identify all the major breeding and moulting sites of the barnacle goose and to enforce the conservation measures that are necessary for limiting the human impact in these areas.

Fridtjof Mehlum & Irina V. Pokrovskaya

Brent goose *Branta bernicla*

No: Ringgås Ru: Chyernaya kazarka



Population size: ?
Population trend: Reasonably stable

General description

The brent goose is a small goose and its population is separated into three sub-species. Two of these, the light-bellied brent goose *Branta bernicla hrota* and the dark-bellied brent goose *B. b. bernicla*, breed in the Barents Sea Region. The third, the black brant *B. b. nigricans*, breeds in eastern Siberia and arctic North America. The light-bellied brent goose breeds from the north-eastern Canadian islands and northern and eastern Greenland to Svalbard and Franz Josef Land. The dark-bellied brent goose has a more easterly breeding distribution and breeds at the Kanin Peninsula and from the from the Yugorski Peninsula eastward through the Taymyr Peninsula, Severnaya Zemlya and to the delta of River Olenyok (Fil'chagov & Leonovich 1992).

Breeding distribution and habitat preferences in the Barents Sea Region

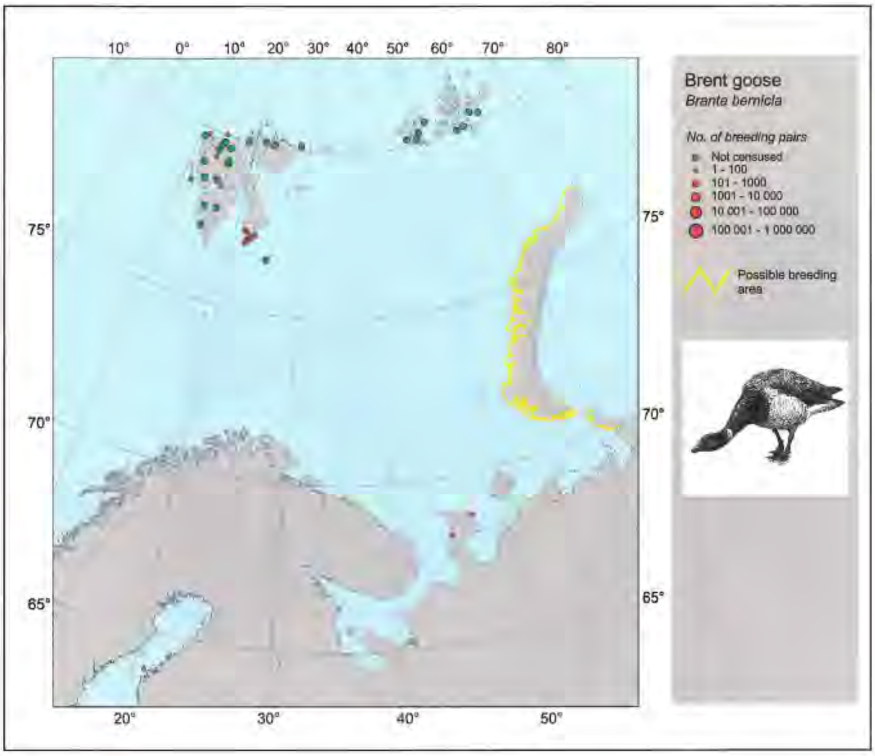
In the Barents Sea Region, the light-bellied brent goose breeds in the Svalbard and Franz Josef Land archipelagos. In Svalbard, the main breeding area is now Tusenøyane, a group of small islands in the south-eastern part of the archipelago, where nests are located in small groups. Its overall breeding distribution in Svalbard is unknown, but other localities are scattered around the archipelago. Apart from Tusenøyane, most of the geese are believed to breed in northern and north-eastern parts of Svalbard, but some pairs nest in bird sanctuaries on the west side of the archipelago. Brent geese nest on elevated spots on relatively flat tundra, near water. In Franz Josef Land, the light-bellied brent goose is not numerous, but is probably distributed over most of the archipelago (Gorbunov 1932, Balabin 1934, Tomkovich 1984, Uspenski & Tomkovich 1986).

The nominate sub-species, the dark-bellied brent goose, breeds in more southerly parts of the Barents Sea Region. At present the only well documented breeding area in the region is on the Kanin Peninsula (Fil'chagov & Leonovich 1992). At the beginning of this century it bred on Kolguev Island (Pleske 1928). Based on questionnaires, Gorbunov (1929) and Portenko (1931) concluded that it bred on Novaya Zemlya in the late-1920s and early-1930s. The present breeding status on Kolguev Island and Novaya Zemlya is uncertain. According to answers to questionnaires given to local people, this sub-species still breeds on these islands (Kalyakin 1993, 1995a).

In Russian parts of the Barents Sea Region, the dark-bellied brent goose prefers to breed on low-lying, wet coastal tundra and salt-marshes ("laidas"). Brood-rearing pairs are often found on river deltas or small lakes along the coast. These habitats are also used during moulting and by the non-breeding part of the population. In Franz Josef Land the light-bellied brent goose nests on the coastal tundra.

Movements

Most light-bellied brent geese leave their wintering areas in northern Denmark during the last week of May (Clausen & Bustnes 1998). They arrive in Svalbard in early June. In 1991, there was a mass arrival in the breeding area in Tusenøyane on 7-8 June (J. Madsen, unpubl. data). In Svalbard, most of the autumn migration takes place in September. Light-bellied brent geese arrive in Franz Josef Land during the first 10 days of June and start their autumn migration at the end of September (Gorbunov 1932).



Dark-bellied brent geese mainly follow the White Sea-Baltic flyway through Estonia, Finland and Karelia when migrating from their wintering sites in western Europe. They rest for some time in Onega Bay and Dvina Bay before continuing to the Kanin Peninsula (Clausen 1997). A small number migrate along the northern coast of Scandinavia and the Kola Peninsula. These flyways merge on the west coast of the Kanin Peninsula, and the geese follow a common flyway further east to the breeding grounds through Kolguev Island, the Sengeisky Strait near the coast of the Malozemel'skaya tundra (between mainland Russia and Kolguev Island) and Pechora Bay (Uspenski 1959b, Syroechkovsky & Litvin 1998).

On the Sovoletski Islands in the White Sea, the most intensive migration is observed from the end of May to early June, and large concentrations of dark-bellied brent geese pass the delta of the River Severnaya Dvina before the end of May (A.E. Cherenkov & V.Yu. Semashko, pers. comm.). The migration usually reaches the east coast of the Barents Sea in the first few days of June. The flocks may comprise as many as 300 birds, but mostly number 20-30 or 50-100 individuals (Mineev 1995). Large concentrations of autumn-migrating dark-bellied brent geese have been recorded at the Sengeisky Strait near the coast of the Malozemel'skaya tundra (Mineev 1987).

Population status and historical trends

The light-bellied brent goose was probably the most abundant goose in Svalbard in previous centuries and probably numbered more than 50 000 individuals (Salomonsen 1958). It was widely distributed on islands all along the west coast of Spitsbergen, as well as along the coasts of the rest of the Svalbard archipelago (Løvenskiold 1964, Norderhaug 1970a). The population declined dramatically during the first half of this century, and the whole Svalbard/Franz Josef Land population was estimated at ca. 4000 individuals in the mid-1950s (Norderhaug 1970a). There are probably several reasons for this dramatic decline, but a major one is thought to be the intensive human harvest of eggs and down on the breeding islands of Svalbard (Løvenskiold 1964). Another potential cause may be the lack of their staple food, eelgrass *Zostera* spp., at the wintering grounds on the North Atlantic coasts of western Europe in 1932-33 (Salomonsen 1958, Madsen 1987).

The Barents Sea population of light-bellied brent geese continued to decline in the 1950s and 1960s and reached about 2000 individuals. A slight recovery has been observed recently, and in the 1990s the winter population reached 4000-6000.

The numbers of light-bellied brent geese in Franz Josef Land are thought to have been low but relatively stable during the last century. The total number on Franz Josef Land is estimated to be about 1000 individuals (Uspenski & Tomkovich 1986).

The dark-bellied brent goose formed large moulting aggregations on Kolguev Island and the southern island of Novaya Zemlya at the beginning of this century. It was one of the main targets for local hunters in these regions. For example, about 20 000 moulting geese were taken on Kolguev Island each year, mainly dark-bellied brent geese (Tugarinov 1941). In the southern part of Novaya Zemlya, about 500 birds were taken from one moulting flock in 1930 (Portenko 1931). However, numbers declined from the 1930s, and by the early 1950s the sub-species was becoming rare in the Barents Sea Region (Dementjev & Gladkov 1952). The numbers have remained low in the European part of the breeding range until recently (Fil'chagov & Leonovich 1992, Kalyakin 1993, Pokrovskaya & Tertitsky 1993). Over the last few years, numbers have increased and the geographical range has expanded. (Syroechkovsky 1995a). The latest estimates of the numbers breeding on Kolguev Island and the southern island of Novaya Zemlya (based on questionnaires) are 150 and 1000 individuals, respectively (Kalyakin 1993, 1995a).

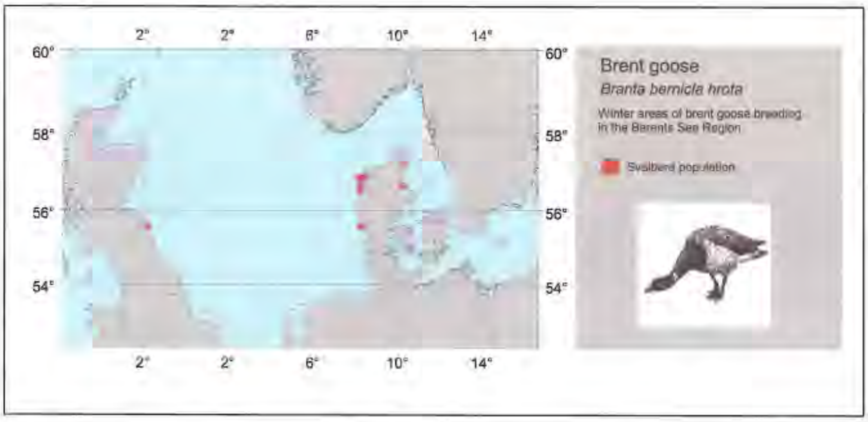
Feeding ecology

Madsen *et al.* (1989) reported that in Tusenøyane, mosses comprised the major part of the diet of light-bellied brent geese during the breeding season, but *Cochlearia officinalis*, *Saxifraga* spp. and *Carex* sp. were also important food items. *Cochlearia* and *Saxifraga* spp. were more important than mosses as food for young goslings. Mosses are generally less nutritious than higher plants, and the diet in Tusenøyane may reflect the low diversity of plant species on the islands and the paucity of higher plants.

In winter, brent geese often feed on salt-marshes, where they eat saltmarsh grass *Puccinellia maritima* and sea plantain *Plantago maritima* as well as eelgrass *Zostera* spp.

Threats

The present breeding sites of the light-bellied brent goose are in remote areas, and the birds are little affected by human activities. The breeding population, however, is small and thus susceptible to human and environmental threats. Most of the birds breeding in Svalbard nest on



Tusenøyane, close to areas where offshore oil drilling may begin (Isaksen & Bakken 1995a). Oil spills may reach Tusenøyane and have a severe impact on the brent goose population.

The reproductive success of the light-bellied brent goose varies greatly from year to year. The condition of the birds when they arrive at the breeding site and the timing of the snow melt may influence the time of egg laying, clutch size and breeding success. Studies in Svalbard have shown that the level of predation by polar bears *Ursus maritimus* and arctic foxes *Alopex lagopus* has a great impact on the breeding success (Madsen *et al.* 1989, 1992). They often visit the breeding islands in years when much sea ice surrounds them. In one year, polar bears took one third of the eggs at a colony in Tusenøyane (Madsen *et al.* 1989). In another year, when arctic foxes were present on the islands, the geese almost completely abandoned their nesting attempts (Madsen *et al.* 1992). Other important predators in Svalbard are glaucous gulls *Larus hyperboreus* and arctic skuas *Stercorarius parasiticus*.

The expansion of the barnacle goose *Branta leucopsis* in Svalbard in the latter part of this century may have prevented the brent goose from recolonising former breeding sites. The barnacle goose now inhabits many of the islands on the west coast of Spitsbergen previously known to be breeding sites for brent geese. These islands may now be "saturated" with geese leaving no room for the brent geese to reestablish. The barnacle goose is now also established as a breeder in Tusenøyane, and Persen (1986) found that it outnumbered the brent geese on some islands. Preliminary studies have shown that aggression between these two geese is common. However, there is no evidence to support the hypothesis that the barnacle goose may be able to displace the brent goose from its breeding sites (Bustnes *et al.* 1995).

The main factors threatening the population of the dark-bellied brent goose are hunting both along the flyways and during the moult, and egg harvesting (Fil'chagov & Leonovich 1992). Predation of eggs and goslings by large gulls and the arctic fox is also an important natural mortality factor.

Special studies

The migration of light-bellied brent geese was studied in 1997 by satellite telemetry (Clausen & Bustnes 1998). The study showed that individuals equipped with satellite transmitters in Denmark in May migrated along the Norwegian coast. Two birds continued to Svalbard, and two crossed the Greenland Sea to northern Greenland and apparently bred there. During the autumn migration, one of the Greenland birds flew east to Spitsbergen before turning south towards the wintering areas. This study indicates that the light-bellied brent geese breeding in northern Greenland are linked to the Svalbard population and not to those breeding in arctic Canada.

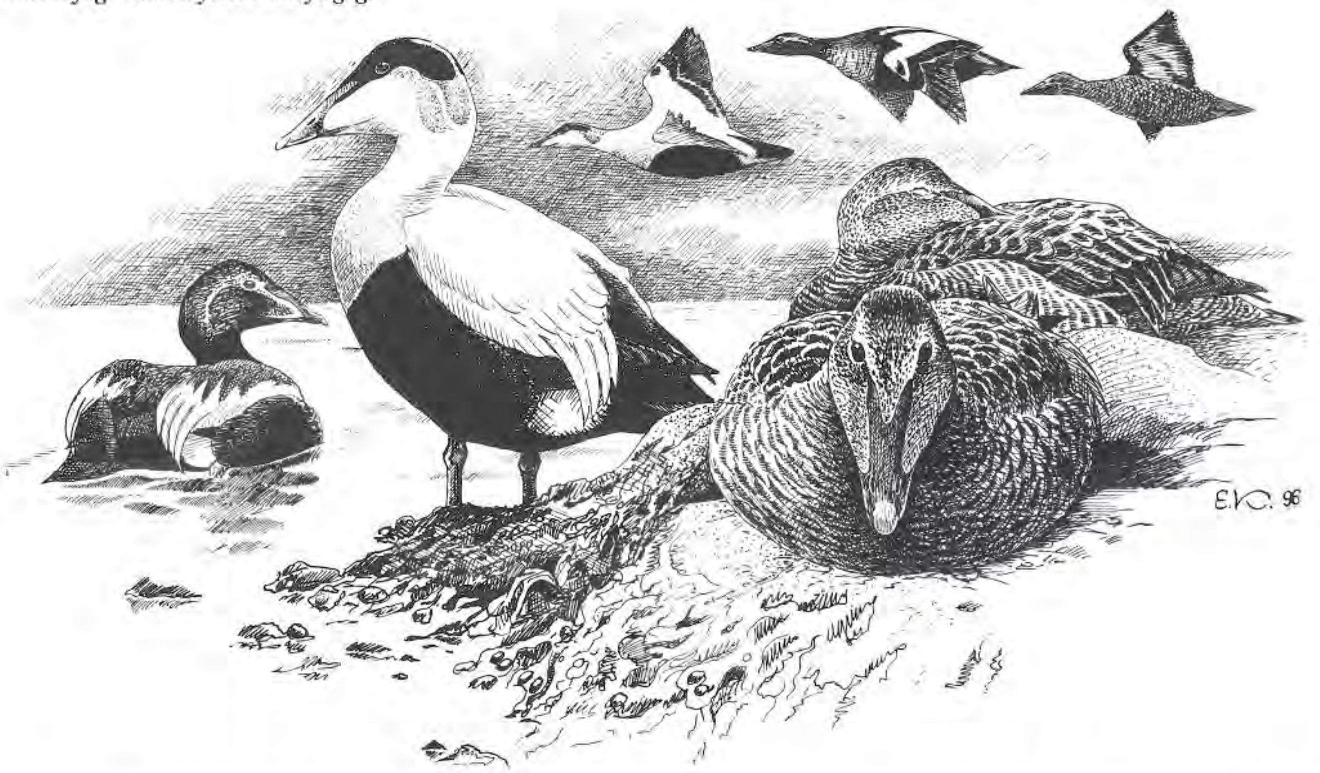
Recommendations

There is a need to determine the proportions of the northern Greenland-Svalbard-Franz Josef Land population of light-bellied brent geese breeding in each of these regions. A more detailed survey of potential breeding sites in Svalbard and Franz Josef Land is recommended.

Fridtjof Mehlum & Irina V. Pokrovskaya

Common eider *Somateria mollissima*

No: Ærfugl Ru: Obyknovennaya gaga



Population size: 120 000-150 000 pairs
Percent of world population: 5-10%
Population trend: Reasonably stable

General description

The Common eider *Somateria mollissima* has a circumpolar distribution and breeds in the arctic and boreal zones of the northern hemisphere. In North America, it breeds from the coast of Maine north to Ellesmere Island, along the northern coast of Canada and the whole coastline of Alaska and the Aleutian Islands (Palmer 1976). In western Europe, it breeds commonly along the Norwegian coast and in the Baltic, in England, the Netherlands and northern France. There are also large populations in Iceland and Greenland. There is a gap in its distribution in Eurasia, from the eastern coast of the Yugorski Peninsula to Chaunskaya Bay. In north-eastern Asia, it breeds from the Chaunskaya Bay area, east along the northern coast of Chukotka and the Bering Sea coast to Olyutorski Bay. It is found along the Okhotsk Sea from Tauyskaya to Penzhinskaya Bay. It also inhabits the Anzhu Islands and Wrangel Island (Cramp & Simmons 1977).

The population in Europe has been estimated at 2-3 million individuals (Laursen 1989, Rose & Scott 1997). The North American population has declined since 1970 (CSWG 1997). The world population may number 3-4 million individuals (Rose & Scott 1997).

The common eider usually breeds close to the marine environment, mostly on small coastal islands. It often nests in colonies, the nest being located on the ground. The clutch size is 3-6 (7) eggs, and broods very often amalgamate (e.g. Munro & Bedard 1977a,b, Bustnes & Erikstad 1991a). In the brood-rearing period, both males and females feed in the intertidal zone by dabbling (Gauthier & Bedard 1976, Bedard *et al.* 1986, Bustnes 1996). Outside the breeding season, common eiders feed by diving, usually in flocks at depths shallower than 10 m. However, they may dive to 40 m (Brun 1971f, Nilsson 1972, Guillemette *et al.* 1992, 1993, Bustnes & Lønne 1995, 1997).

Several different sub-species of the common eider in the eastern Atlantic have been identified (Schiøler 1926), but their distribution is not fully agreed upon. However, there seems to be agreement that the nominate race *S. m. mollissima* breeds in Varangerfjord, the White Sea, on Novaya Zemlya and on Vaygach

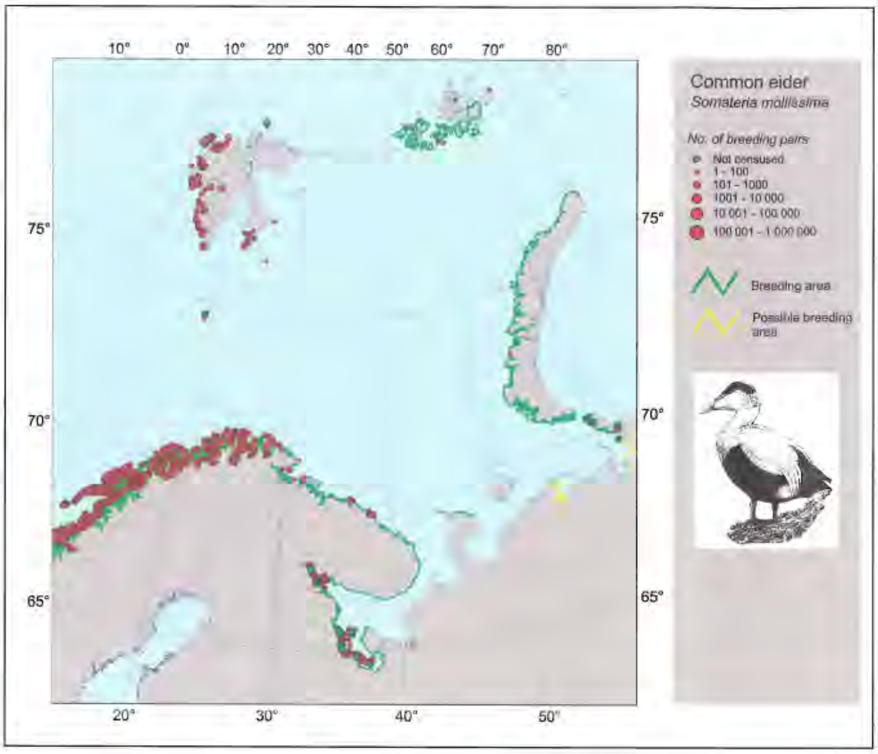
Population sizes and trends of the common eider *Somateria mollissima* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	50 000	1982-90	F	1980-93	(0)	-	1-6
MC	2500	1995	0	1980-95	(0)	-	7
WS	10 000	1995	0	1984-95	+2	1964-76	8-10
ND	3500	1960	(0)	-	-1	1960	11-12
NZ	25 000	1945	(0)	-	(0)	-	13
FJL	1000	1981	(0)	-	(0)	-	14
SV	17 000	1981-85	(0)	-	0	1973-85	15
All	109 000	1945-95	F	1980-93	(F)	-	

1. Bremdal & Røv 1982, 2. Strann & Vader 1986, 3. Anker-Nilssen, Bakken *et al.* 1988, 4. Strann 1992a, 5. Nygård 1994, 6. Anker-Nilssen et al. 1996, 7. Y. Krasnov, T.D. Paneva, I.P. Tatarinkova, unpubl. data, 8. V. Bianki, A. Koryakin, V. Kokhanov, V.D. Panarin, G. Shlyarevich, E. Shutova, unpubl. data, 9. Bianki 1984, 10. A. Cherenkov & V. Semashko, pers. comm., 11. Karpovich & Kokhanov 1963, 12. Kalyakin 1993, 13. Uspenski 1969a, 14. Uspenski & Tomkovich 1986, 15. Prestrud & Mehlum 1991

Island (Haftorn 1971, Palmer 1976, Cramp & Simmons 1977, Stepanyan 1990). Some intermediate sub-species have been identified along the rest of the Norwegian coast, these being referred to as *S. m. norvegica* by Schiøler (1926) or *S. m. islandica* by Palmer (1976). In Svalbard, the sub-species has been identified as *S. m. borealis* (Haftorn 1971, Cramp & Simmons 1977). The sub-species in Franz Josef Land has not been determined, but Palmer (1976) speculated that it may belong to the nominate.

The populations in North America have been divided into four sub-species. The northern *S. m. borealis*, the eastern American eider *S. m. dresseri*, the Pacific eider *S. m. v-nigra*, and *S. m. sedentaria* that breeds in the Hudson Bay area (Palmer 1976).



Breeding distribution and habitat preferences in the Barents Sea Region

The common eider breeds commonly along the whole Norwegian and Murman coast, around most of the White Sea, and in Svalbard including Bjørnøya. On Novaya Zemlya, common eiders inhabit small inshore islands on the coasts of Severny and Yuzhny Islands. In the Vaygach area, they nest mainly on small islands distant from Vaygach Island (Karpovich & Kokhanov 1963). On the Yugorski Peninsula, most of the nesting sites are concentrated on small islands off the coast (Uspenski 1958, 1965, Kalyakin 1984, Mineev 1994). In Franz Josef Land, common eider colonies are known on eight islands (Gorbunov 1932, Parovshchikov 1962, Tomkovich 1984, Frantzen *et al.* 1993).

The islands on which common eiders nest vary in character through the Barents Sea Region because of differing climatic conditions. In the southern part, common eiders nest cryptically on islands that are often vegetated with various trees and juniper, or simply grass (see Cramp & Simmons 1977). Along the Norwegian coast, common eiders also breed close to fishing villages and other settlements, often in man-made shelters (Soot-Ryen 1941a, Strann 1992a, Suul 1992).

In the high-Arctic, in Svalbard, Franz Josef Land and in the northern part of Novaya Zemlya, the vegetation on the islands is very limited, if there is any at all (Ahlen & Andersson 1970) and the birds tend to nest openly.

Movements

Female common eiders may swim more than 20 km with their brood from the nesting colonies to reach the brood-rearing areas (Gauthier & Bedard 1976, Bustnes 1996). Once at the brood-rearing sites, the birds may stay within a few hundred metres of shoreline for several weeks (Munro & Bedard 1977b, Bustnes 1996). Common eider females are natally philopatric, and often return to the island where they hatched (Swennen 1976, 1990). Males, however, disperse much farther from the natal area, and may breed as far as 1700 km away (Swennen 1990).

Pair formation takes place in autumn and the same birds may mate for more than one year (Spurr & Milne 1976). In spring, common eiders move from the winter areas and gather around the islands where they rest some time before breeding starts (Palmer 1976). When the females start incubating, the males flock, leave the islands and start moulting. In the Tromsø area, the moulting and breeding areas seem to overlap (J.O. Bustnes, unpubl. data). In Svalbard, males move from the nesting colonies in the fjords, to the most important moulting areas on the outer part of the west coast. Important areas are Prins Karls Forland and south of Isfjorden (Prestrud & Mehlum 1991, Isaksen & Bakken 1995a). In Svalbard, common eiders have a nesting strategy that differs from that of most other populations, the male staying at the nest for 1-2 weeks after the female has started incubating (Ahlen & Andersson 1970, Campbell 1975, Prestrud & Mehlum 1991).

In the Barents Sea Region, the various common eider populations have different autumn migration patterns. The birds that breed along the Norwegian coast are resident or migrate locally. Bustnes & Erikstad (unpubl. data) found that females marked with wing tags in the Tromsø area mostly stayed within 20 km (maximum 50 km) of the nesting colony during the autumn and winter. Occasionally, females stayed at the same site the whole year. Of 940 females ringed on their nest on Sommarøy (60 km from Tromsø), none have been recovered more than 25 km away. Of 68 females ringed on their nest in 1985, 11 were caught in the local harbour, 1-2 km away, during the winter (H. Ludvigsen, pers. comm).

In autumn, the common eiders in northern Russia migrate to open water in the Barents Sea. Two birds ringed in summer on the Murman coast (Seven Islands and Aynov Islands), were recovered in winter in eastern Finnmark (Kongsfjord and Nesseby). Some populations winter in the White Sea, especially in the western part of Onezhski Bay and along the Terski coast on the Kola Peninsula. In years with favourable ice conditions, birds also winter along the Karel'ski coast (Shklyarevich 1979). Another wintering area is along the south-western part of Yuzhny Island (Novaya Zemlya).

The Svalbard population winters along the Norwegian coast and on Iceland. There is little detailed knowledge about the distribution of Svalbard birds along the Norwegian coast. However, two birds colour-ringed on Sommarøy during the winter were observed in the summer in Kongsfjord, a third was found in Sallyhamna in northern Svalbard (F. Mehlum, pers. comm.) and a fourth was found dead in Gipsvika, central Spitsbergen (H. Ludvigsen, pers. comm.). A bird ringed on its nest in Kongsfjord drowned in a gill net 12 km from Tromsø. This indicates that birds from different colonies winter in the same areas. Four birds ringed in Svalbard have been recovered in Iceland. Recent surveys have also shown that common eiders winter in the restricted ice-free waters off the west coast of Svalbard (G. Bangjord, pers. comm.). Spring migration starts in Russia in the second half of March and lasts through April and May (Bianki 1989). Common eiders arrive on the Novaya Zemlya coast at the beginning of April and at the Vaygach and Yugorski Peninsulas at the beginning of May (Uspenski 1965, Mineev 1994). The first common eiders appear in Franz Josef Land and the Aynov Islands at the end of April (Parovshikov 1962, Tatarinkova & Chemyakin 1970a) and on the eastern Murman coast at the beginning of May (Karpovich 1984). Moulting males and non-breeding birds also congregate near the nesting sites in the eastern Barents Sea.

Population status and historical trends

The total population in Nordland (Bremdal & Røv 1983), Troms and western Finnmark (Strann & Wader 1986, Anker-Nilssen, Bakken *et al.* 1988), and Porsangerfjord (Strann 1992b) has been estimated to be 35 000-40 000 pairs. There are no known estimates of the breeding population in eastern Finnmark. However, it is likely that the population in the Norwegian part of the Barents Sea Region numbers about 50 000 pairs or more. The wintering population in the same area has been estimated to be 280 000 individuals (Nygård *et al.* 1988). The Norwegian winter population seemed to decline temporarily in the 1980s (Nygård 1994), and in Troms the population dropped significantly between 1981 and 1993 (Anker-Nilssen *et al.* 1996).

In the White Sea, the population in the Kandalaksha State Nature Reserve (Aynov Islands, Gavrilovskie archipelago, Seven Islands in the Barents Sea and Kandalaksha Bay Islands) was about 7500 pairs in 1995 (V.V. Bianki, A.S. Koryakin, V.D. Kokhanov, G.A. Shlyarevich, E.V. Shutova, Yu.V. Krasnov, T.D. Paneva, I.P. Tatarinkova, unpubl. data). It rose from 3400 to 14 000 pairs between 1964 and 1976, but had declined to 4000 pairs by 1983 as a result of disease and predators (Bianki 1984). At present, the common eider population in the protected areas is relatively stable. In Onezhski Bay, A. Cherenkov & V. Semashko (pers. comm.) estimated that there were 5000 pairs of common eiders in more than 300 colonies. They also noted an increase in recent years.

More than 62 000 common eiders were counted in Varangerfjord and on the Kola coast in March 1994 (Nygård, Jordhøy *et al.* 1995). Aerial surveys in February and March 1999 gave about 51 000 common eiders along the Finnmark coast, excluding Varangerfjord (Systad & Bustnes 1999).

The size of the population on and around Vaygach Island is not known. The last survey, made in 1960 by Karpovich & Kokhanov (1963), estimated the population to be 5500-6000 pairs, based on the number of nests and moulting males found. The authors noted a decline in the density of common eiders in the area. Kalyakin (1993) estimated the total number of eiders (common and king eiders) in the area to be 4000-5000 individuals. Data from the Yugorski Peninsula are contradictory. Kalyakin (1984) estimated that there were 1000 pairs of common eiders in 1983. However, Mineev (1994) stated that the common eider was a rare species in the area in the 1980s and that the population was declining.

Only a few birds nest on the islets along the coast of Kolguev Island. Only four nests were found on the Tonkie Koshki Islands off the south-west coast of Kolguev Island in 1987 (Ponomareva 1995).

The present size of the common eider population on Novaya Zemlya is not known. According to Demme (1946, cited by Uspenski 1969a), 25 000 pairs nested in the archipelago in 1945, most of them being concentrated along the west coast. The largest colonies were in Rusanov Bay on Pukhovyi Island, on the islands at the mouth of the River Sakhanikha and north-east of Mezhdusharski Bay, and in Pukhovoy Bay (Uspenski 1969a, Pokrovskaya & Tertitsky 1993).

The total number of common eiders in Franz Josef Land has been estimated at 1000-3000 individuals (Uspenski & Tomkovich 1986).

In Svalbard, Prestrud & Mehlum (1991) estimated the breeding population to be 13 500-20 500 pairs and a late summer population to be 80 000-140 000 individuals. The population may have been much larger early in the 1900s, but numbers had probably been overestimated by previous authors. There has been no evident rise in the population

Diet of the common eider *Somateria mollissima* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Nordland/Troms	1934-35	*Littorina sp., Mytilus, Nucella sp.*, Gammaridaea	Adults and ducklings	1
MC	Seven Islands	1977	*Mytilus edulis* (72%), Gastropoda (9.4%), *Crustacea* (1%)	Adults	2
WS	Kandalaksha Bay	1963 1971-75	*Littorina sp., Mytilus edulis*, Gastropoda, Echinodermata	Adults and ducklings	2,3
NZ	Bezymyannay Bay	1950	Molluscs (77.3%), Crustacea (22.6%), Algae (0.1%)	Adults	4
FJL	Tikhaya Bay, Hooker Island	1991	*Maragrites groenlandicus Trochidae*, Polychaeta	Adults	5
SV	Nordaustlandet Billefjorden	1923	Molluscs *(Chiton, Cardium, Mya* sp.), Crustaceans *(Gammarus, Hyas, Mysis sp.,* Holothurians)	Adults	6
	Sørkapp area Forlandet	1954	*Mysis* sp.	Females and broods	7

1. Soot-Ryen 1941b, 2. Bianki *et al.* 1979, 3. Pertsov & Flint 1963, 4. Belopolski 1957b, 5. Weslawski & Skakuj 1992, 6. Løvenskiold 1964, 7. F. Mehlum, pers. comm.

since the bird sanctuaries were established in 1973 (Prestrud & Mehlum 1991).

These regional counts add up to 109 000 pairs, but the total population in the Barents Sea Region is likely to be considerably larger because some areas are poorly covered. We suggest that the total breeding population is somewhere between 120 000 and 150 000 pairs.

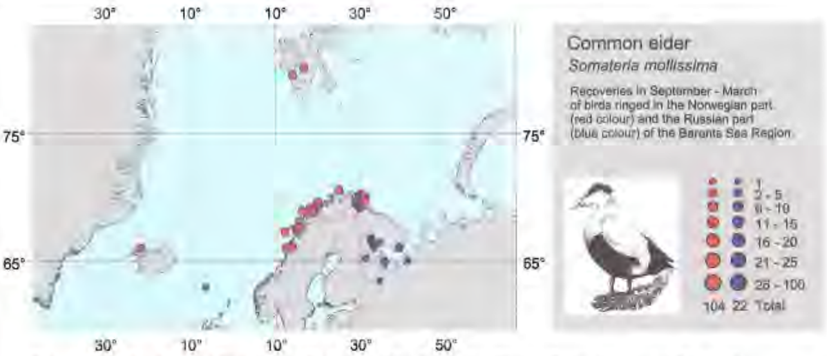
Feeding ecology

For most of the year, common eiders feed on sessile or slowly moving benthic organisms, the blue mussel *Mytilus edulis* playing a major role. However, the species is omnivorous and eats most available molluscs, echinoderms, polychaetes and crustaceans, as well as fish roe. What determines its choice of food is a complicated interplay between different factors. Availability will clearly influence the choice, but the various foods have different energy contents (Goudie & Ankney 1986, Guillemette *et al.* 1992, Bustnes & Lønne 1995), and differences in energetic quality between prey species seem to influence food selection. For instance, common eiders tend to select small blue mussels and support has been found for the hypothesis that they try to reduce the amount of indigestible shell in the diet (Bustnes & Erikstad 1990, Bustnes 1998). Another factor influencing their diet is their physical condition, and birds in poor condition may adopt a more risk-prone feeding strategy and search for less common, high-energy food such as crabs (Guillemette *et al.* 1992). The depth to which they need to dive will also influence their choice of diet (Beauchamp *et al.* 1992).

There are numerous studies of the winter and spring diets of common eiders in the Barents Sea Region. In Troms blue mussels have been found to be very important (up to 46% by wet weight) (Bustnes & Erikstad 1988, 1990). Sea urchins *Strongylocentrotus droebachiensis* (35%) (Bustnes & Lønne 1995), *Chlamys islandica* (Brun 1971f) and capelin *Mallotus villosus* roe (Gjøsæter & Sæthre 1974, Bustnes & Erikstad 1988) are also important (see also Soot-Ryen 1941b).

In the White Sea 66% and on the Murman coast 72% of the common eider diet consists of blue mussels, but gastropods, echinoderms and crustaceans are also important (Bianki *et al.* 1979).

In Svalbard, the autumn diet of common eiders consisted of bivalves and the amphipod *Gammarellus homari* (Lydersen *et al.* 1989).



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Threats

Increased exploitation of benthic organisms, including the trawling of kelp forests and mussel beds, may be a potential threat for the common eider feeding areas. Along the coast of Norway, and in some colonies in Svalbard, common eider down is harvested in large quantities (Mehlum *et al.* 1991, Suul 1992). Some places in Norway, eggs are also harvested. These activities probably have little impact at the moment, but are potentially disturbing to the birds. Mehlum *et al.* (1991) found no difference in nesting success between harvested and non-harvested nests in Svalbard. On Franz Josef Land and Novaya Zemlya, common eiders are shot and eggs collected near human settlements. The species has been exploited for many years by local inhabitants on Vaygach Island, the Yugorski Peninsula and in unprotected parts of the White Sea. According to Karpovich & Kokhanov (1963), 87% of the destroyed nests in the Vaygach area in 1960 had been ravaged by poachers. Koryakin (1986) found that, in the White Sea, disturbance was the most important factor reducing the nesting success. Human disturbance also increases the mortality of ducklings caused by successful gull attacks (Munro & Bedard 1977a, Koryakin 1982, 1983, 1986, Swennen 1989, Åhlund & Götmark 1989, Keller 1991).

Recent studies have shown that sea ducks are extremely vulnerable to drowning in fishing gear (Follestad & Strann 1991, Stempniewicz 1994) and drowned common eiders have been reported along the Norwegian coast, especially during the spring fisheries for cod and lumpsuckers *Cyclopterus lumpus* (Bustnes & Erikstad 1988, Follestad & Strann 1991). Of 94 ringed birds recovered from Sommarøy, at least 60% drowned in different types of fishing gear, especially gill nets set for lumpsuckers (36%) (H. Ludvigsen, pers. comm.).

Common eiders are very vulnerable to oil spills and large numbers have died during at least two episodes in Norway (Barrett 1979b, Røv & Frengen 1982). Planned oil drilling activities in the Barents Sea are a potential threat to the common eider. In the Nenetski district, oil exploitation in the Pechora area is a great potential threat to the environment (Anon. 1995a).

Blue mussels easily accumulate environmental toxins (Zachariassen 1991) and since common eiders may eat 2 kg of mussels per day, they may ingest large concentrations of toxins in polluted areas. Bustnes (1992a) found a high mortality of eggs and young in common eider nests in Ranafjord, close to the Arctic Circle. This fjord was contaminated with PAH (*polycyclic aromatic hydrocarbons*), a group of toxins that is widely distributed in the environment and which has been found to kill common eider eggs in experimental studies (Brunström *et al.* 1990). Potentially, PCB (*polychlorinated biphenyls*) may have the same effects, but in the Barents Sea Region only low concentrations have been found in common eiders (Savinova, Polder *et al.* 1995).

In some areas, especially close to settlements, land-use changes may be a problem. Mud flats used as brood-rearing areas are often taken over for other purposes, such as industry, waste storage, harbours and roads. This has, for example, been the case around Tromsø.

The common eider has several natural enemies which may drastically reduce its reproductive output. Along the coasts of Norway, the Kola Peninsula and the White Sea, these include crows, foxes and gulls which feed on eggs, while herring gulls and greater black-backed gulls may kill large numbers of ducklings (e.g. Munro & Bedard 1977a, Mendenhall & Milne 1985). In Svalbard (Ahlen & Andersson 1971, Campbell 1975, Mehlum 1991a) and on Novaya Zemlya, Vaygach Island and the Yugorski Peninsula, glaucous gulls, arctic foxes and polar bears are effective predators of common eider nests. Birds of prey, such as the white-tailed eagle *Haliaëtus albicilla*, often kill common eiders along the Norwegian coast (Norderhaug 1978). Of introduced predators, the North American mink *Mustela vison* is a threat to nesting common eiders on the Norwegian coast and the rest of the Scandinavian peninsula (e.g. Gerell 1985). On Sommarøy, seven of 94 common eiders found dead were killed by mink (H. Ludvigsen, pers. comm.).

In Svalbard, common eiders may be subjected to increasing competition for nest sites due to the rising population of barnacle geese *Branta leucopsis*.

Parasites may seriously reduce the reproductive output of common eider. In the White Sea, up to 90% of all common eider ducklings may be killed by trematodes of the genus *Microphallus* sp. (Kulachkova 1979, Karpovich 1987). They use periwinkles (*Littorina* sp.), the food of common eider ducklings, as intermediate hosts (Galaktionov *et al.* 1993). Common eiders wintering in the White Sea also suffer from unfavourable ice conditions in severe winters, when the benthos is mechanically affected by ice (Karpovich 1979).

Special studies

A study of the ecology of the common eider has been carried out near Tromsø over the last 10 years. The survival rate of common eider females has been found to vary annually between 60 and 100% (Erikstad *et al.* 1994). The brood-rearing system (Bustnes & Erikstad 1991a, b, Bustnes 1992b, Erikstad *et al.* 1993), clutch size regulation (Erikstad *et al.* 1993, Erikstad & Bustnes 1994), egg size variation (Erikstad, Tveraa *et al.* 1998) and cost of incubation (Erikstad & Tveraa 1995) have been studied in detail. Site fidelity has been found to be high both for nest sites and brood-rearing areas (Bustnes & Erikstad 1993, Bustnes 1996). Studies of the winter biology comprise work on diet (Bustnes & Erikstad 1988, 1990, Bustnes 1998), winter habitat use, especially in comparison with the king eider (Bustnes & Lønne 1995, 1997), and the effect of common eider predation on sea urchins in kelp forests (Bustnes & Lønne 1995). A study has been made on the feeding activity of the common eider relative to the length of the day, showing that the common eider increases the proportion of the day used for feeding when the days are short and continues feeding when light intensities are low (Systad *et al.* 2000).

Mehlum (1991b) present data on the population size of common eiders and the factors limiting the reproductive output in Svalbard, such as ice conditions. Work has also been done there on different reproductive strategies, such as nest parasitism (Bjørn & Erikstad 1994).

In the White Sea and on the Murman coast, the distribution and population dynamics (mostly in Kandalaksha Bay) have been studied by Gerasimova (1959, 1961), Karpovich (1965, 1972, 1979, 1987), Karpovich & Kokhanov (1963, 1968), Bianki (1968, 1972, 1975) and Koryakin *et al.* (1989). Data collected since 1933 suggest that common eider numbers fluctuate in 20-year cycles. Pertsov & Flint (1963), Bianki, Karpovich *et al.* (1975, 1979), Tatarinkova *et al.* (1979) and Shklyarevich & Shklyarevich (1982) have studied the feeding ecology of common eiders, showing that their diet is varied in this area. Their behaviour and breeding biology have been studied by Bianki & Boiko (1968), Goryainova (1972), Bianki *et al.* (1979), Koryakin (1982, 1983, 1986, 1989a,b), Tatarinkova *et al.* (1989) and Ponomareva (1995). Parasites and their influence on the population of common eiders have been studied by Belopolskaya (1952), Kulachkova (1957, 1958a, b, c, 1979), Galaktionov *et al.* (1993) and Krasnov *et al.* (1995).

Recommendations

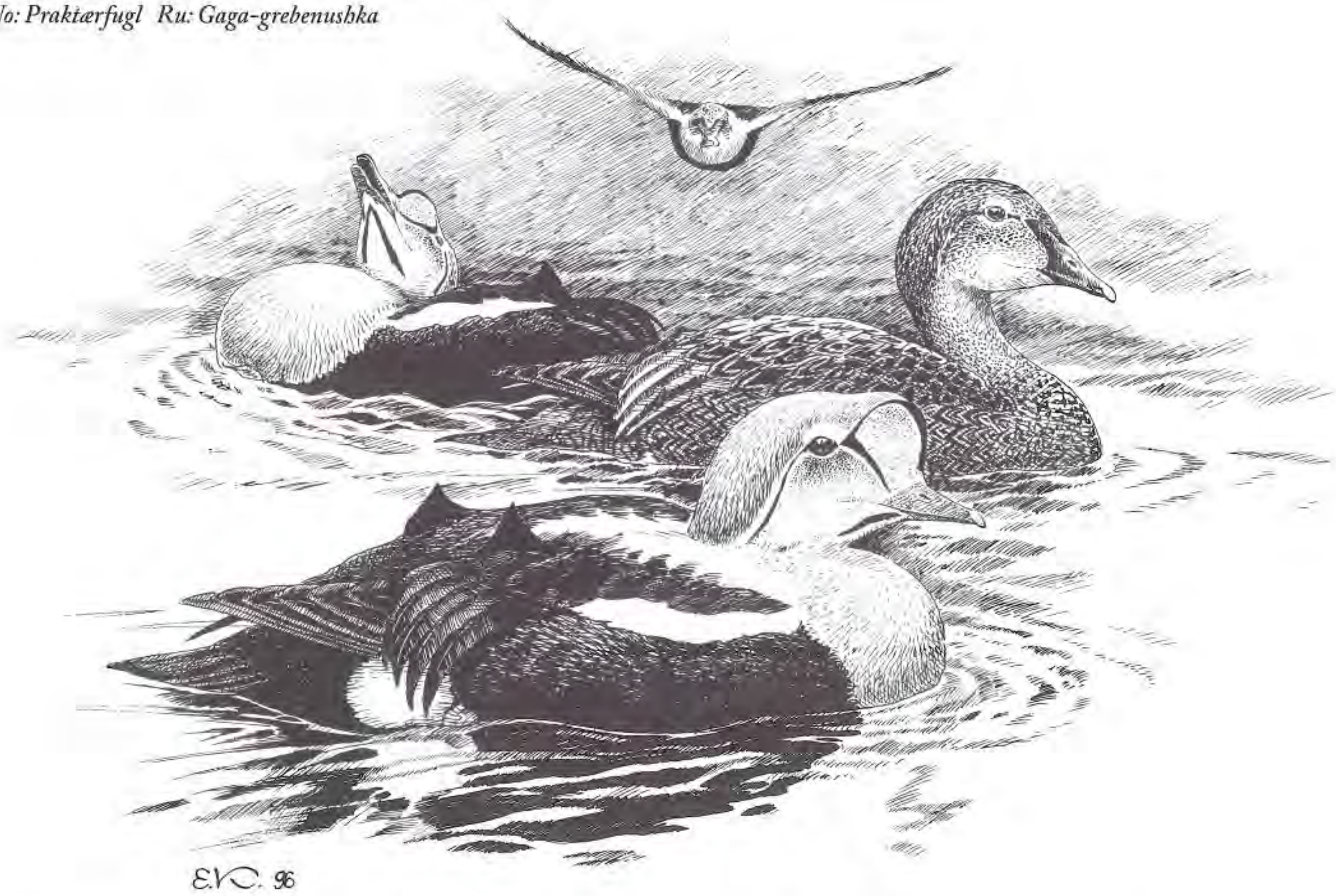
In the Barents Sea Region, the common eider is a well-studied species and much basic information has been acquired about its general biology and ecology. These studies should continue because they will provide important population data needed to develop good management strategies. There are, however, still gaps in our basic knowledge about common eiders in this region. These include the population sizes and trends in the eastern and north-eastern Barents Sea (Nenetski district, Novaya Zemlya and Franz Josef Land), where better mapping of important wintering and moulting areas is also needed. Along the Norwegian coast, the effects of the common eider by-catch in fishing gear should be studied.

It is important to develop management strategies that will reduce by-catches in fishing gear. Possible solutions to this problem may include reducing the number of nets in areas that are important for birds, or setting the nets in deeper water. This is important during both the lumpsucker and cod fisheries.

Jan Ove Bustnes & Grigori M. Tertitski

King eider *Somateria spectabilis*

No: Praktærfugl Ru: Gaga-grebenushka



Population size: <10 000 pairs
Percent of world population: <5%
Population trend: Reasonably stable?

General description

The king eider *Somateria spectabilis* has a circumpolar distribution and is more northern than the other *Somateria* species. It breeds relatively commonly in the arctic regions of North America and Russia, and also breeds in Greenland and Svalbard. It migrates south in autumn, but in Europe most of the wintering population remains in the Barents Sea Region (Alerstam 1984).

The size of the world population is poorly known. The Russian population has been estimated at 1-1.5 million individuals (Uspenski 1972a). Bellrose (1976) estimated the North American breeding population to be at least 1.5 million, but the population has decreased dramatically there since 1960 (CAFF 1997). The world population may be about 3 million breeding birds (Rose & Scott 1997). The population wintering on European coasts is somewhere between 100 000 and 300 000 individuals (Nygård *et al.* 1988).

The king eider is monotypic. It is a solitary nester that usually breeds close to freshwater ponds and rivers on both mainland and island shores. The breeding sites are grassy or mossy meadows (Spangenberg & Leonovich 1960, Mineev 1987). The clutch size is 4-5 (3-7) eggs and broods occasionally amalgamate. Young are reared in both fresh water and on the sea, and many broods move to the sea before flight (Uspenski 1969a, Norderhaug 1977). During winter, the king eider inhabits marine habitats only and feeds in deeper water (20-40 m) than other sea ducks (Brun 1971f, Bustnes & Lønne 1995, 1997). It is often found several kilometres off the shore and may also winter in open water in the Arctic Ocean (Cramp & Simmons 1977).

Breeding distribution and habitat preferences in the Barents Sea Region

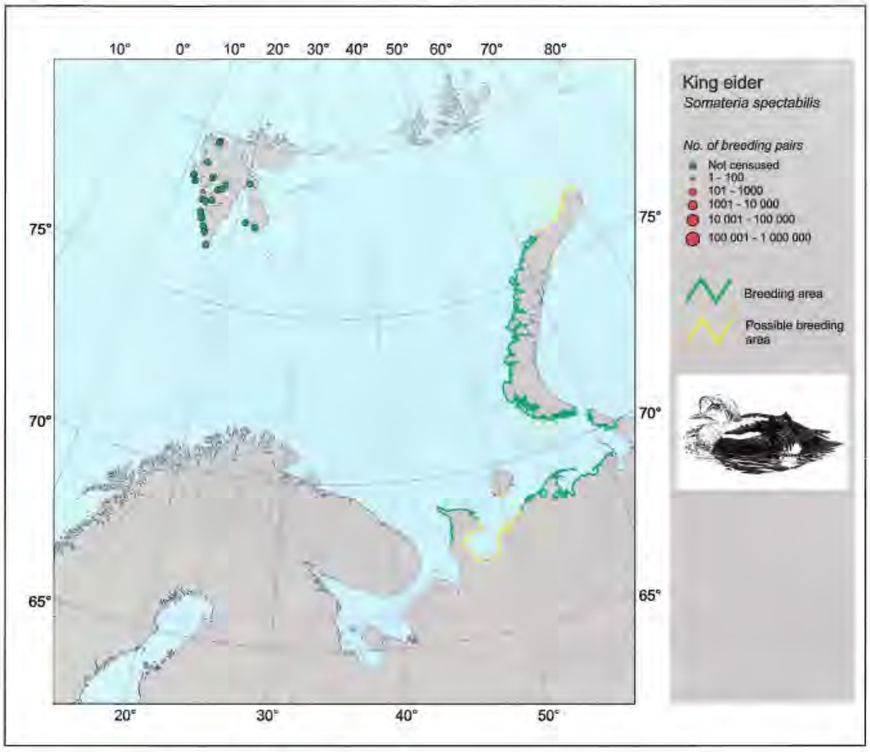
The majority of king eiders in the Barents Sea Region breeds in Russia, from Cape Kanin and Novaya Zemlya eastwards (Palmer 1976, Cramp & Simmons 1977). The main breeding sites are on the mainland tundra east of the White Sea. On the Bol'shezemel'skaya tundra, the species nests near the coast and around karst lakes. On the Yugorski Peninsula, the density of birds varied from 0.2 to 2.2 individuals per km^2 in 1981-1987. Counts of 14.1-23.2 individuals per km^2 were made in Khaypudyrskaya Bay in 1976-1977, prior to the moulting period (Mineev 1987, 1994). King eiders nest on Kolguev Island and Novaya Zemlya up to 77° N and sporadically in the White Sea (Dementjev & Gladkov 1952, V. Bianki, pers. obs.).

In Svalbard, the most important breeding area for king eiders is along the west coast (Norderhaug 1977, Prestrud 1991). The nesting habitat here often includes hummocks surrounded by fresh water (Palmer 1976).

Movements

King eider migration is gradual; birds move from the breeding areas to the moulting areas and later to the wintering areas. Important moulting areas within and near the Barents Sea Region are around the Yamal Peninsula, around Vaygach Island, on the west side of Novaya Zemlya and around Kolguev Island (Palmer 1976), but no recent data are available.

King eiders breeding in north-west-



ern Russia winter in the area from Kolguev Island and the White Sea westwards along the coast to Finnmark and Troms and as far south as Sør-Trøndelag (Palmer 1976, Cramp & Simmons 1977, Anker-Nilssen, Bakken *et al.* 1988, Nygård *et al.* 1988, Nygård, Jordhøy *et al.* 1995). They start to arrive on the Murman coast in October (Kokhanov 1967). On the Norwegian coast, most of the wintering birds remain on the outer side of the coastal islands. Part of the population, however, moves into sounds and fjords, but the birds prefer to feed in relatively deep water (Anker-Nilssen, Bakken *et al.* 1988, Bustnes & Lønne 1997). In Troms, the bulk of wintering king eiders arrive inshore in late November, but probably stay at sea before moving inshore. Most birds leave the inshore area in late March and early April (Bustnes & Lønne 1995, 1997, Systad *et al.* 2000), possibly to feed on capelin roe deposited along the outer coast (Gjøsæter & Sætre 1974). Very large flocks of several thousand individuals may be seen off the coast of Troms in April (H. Ludvigsen, pers. comm.).

Recent surveys on the north coast of Varangerfjord have shown that numbers increase from late November (<150) and mid-January (370) (J.O. Bustnes, unpubl. data), to even higher numbers in March (542) (Nygård, Jordhøy *et al.* 1995) and May (1030) (Fox & Mitchell 1997a). This could indicate that birds gather there before migrating to the breeding areas.

The spring migration in north-western Russia was observed in late April in 1963. On 24 April, two flocks of 300 and 2300 birds, mostly adult males, were recorded near the Rybachi Peninsula. Three flocks of 600, 1000 and 2000 birds were recorded on 24-26 May 1964 near the Aynov Islands. These were mostly immature (Kokhanov 1967). In May 1993, 3-13 birds were counted every five days at the Gavrilovskie Islands (T.D. Paneva, pers. comm.). Spring migration along the Murman coast ends in late June, but flocks of mostly immature birds stay on the Murman and Finnmark coasts during the summer (Kokhanov 1967, Anker-Nilssen, Bakken *et al.* 1988).

In Svalbard, flocks of males migrate to the south-west coast (from Hornsund to Sørkapp) to moult after the females start incubating (Løvenskiold 1964, Prestrud 1991). The breeding population in Svalbard probably winters along the Norwegian coast (Palmer 1976). In the Sørkapp area, autumn migration takes place in September (Løvenskiold 1964). In May, birds pass Bjørnøya on their spring migration (Williams 1971a).

Population status and historical trends

Winter surveys of king eiders have been carried out in northern Norway since 1980. Although the population trend seems somewhat negative, Nygård (1994) argued that the population is probably stable and the trend is a consequence of methodological problems. The birds may change areas from one year to another, and stay far out at sea. In Troms and Finnmark, Anker-Nilssen *et al.* (1996) found little change in the wintering population during the last 15 years. The wintering population in Norway has been estimated to be roughly 70 000-100 000 birds (Nygård *et al.* 1988). Aerial surveys in February and March 1999 gave about 30 000 king eiders along the Finnmark coast, excluding Varangerfjord, but numbers varied greatly throughout the winter (Systad & Bustnes 1999).

An aerial survey on the Murman coast in February 1967 revealed 37 000 eiders (eider and king eider) between Teriberka and Svyatoy Nos and 9500 from Svyatoy Nos to Chavanga (Karpovich *et al.* 1969). There were 35 000 in this area in March 1994, 96% being eiders. 5300 king eiders were counted from Finnmark to Svyatoy Nos, 1800 in Norwegian territory and 3500 in the Russian part (Nygård, Jordhøy *et al.* 1995).

No major changes seem to have taken place concerning the number of king eiders recorded in the White Sea. The

Population sizes and trends of the king eider *Somateria spectabilis* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	0						
MC	0						
WS	?	-	(0)	-	(0)	-	
ND	?	-	(0)	-	(0)	-	
NZ	?	-	(0)	-	-1	1960	1
FJL	0						
SV	500	1982-85	(0)	-	(0)	-	
All	(<10 000)	-	(0)	-	(0)	-	2

1. Karpovich & Kokhanov 1963, 2. Prestrud 1991

Diet of the king eider *Somateria spectabilis* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NZ	Bezymyannaya Bay	1952	*Mytilus edulis* *Saxicava* sp. *Ideotea* sp. Pteropods Planktonic molluscs	Adults	1
SV	Sørkapp	1954	Sea slugs *Holthuridae* sp.	Adults	2

1. Dementjev & Gladkov 1952, cited by Cramp & Simmons 1977, 2. Løvenskiold 1964

population of king eiders in Svalbard has been estimated to be 2500-5000 individuals in August (Prestrud 1991). This means that the number of breeding pairs is probably not much larger than 500.

Feeding ecology

The king eider feeds on the same benthic species as the eider, but the diet is usually more varied and differ in the proportions of prey species (Cottam 1939, Bustnes & Erikstad 1988, Goudie & Ryan 1991). Presumably, the difference arises because the king eider feeds in deeper water than the eider, often 20-30 m (down to 40 m) (Brun 1971f), and a recent study in Troms found mean diving depths of more than 20 m (Bustnes & Lønne 1997). Several studies of the feeding ecology of king eiders have been carried out on the Murman, Finnmark and Troms coasts in winter and spring. At Pechenga, Siivonen (1941) found a predominance of sea urchins *Strongylocentrotus droebachiensis*, blue mussels *Mytilus edulis* and crabs. On the Finnmark coast, Gjøsæter & Sætre (1974) found that king eiders fed on capelin roe. On the coast of Troms, Soot-Ryen (1941b) found that mussels and echinoderms predominated. Bustnes & Erikstad (1988) recorded a predominance of echinoderms *Ophiopholis acuelata, S. droebachoiensis and Asterias rubens* amounting to 68% of the wet weight. Bustnes & Lønne (1995) reported sea urchins and molluscs as the most important food items.

During the breeding season, the birds feed on lakes, taking chironomid larvae and other insects, and crustaceans (Dementjev & Gladkov 1952, Bauer & Glutz 1969, Cramp & Simmons 1977).

Threats

In Troms, many king eiders drown in fishing gear (Bustnes & Erikstad 1988, H. Ludvigsen, pers. comm.). Estimates are difficult to make, but probably several thousand drown every year. This seems to be a problem along the whole coast of Finnmark and Troms. Both the cod *Gadus morhua* and lumpsucker *Cyclopterus lumpus* fisheries in spring kill birds. Like other sea ducks, this species is vulnerable to oil spills, both on the sea and in the tundra areas where the breeding sites may become polluted (Anon. 1995a). Nest destruction and poaching by man may also be a problem on the nesting sites.

Special studies

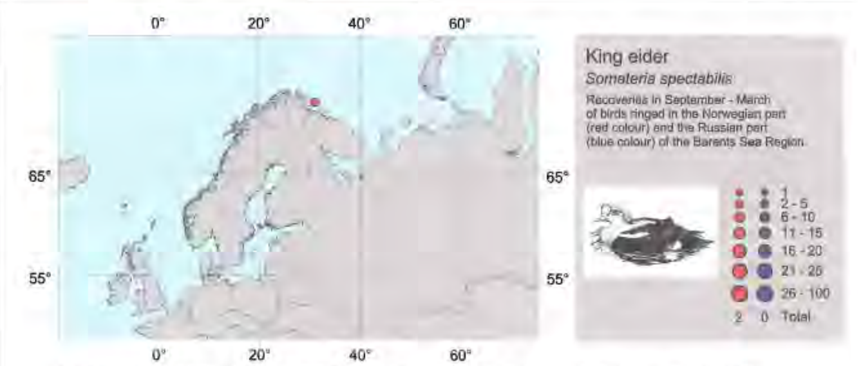
A study of the winter biology of king eiders is taking place in the Tromsø area, where habitat use, feeding ecology and flocking behaviour are being investigated. An important topic has been a study of the ecological differences between king eiders and eiders. The king eider feeds in deeper water with a different bottom substrate, and less kelp forest than the eider. Sea urchins are a dominant part of their diet, and the flock sizes change through the winter from large to small, possibly related to food depletion (Bustnes & Erikstad 1988, Bustnes & Lønne 1995, 1997, Systad *et al.* 2000).

Recommendations

Because of the declining population in North America (CSWG 1997), it is of great importance to establish a better population monitoring programme in the region. This should include the wintering grounds in Norway and, if possible, also the breeding grounds. It is important to obtain more detailed knowledge about the breeding areas of the wintering population. Migration routes and moulting areas should be mapped better and information about where the birds stay between leaving the nesting grounds and reaching the wintering areas would be valuable. Recent advances in satellite telemetry would make such a study possible. It would also be of great interest to know more about the breeding biology and the threats to the populations in the breeding areas.

The protection of the known nesting and moulting areas on the Yugorski Peninsula, i.e. between the rivers Lymbadayakha and Selyakha, the lower stretches of the rivers Tabyu, Saayakha and Sopchauy and the tundra around Kara Bay should be improved (Mineev 1994). Reducing the by-catch in the gill net fishery in important wintering areas for king eiders, and improved control to prevent oil spills would be of great value for preserving the species.

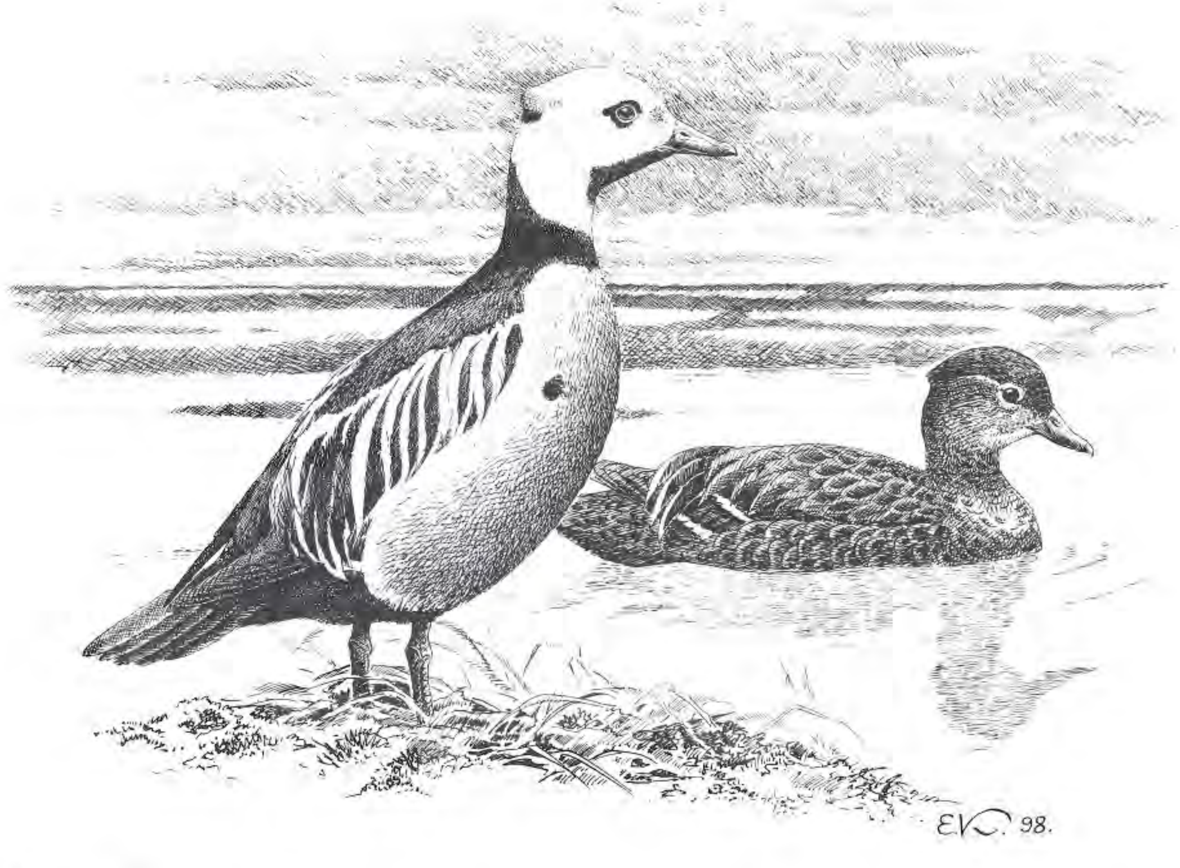
Jan Ove Bustnes & Vitali V. Bianki



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Steller's eider *Polysticta stelleri*

No: Stellerand Ru: Sibirskaya gaga



Population size:
25-40 000 wintering birds
Percent of world population: 15-20%
Population trend: Reasonably stable

General description

The Steller's eider breeds on the northern coast of Siberia, mainly from the Kara Sea and eastwards. A few pairs breed in northern Alaska. It winters around the Alaska Peninsula and Aleutian Islands, and off the south tip of the Kamchatka Peninsula. In western Europe it winters in the eastern Barents Sea, and in the Baltic Sea (Nygård, Frantzen *et al.* 1995).

The Steller's eider is considered to be a threatened species and the size of the world population seems to be about 220 000 birds (Pihl 1997). Of these, about 30 000-50 000 winter in Europe. In North America there has been a dramatic population decline since 1960 (Kertell 1991, Petersen 1997).

The Steller's eiders is a small sea duck. The male has a white head with green tufts on the side of the crown, and green spots in front of the eyes. The throat, the lower neck and back are black. The chest, flanks and belly are light to dark brown. The female is dark brown. It usually nests close to freshwater pools, often several kilometres inland (Palmer 1976, Cramp & Simmons 1977). During winter it stays in marine habitats.

Breeding distribution and habitat preferences in the Barents Sea Region

There are several records of possible breeding in the Barents Sea Region in Finnmark, on the Murman coast and on Novaya Zemlja. Most of these are not confirmed (see Nygård, Frantzen *et al.* 1995 for a review). However, in Kandalaksha Bay, two breeding records have been confirmed. In 1979, one female with five small ducklings was observed in Rugozerskaja Bay about 3 km west of Veliky Island (66° 30' N, 33° 00' E) (Kohanov 1998). In 1991, one nest was found on Plosky Berezjnoj Island (Vachev Archipelago) (66° 45' N, 32° 58' E) in early July 1991 (Bianki *et al.* 1993). In addition, one duckling was observed on a lake near the Seven Island Archipelago off the eastern Murman coast in early July 1987 (Krasnov 1992).

In the Barents Sea Region, a large population winters along the Murman coast and west to Varangerfjord. Individuals are also encountered sporadically along the coast of northern Norway, and in the White Sea (Frantzen & Henriksen 1992, Henriksen & Lund 1994, Nygård, Frantzen *et al.* 1995, Nygård, Jordhøy *et al.* 1995). In Varangerfjord, it is habitat-specific and is found close inshore in shallow water predominantly with kelp beds (Fox & Mitchell 1997, Bustnes & Systad unpubl. ms.).

In summer, some non-breeding birds remain along the coasts of Finnmark and Murman, and in the White Sea (Frantzen & Henriksen 1992, Nygård, Frantzen *et al.* 1995).

Movements

Birds from the Taymyr Peninsula probably migrate along the coast of the Kara

Sea to the mouth of the White Sea. Parts of the population then moves on south to the Baltic, while the majority ends up on the coasts of Kola and eastern Finnmark (Nygård, Frantzen *et al.* 1995). The birds arrive in Varangerfjord in October and leave in the first half of May (Henriksen & Lund 1994, Fox & Mitchell 1997a).

Population status and historical trends

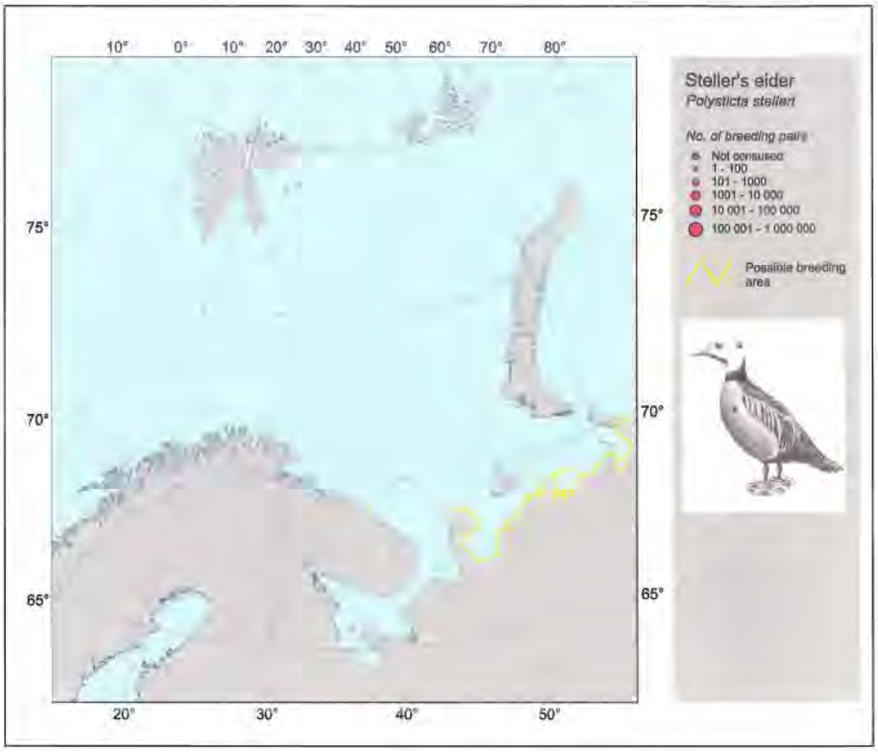
The numbers in Varangerfjord during winter and spring vary among years, and between 4000 and 13 000 individuals have been counted since 1980 (Frantzen & Henriksen 1992, Fox & Mitchell 1997a). Nygård, Jordhøy *et al.* (1995) counted 22 000 individuals along the Murman coast and in Varangerfjord in March 1994, and assumed that the winter population in the region was between 25 000 and 40 000 birds.

There have been no recent marked changes in the number of wintering Steller's eiders in Varangerfjord, but the trends for the Barents Sea Region as a whole are unknown. There are, however, some indications that the wintering population has increased off the eastern Murman coast, from Dalnye Zelentzy to Vostochnaya Lizta, during the 1970s and 1980s. The first observation in this area was made in 1967 (Kokhanov 1979). The population wintering in the Baltic Sea has increased considerably during the last 10-15 years (Nygård, Frantzen *et al.* 1995).

Feeding ecology

In January-February, Steller's eiders in the Pechenga region fed mainly on *Margarites* sp., *Onoba* sp. and other molluscs, as well as amphipods and isopods (Siivonen 1941). Stomachs of five males from the mouth of River Sosnovka (Terski coast of the eastern Kola Peninsula) contained *Hydrobia ulvae*, *Littorina* sp. *Arenicola marina* and *Gammarus locusta* (Kokhanov 1979). The food of four Steller's eiders drowned in gill nests in Varangerfjord consisted of invertebrates, mainly small gastropods and crustaceans (Mitchell *et al.* 1996).

Data from 29 birds collected in Varangerfjord between 1996 and 1998 showed a predominance of small gastropods such as *Margarites helinicus* and *Lacuna vincta*, in addition to *Mytilus edulis* and a large proportion of crustaceans, such as *Gammarus oceanicus*, *Ampithoe rubricata*, *Idotea emarginata* and *I. granulosa* (Bustnes *et al.* 2000).



Threats

The species is vulnerable to oil spills when in the marine environment, especially since it is very gregarious. Small numbers of Steller's eiders have been killed on several occasions by oil spills in Varangerfjord (Aronsen 1973, Barrett 1979b). They are also vulnerable to drowning in fishing gear, especially that of the Lumpsucker *Cyclopterus lumpus* fisheries during spring (Frantzen & Henriksen 1992), but the numbers of birds killed are unknown. The exploitation of the natural resources on the tundra can cause problems for breeding birds (Anon. 1995a). Illegal hunting during winter has possibly increased on the eastern Murman coast in recent years.

Special studies

A study of migration times and local movements of wintering Steller's eider has been carried out in Varangerfjord (Henriksen & Lund 1994). In addition, several counts of wintering birds have been carried out recently (see Frantzen & Henriksen 1992). Wintering and summering birds have been surveyed in several areas of Kandalaksha State Nature Reserve (A. Koryakin, pers. obs.). A recent paper on the origin, distribution and size of the Steller's eider population wintering in Europe has been published by Nygård, Frantzen *et al.* (1995). A diet study was carried out on the eastern Kola Peninsula (Kokhanov 1979). Fox & Mitchell (1997a, b) studied flocking behaviour and habitat use in Varangerfjord in spring. An ongoing study on winter biology is being conducted in Varangefjord (Bustnes *et al.* 2000, Bustnes & Systad unpubl. ms.).

Recommendation

Because of the low number of this species world-wide, we recommend more ecological studies that focus on the breeding biology and wintering constraints to understand what factors are bottlenecks for the population. For the birds in the Barents Sea Region, the breeding and moulting areas are unknown, and it will be of great importance to locate such areas, e.g. through the use of satellite transmitters. It will also be important to get good data on adult and juvenile survival. Studies of the possible influence of human activities on Steller's eider, such as hunting, fishing activities and oil spills are also recommended. Protection of special habitats, both on the breeding grounds and during moult and winter will be required (see also Nygård, Frantzen *et al.* 1995, Fox *et al.* 1997, Pihl 1997). For more details see Pihl (1997).

Jan Ove Bustnes, Vitali V. Bianki & Alexander S. Koryakin

Long-tailed duck *Clangula hyemalis*

No: Havelle Ru: Moryanka

Population size: ?
Population trend: Reasonably stable?

General description

The long-tailed duck *Clangula hyemalis* has a circumpolar distribution and breeds throughout northern Canada, Alaska, Siberia, the Kola Peninsula, Svalbard, Greenland, Iceland and Fennoscandia.

The size of the world population is uncertain, but has been estimated to be about 8 million individuals (Rose & Scott 1997). Recent surveys have estimated that 4.25 million winter in the Baltic Sea alone (Pihl 1995).

The long-tailed duck is monotypic and usually breeds near lakes. The clutch size is 6-9 (5-11) eggs and broods may amalgamate (Alison 1975). In winter, the long-tailed duck stays in marine habitats. It shows great variation in habitat use and dives to various depths (e.g. Stott & Olson 1973, Palmer 1976).

Breeding distribution and habitat preferences in the Barents Sea Region

The long-tailed duck breeds commonly in most of northern Norway (Båtvik 1994a). Breeding pairs are found on the Seven Islands (Y.V. Krasnov, pers. comm.) and the White Sea islands (Bianki *et al.* 1990). It breeds in small numbers on Novaya Zemlya (e.g. Strøm *et al.* 1994), Kolguev Island and Vaygach Island, but is a more common breeding bird on the tundra in the Nenetski district (Cramp & Simmons 1977). A small breeding population is also found in Svalbard (Fjeld & Bakken 1993, Isaksen & Bakken 1995a), including Bjørnøya (Bakken & Mehlum 1988).

In northern Norway, the long-tailed duck breeds commonly close to lakes in inland and alpine areas (Haftorn 1971, Båtvik 1994a). However, in Finnmark and Svalbard, it often breeds near the sea (Løvenskiold 1964, Båtvik 1994a, Isaksen & Bakken 1995a). In Svalbard, the young may be taken to the sea immediately after hatching (Løvenskiold 1964, Isaksen & Bakken 1995a).

In western Russia, long-tailed ducks breed on the tundra (Cramp & Simmons 1977). The nesting densities on the Bol'shezemel'skaya tundra reach 6.3 individuals per km^2 and on the Yugorski Peninsula 10.1 individuals per km^2 (Mineev 1987, 1994).

Long-tailed ducks winter in large numbers along the Norwegian and Murman coasts (Lund 1962, Nygård *et al.* 1988, Nygård, Jordhøy *et al.* 1995). Some birds may also winter in open water as far north as Novaya Zemlya (Dementjev & Gladkov 1952). Reports from fur trap-

Population sizes and trends of the long-tailed duck *Clangula hyemalis* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	?	-	(-1)	1980-93	(0)	-	1, 2, 3
MC	?	-	(0)	-	(0)	-	
WS	?	-	(0)	-	0	1960-84	4
ND	?	-	(0)	-	(0)	-	
NZ	?	-	(0)	-	(0)	-	
FJL	?	-	(0)	-	(0)	-	
SV	?	-	(0)	-	(0)	-	
All	?	-	(0)	-	(0)	-	

1. Nygård 1994, 2. Båtvik 1994a, 3. Anker-Nilssen *et al.* 1996, 4. Bianki *et al.* 1990

pers and other occasional observations have shown that long-tailed ducks are even present on Svalbard during the dark period (Løvenskiold 1964). Recent observations in February 1997 and 1998 indicate that more than 1500 birds winter in open waters off the west coast of Svalbard (G. Bangjord, pers. comm.).

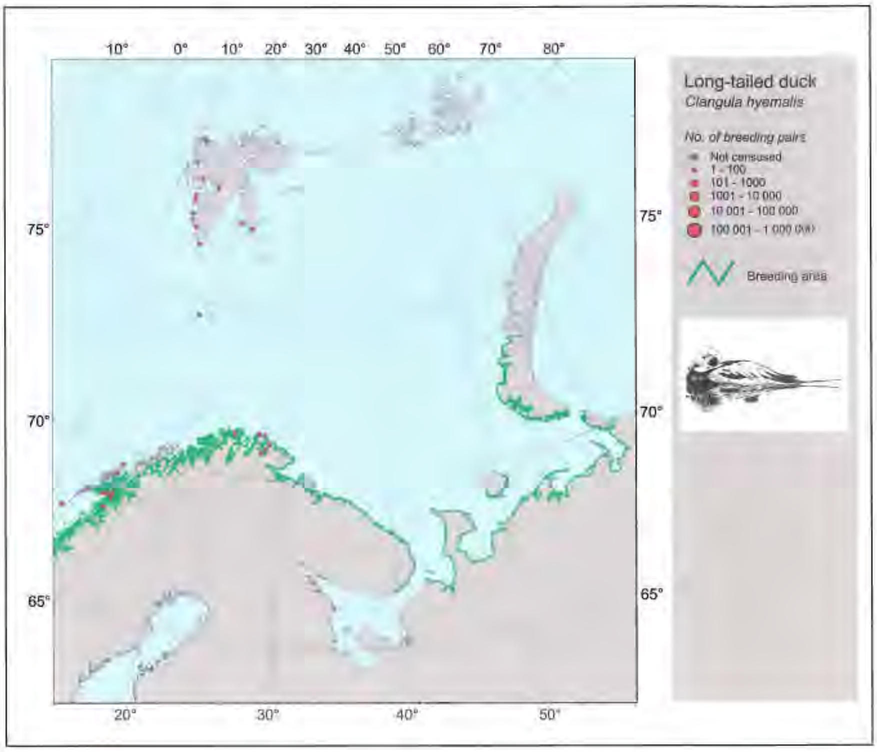
Movements

Males leave the nesting areas shortly after incubation begins and move to the moulting areas. In the western Palaearctic, these seem to be close to the breeding areas, either on lakes or the sea (Cramp & Simmons 1977). In Svalbard, many males moult in the Sørkapp area (Løvenskiold 1964).

Most birds that breed in Scandinavia probably winter along the Norwegian coast, predominantly north of the Arctic Circle (Lund 1962, Alerstam 1984). Two birds ringed in Norrbotten, Sweden, have been recovered in northern Norway (Andøya and Balsfjord). Birds breeding in Russia winter in the Baltic, but a few ring recoveries have shown that some birds migrate along the Kola Peninsula and winter in northern Norway (Alerstam 1984), and large numbers usually pass Nordkapp (Mathiason 1970, Laursen 1989). One bird ringed on Sommarøy in late December 1984 was shot in the Ust'sylemski area, Komi, in late May 1985 (H. Ludvigsen, pers. comm.). It appears that wintering birds mostly return to the same place each winter; on Sommarøy, 8 of 68 ringed birds have been caught in the local harbour in more than one year. However, a female ringed on Sommarøy in November 1986 was found dead on eastern Iceland in March 1992 (H. Ludvigsen, pers. comm.). Birds from the tundra in western Russia pass Mezen, Dvina and Onezhski Bay in the White Sea. Kandalaksha Bay (WS) is on the autumn flyway of birds migrating from the Kola Peninsula to the Gulf of Bothnia (Bianki *et al.* 1990).

Population status and historical trends

The Norwegian breeding population has been estimated to be roughly 5000-10 000 pairs, but the population seems to be decreasing (Båtvik 1994a, Nygård 1994). Breeding records show that the density is high in Finnmark (Båtvik 1994a). The winter population along the coast of northern Norway has been estimated to be 50 000 individuals (Nygård *et al.* 1988) and seems to be stable



(Nygård 1994). Anker-Nilssen *et al.* (1996) found a significant negative trend for the population wintering in Salten (NC) between 1988 and 1993.

There was no significant change in the number of long-tailed ducks in Onezhski Bay (WS) between the early 1960s and 1981-1984 (Bianki *et al.* 1990).

On the Murman and Finnmark coasts, 6000 long-tailed ducks were recorded during an aerial survey from Svyatoy Nos to Vardø in March 1994 (Nygård, Jordhøy *et al.* 1995).

No numbers are available for Novaya Zemlya and Svalbard.

Feeding ecology

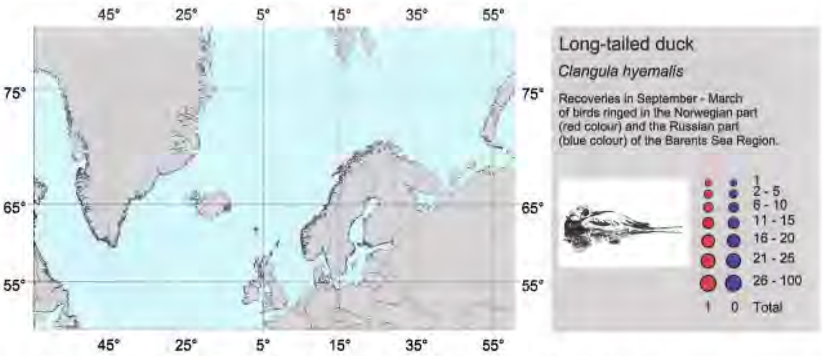
The long-tailed duck is a small sea duck which feeds on a diet with a higher energy content (crustaceans and sometimes fish) than larger sea ducks (Cottam 1939, Johnsgaard 1975, Johnson 1984, Sanger & Jones 1984, Goudie & Ankney 1986, Goudie & Ryan 1991). Some studies have found a predominance of molluscs, such as blue mussels *Mytilus edulis* (Madsen 1954, Nilsson 1972, Stott & Olson 1973), especially in brackish waters (Cramp & Simmons 1977). In summer, on fresh water, it mainly feeds on insects; stonefly Pteronarcydae and caddisfly Trichoptera larvae, beetles and fish (Dementjev & Gladkov 1952, cited by Cramp & Simmons 1977), or chironomid larvae (Bengtson 1971a). In northern Scandinavia, the fairy shrimp *Polyartemia forcipata* is very important food for long-tailed duck broods, and determines much of their distribution (Pehrson 1974).

There are few studies of diet in the Barents Sea Region, but the stomach of one bird from Pechenga contained 1709 molluscs (Siivonen 1941). Birds wintering in eastern Murman ate mainly amphipods (Dementjev & Gladkov 1952, cited by Cramp & Simmons 1977). Bustnes & Systad (unpublished data) found that long-tailed ducks in Varangerfjord fed on gastropods and blue mussels in autumn, and on capelin *Mallotus villosus* (roe and/or dead fish) in spring. While staging in the White Sea, long-tailed ducks feed chiefly on molluscs and crustaceans (Bianki *et al.* 1990).

Threats

Gill nets are a serious threat to wintering long-tailed ducks (Stempniewicz 1994). Birds drown along the Norwegian coast, especially during the spring fisheries for cod *Gadus morhua* and lumpsuckers *Cyclopterus lumpus*, but long-tailed ducks are probably not as vulnerable as eiders. Of 68 birds ringed on Sommarøy in winter, only one has been reported drowned in a gill net (H. Ludvigsen, pers. comm.).

Oil is always a potential threat for long-tailed ducks (Aronsen 1973, Barrett 1979b). Oil drilling may become a problem, especially if water bodies on the tundra and shallow sea areas become polluted.



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Special studies

The wintering ecology and feeding behaviour of the long-tailed duck has been studied in the Tromsø area. It was found to feed at a much higher rate and responded more to the low daylight than the eider and king eider, and even disappeared from the study area in the darkest period (Systad *et al.* 2000). The autumn migration was studied in Onezhski Bay on the White Sea (Bianki, Kokhanov *et al.* 1975, Bianki *et al.* 1990). The biology of long-tailed ducks breeding on the tundra in western Russia was studied by Mineev (1994).

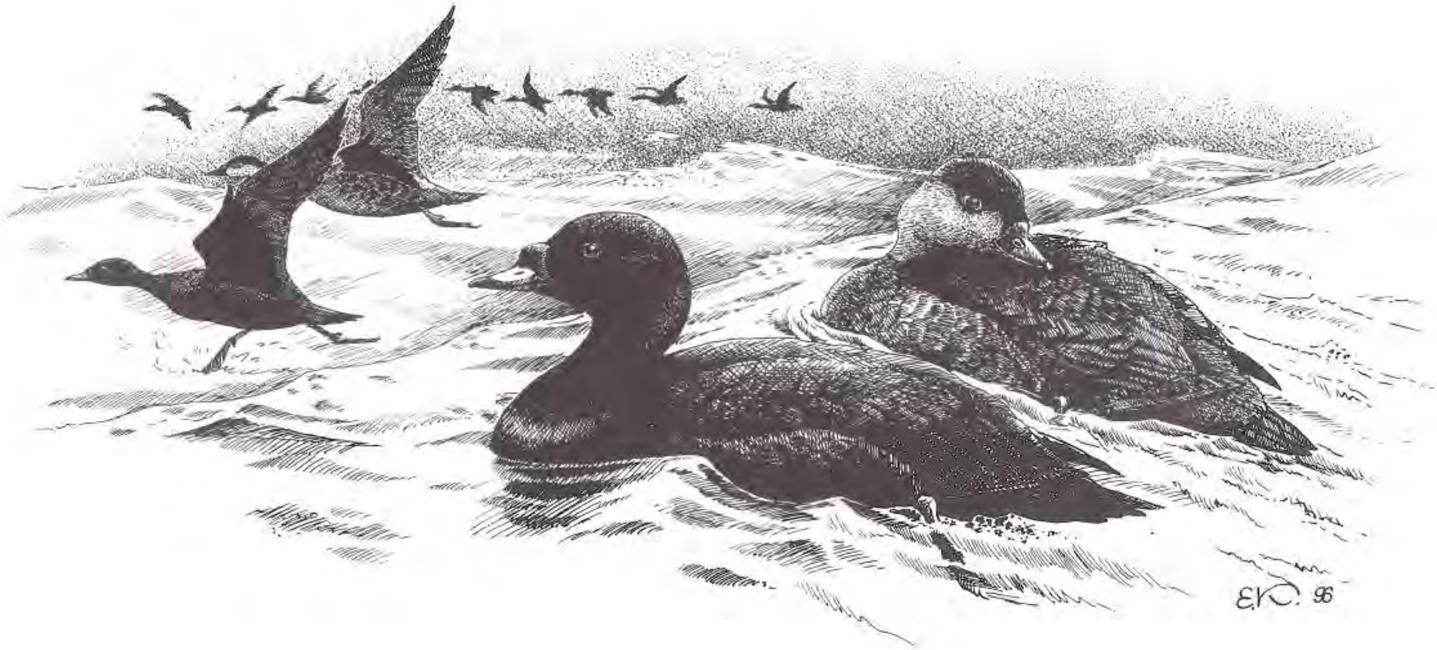
Recommendations

Compared to most other marine birds, the long-tailed duck is a poorly known species in the Barents Sea Region. More effort should be put into mapping important breeding and moulting areas. It would also be valuable to know more about its breeding ecology throughout the region. It is desirable to establish monitoring programmes of breeding populations and systematic observations along migration routes. Reducing gill net by-catches and controlling oil spills and other disturbing activities would also benefit this species.

Jan Ove Bustnes & Vitali V. Bianki

Black scoter *Melanitta nigra*

No: Svartand Ru: Sin'ga



Population size: ?
Population trend: Small decrease

General description

In North America, the black scoter *Melanitta nigra* breeds commonly only in western Alaska. In Eurasia, it breeds in northern Fennoscandia, on the Kola Peninsula and east to the Bering Strait. It also breeds in Iceland, but probably not in Greenland.

The size of the world population is not known. The wintering population in north-west Europe is estimated to be 1.6 million individuals (Rose & Scott 1997).

The black scoter breeds close to freshwater ponds, lakes and rivers in tundra and wooded country, both inland and in coastal areas. The clutch size is 6-8 (5-11) eggs.

The nominate sub-species *M. n. nigra* occurs in Fennoscandia and eastwards to the River Olenek in northern Asia, and *M. n. americana* breeds in northern Asia east of the River Jana and in western Alaska (Palmer 1976). In winter, the black scoter stays mostly in shallow, inshore marine waters (Stott & Olson 1973).

Population sizes and trends of the black scoter *Melanitta nigra* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	?	-	F	1980-93	-1	1900-74	1, 2, 3
MC	?	-	(0)	-	(0)	-	
WS	?	-	(0)	-	-1	1970-75	4
ND	?	-	(0)	-	(0)	-	
NZ	?	-	(0)	-	(0)	-	
FJL	0						
SV	?	-	(F)*	1981-96	(F)*	1932-81	5
All	?	-	(F)	-	(-1)	-	

1. Haapanen & Nilsson 1979, 2. Nygård 1994, 3. Strann 1996, 4. V. Bianki, unpubl. data, 5. Strann 1998
* Bjørnøya

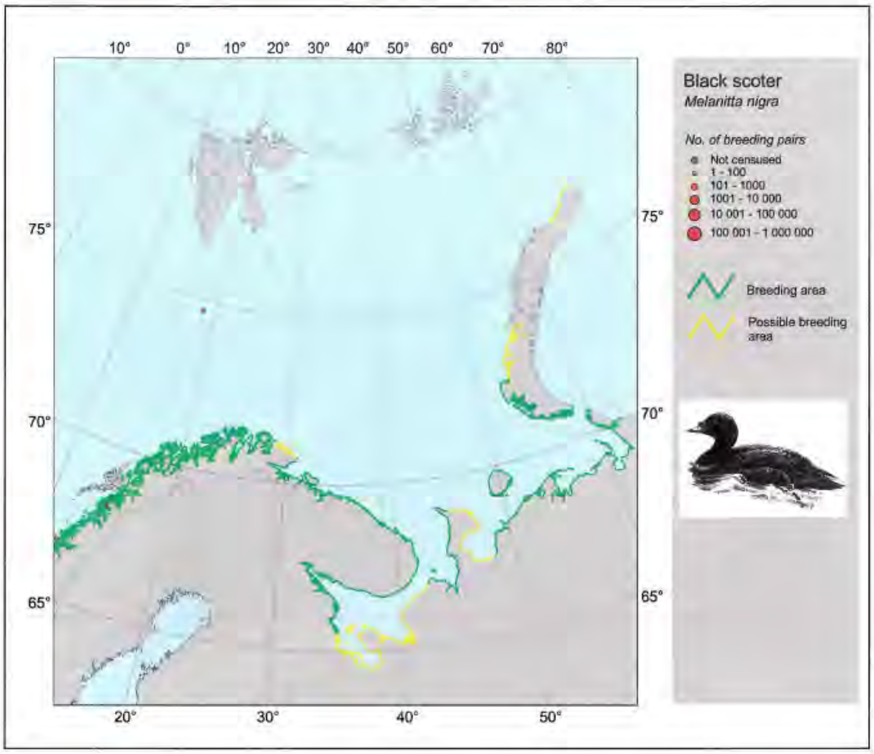
Breeding distribution and habitat preferences in the Barents Sea Region

The distribution of breeding black scoters in the Barents Sea Region is poorly known. The species breeds relatively commonly in suitable habitats in northern Norway, but seems less coastal than the velvet scoter (Båtvik 1994b). It breeds sporadically in Svalbard (Løvenskiold 1964), but seems to be more regular on Bjørnøya (two pairs in 1996; Strann 1998). It is absent from the northern island of Novaya Zemlya and from Franz Josef Land. In northwestern Russia, it nests commonly, but only sporadically in the White Sea (V. Bianki, unpubl. data).

It winters in small numbers only in northern Norway (Nygård *et al.* 1988).

Movements

The black scoters from the eastern part of the Barents Sea probably migrate westwards along the coasts of the Bol'shezemel'skaya and Malozemel'skaya tundras, across the Kanin Peninsula, Mezenski Bay, the White Sea basin (Dvinski Bay and Onezhski Bay) and overland to the Baltic and the North Sea. Birds from most of Fennoscandia are also assumed to winter in this area. Those breeding in North Norway have been



thought to winter along the coast, but there is little evidence for this (Cramp & Simmons 1977).

In July, after the females have started incubating, many males migrate to moult in Danish waters, but the Pechora Sea is also an important moulting area from mid-July (Palmer 1976). When migrating at low altitudes, scoters often stop on the southwest shores of Dvinski Bay and Onezhski Bay (Bianki & Krasnov 1976, Kokhanov 1983). In late September-October, young birds and adult females migrate along the same flyway.

The spring migration takes place in May. Birds fly over the Gulf of Riga, the Gulf of Finland and the White Sea to the tundra in northern Russia (Bergmann & Donner 1964). In 1958, a more intensive migration took place in the northwestern part of Kandalaksha Bay compared with its south-eastern part (Flerov & Skalinov 1960, Kurochkin & Skokova 1960). Only a few birds migrate in the eastern Murman area (T.D. Paneva, pers. comm.)

Population status and historical trends

The size of the breeding population in the Barents Sea Region is unknown. The Norwegian breeding population has been estimated to be 1000-5000 pairs, most of which breed in southern Norway (Båtvik 1994b). The breeding population of black scoters has decreased considerably in northern Fennoscandia during this century (Haapanen & Nilsson 1979). However, Strann (1996) found that the number of nesting pairs (10) was stable at Slettnes, Finnmark between 1989 and 1996. Nygård *et al.* (1988) estimated that about 500 birds wintered in the Norwegian part of the Barents Sea Region, but the number is probably higher. There is no clear trend in the Norwegian wintering population (Nygård 1994). Aerial surveys in March 1994 revealed 26 black scoters in the Varangerfjord area, but none on the Murman coast (Nygård, Jordhøy *et al.* 1995). In the northern part of Kandalaksha Bay, the number of migrating black scoters has declined several-fold during the last 20 years, especially in July to October (V. Bianki, unpubl. data).

Feeding ecology

In winter, the black scoter feeds in shallow (<20 m) marine waters (<2 km from the shore) (Stott & Olson 1973, Cramp & Simmons 1977). Its diet consists of various benthic organisms, mainly molluscs, and the blue mussel *Mytilus edulis* often predominates. It seems to take crustaceans and polychaetes to a lesser extent than the velvet scoter (Cottam 1939, Madsen 1954). In Svalbard, le Roi (1911) found mainly the gastropod *Margarites helicinus* in the diet.

In fresh water, the diet has been found to consist of insects, often caddisfly Trichoptera and dragonfly larvae Odonata the mussel *Anodonta* sp., pond snails *Lymnaea* sp., annelids, small fish and seeds (Madsen 1954, Bengtson 1971a). Ducklings feed mainly on insects (Bengtson 1971a).

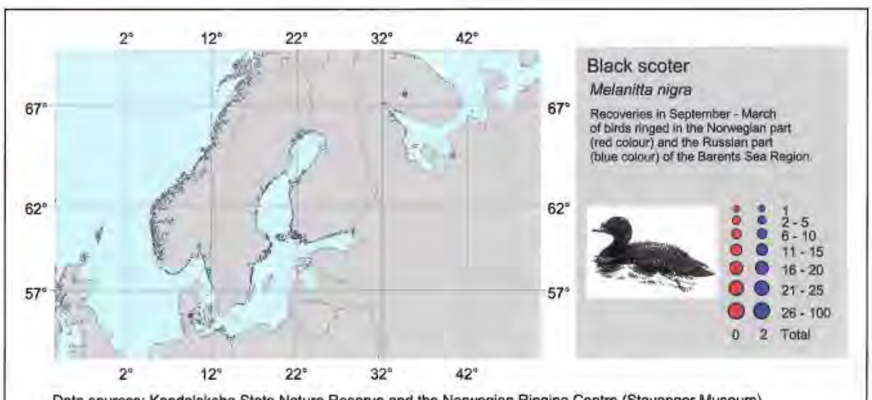
In the White Sea, black scoters feed mostly on *Mytilus edulis* in summer (Bianki *et al.* 1995).

Threats

Black scoters often drown in fishing gear (Stempniewicz 1994), but to what extent this happens on the Norwegian coast is unknown. Oil spills are a potential threat to black scoters, as they are for other sea ducks. Exploitation of natural resources, including oil, on the tundra in western Russia is a great potential problem for breeding and moulting birds (Anon. 1995a). Hunting in spring in northern Norway and possibly northern Finland may be a serious threat locally (Bustnes & Nilsen 1995).

Special studies

Between 1958 and 1984, the feeding habits, moulting migration and winter biology of the species were studied in the White Sea (Bianki, Kokhanov *et al.* 1975, Bianki & Krasnov 1976, Kokhanov 1983, Bianki *et al.* 1995).



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Diet of the black scoter *Melanitta nigra* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
WS	Kandalaksha Bay	?	*Mytilus edulis*	Adults	1
ND	Pechora	1952	Caddisfly, dragonfly and chironomid larvae	Adults	2
SV	?	1911	*Margarites helicina*	Adults	3

1. Bianki *et al.* 1995, 2. Cramp & Simmons 1977, 3. le Roi 1911

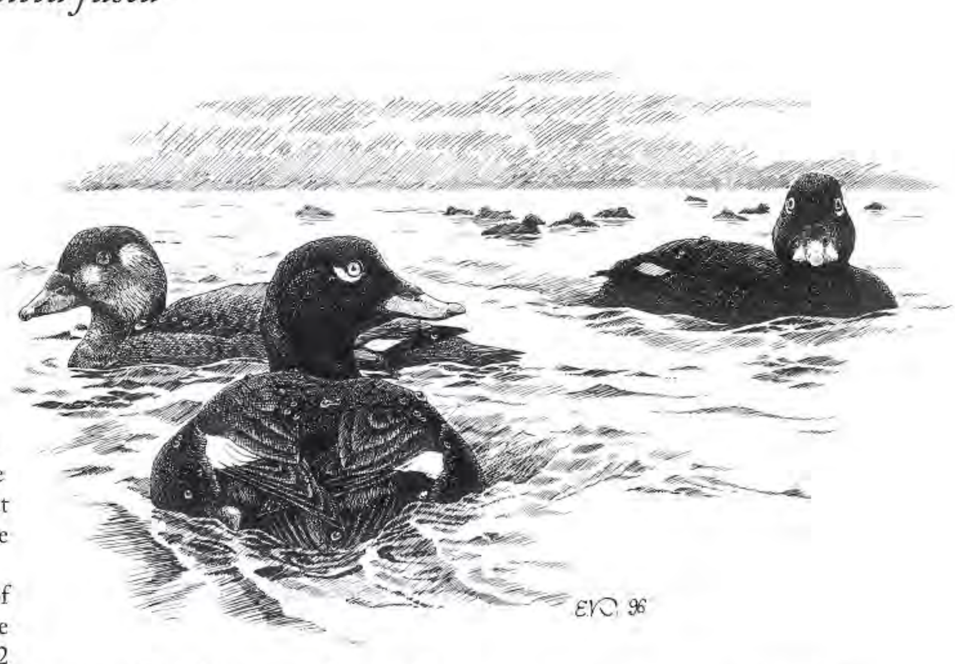
Recommendations

An unexplained mass mortality of scoters in summer has been observed recently in Alaska (Goudie *et al.* 1994). It is not known whether this has taken place in the Barents Sea Region. It is therefore important to get a better estimate of the population in the Barents Sea Region, to map breeding and moulting areas, especially in the Pechora Sea, and to continue monitoring the migration of black scoters in the White Sea. Programmes to monitor the breeding populations in suitable sites in both countries would be of great value. It will also be of great value to protect some of the known moulting and breeding areas from various disturbing activities (e.g. oil exploitation).

Vitali V. Bianki & Jan Ove Bustnes

Velvet scoter *Melanitta fusca*

No: Sjøorre Ru: Turpan



Population size: ?
Population trend: Small decrease?

General description

The velvet scoter *Melanitta fusca* breeds in north-western Canada, Alaska, most of Siberia and north-western Russia, but seems to avoid the northernmost areas. It is absent in the Bering Strait, Iceland and Greenland, but Fennoscandia and the Kola Peninsula are important breeding areas.

The size of the world population of velvet scoters is very uncertain, but Rose & Scott (1997) assumed it to be around 2 million birds. This estimate is probably too low since the wintering population in western Europe alone has been estimated to be 1 million (Durinck *et al.* 1994).

The velvet scoter nests close to small lakes, mainly inland, but may also breed in brackish water (Koskimies 1954). The clutch size is 7-9 (5-12), and brood amalgamation commonly occurs (Kehoe 1989). In winter, the velvet scoter stays mostly in marine habitats close to the shore where there is a sandy bottom, but may also be found on lakes (Stott & Olson 1973, Vermeer & Bourne 1984).

The nominate sub-species *M. f. fusca* breeds in Fennoscandia and east to the River Yenisei in northern Asia. *M. f. stejnegeri* breeds in Asia east of the Yenisei, and *M. f. deglandi* breeds in North America (Palmer 1976).

Breeding distribution and habitat preferences in the Barents Sea Region

The velvet scoter breeds in suitable habitats in northern Norway, both inland and along the coast (Haftorn 1971, Haapanen & Nilsson 1979, Båtvik 1994c). On the Kola Peninsula and in the Nenetski district, it commonly breeds beside ponds and lakes on the tundra and taiga. Velvet scoters also breed on the White Sea islands.

In northern Norway, north of the Arctic Circle, it is relatively common in winter (Nygård *et al.* 1988).

Movements

The velvet scoter is at least partly migratory and birds breeding in Norway have been found in Scotland. However, details of the migration routes are not known (Båtvik 1994c). The birds wintering along the northern coast of Norway are probably a mixture of those breeding in Norway and north-western Russia (Cramp & Simmons 1977, Båtvik 1994c).

Birds breeding in and around the White Sea and on the east European tundra migrate south-west to the Baltic Sea in autumn (Bauer & Glutz 1969, Durinck *et al.* 1994). Spring migration routes appear to be the reverse of the autumn ones (Bauer & Glutz 1969). The White Sea, the Kolguev area and the Pechora Sea are important moulting areas for adult males and non-breeders (Cramp & Simmons 1977, Mineev 1981, 1987). In the Vaygach area, Mineev (1987) found that males migrate westwards in July, as soon as the females start incubating.

Population status and historical trends

The size of the breeding population in the Barents Sea Region is unknown. An estimated 1000-1500 pairs breed in the whole of Norway (Båtvik 1994c, Nygård 1994), and according Båtvik (1994c), about half may be found in northern Norway.

During this century, the population of velvet scoters has declined considerably in northern Fennoscandia (Haapanen & Nilsson 1979, Båtvik 1994c).

About 2000 birds winter in Balsfjord (K.-B. Strann, pers. comm). The total population wintering in northern Norway is estimated to be 12 000 (Nygård *et al.* 1988), and the Norwegian wintering population seems to be stable (Nygård 1994). Anker-Nilssen *et al.* (1996), however, found that the wintering population in Salten decreased significantly between 1988 and 1993, but other parts of the

Population sizes and trends of the velvet scoter *Melanitta fusca* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	?	-	F	1980-93	-1	1900-74	1, 2, 3
MC	?	-	(F)	-	?	-	
WS	?	-	-1	-	-1	-	4
ND	?	-	(F)	-	(0)	-	
NZ	0						
FJL	0						
SV	0						
All	?	-	(F)	-	(-1)	-	

1. Haapanen & Nilsson 1979, 2. Nygård 1994, 3. Anker-Nilssen *et al.* 1996, 4. V. Bianki, unpubl. data

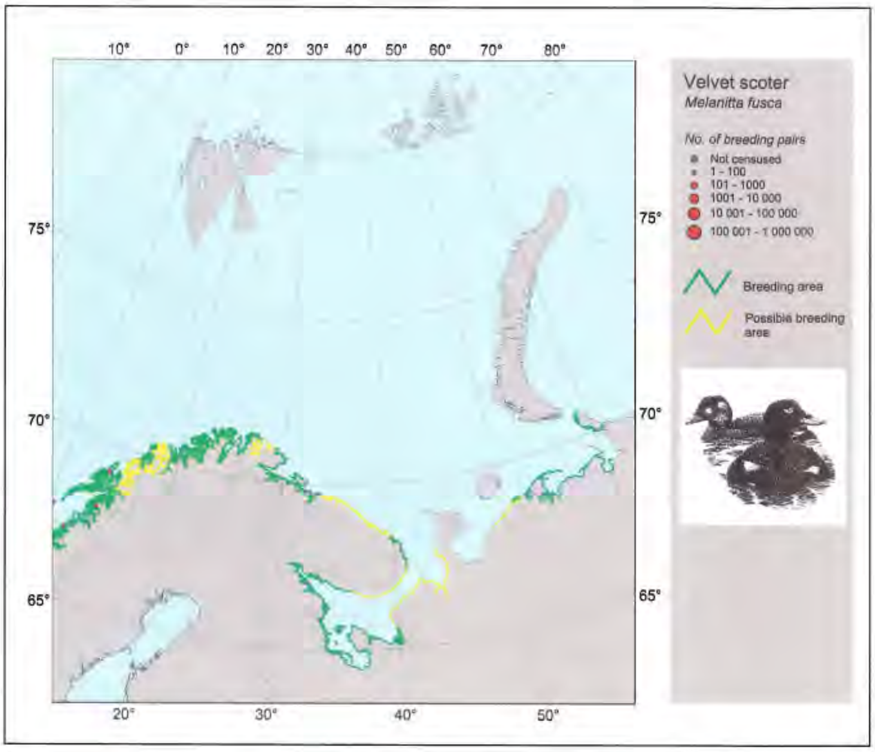
Norwegian coast did not show any significant trends. In March 1994, 94 velvet scoters were counted along the Varangerfjord and Murman coasts (Nygård, Jordhøy *et al.* 1995).

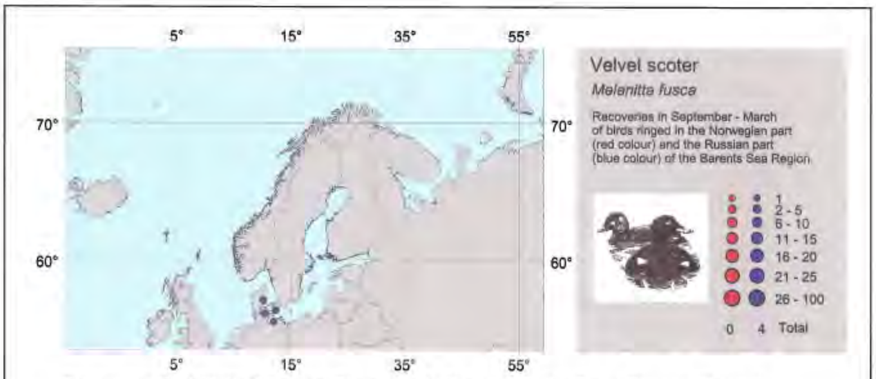
There has been a gradual decrease in the population of velvet scoters on the islands of the Kandalaksha State Nature Reserve, but small breeding numbers make it difficult to determine the general population trend. The changes are probably due to predators and other natural causes (V. Bianki, unpubl. data).

Feeding ecology

Outside the breeding season, the velvet scoter stays mainly in marine waters, often in areas with rocky and sandy bottoms (Stott & Olson 1973, Vermeer & Bourne 1984). It feeds on various benthic organisms. In brackish waters, it feeds mainly on various molluscs, mostly bivalves; often blue mussels *Mytilus edulis*. However, crustaceans, such as amphipods and crabs, and polychaetes are also important (Cottam 1939, Madsen 1954, Vermeer & Bourne 1984, Goudie & Ankney 1986). The diet in the breeding season consists of insects, often caddisfly Trichoptera larvae (Cottam 1939).

In the White Sea, the velvet scoter feeds chiefly on molluscs living on a soft bottom in the sub-littoral zone (Bianki, Karpovich *et al.* 1975, Bianki *et al.* 1995). On lakes, it eats insects and insect larvae (Bauer & Glutz 1969), especially caddisfly Trichoptera (Mineev 1987).





Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Threats

Oil is a potential threat, and oil drilling may become a problem for migrating and wintering birds in the Barents Sea Region. The exploitation of natural resources in north-western Russia may destroy breeding, moulting and staging grounds. Velvet scoters are also vulnerable to drowning in fishing gear (Stempniewicz 1994). Birds may drown as bycatches in spring on the Norwegian coast (J.O. Bustnes, pers. obs.). Velvet scoters have been shot in spring in northern Norway and perhaps also Finland, but the importance of this threat is unknown (Haapanen & Nilsson 1979, Bustnes & Nilsen 1995).

Special studies

Studies of the feeding ecology, breeding ecology and migration were carried out in the White Sea from 1958 to 1994 (Bianki, Karpovich *et al.* 1975, Bianki *et al.* 1995). The few pairs breeding among the Kandalaksha skerries are studied annually.

Diet of the velvet scoter *Melanitta fusca* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
WS	Kandalaksha Bay	1958-94	Molluscs	Adults	1
ND	Yugorski Peninsula	1987	Trichoptera	Adults/ chicks	2, 3

1. Bauer & Glutz 1969, 2. Bianki, Karpovich *et al.* 1975, 3. Mineev 1987

Recommendations

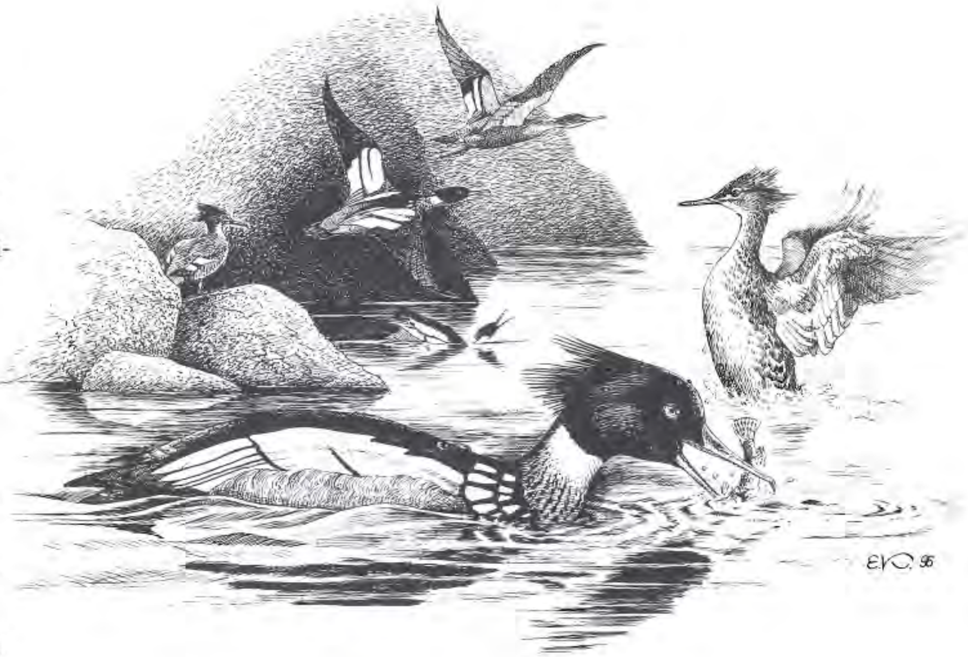
There is a great need for better estimates of the size of velvet scoter populations and for better mapping of moulting areas, such as in the Pechora Sea. A programme to monitor breeding populations would be of great value for understanding the population dynamics of the species. The annual breeding surveys in the White Sea should continue and new monitoring programmes should begin at other suitable places in Norway and western Russia. Important moulting and breeding areas should be mapped and protected.

Jan Ove Bustnes & Vitali V. Bianki

Red-breasted merganser *Mergus serrator*

No: Siland Ru: Dlinnonosy krokhal

Population size: ?
Population trend: Small decrease?



General description

The red-breasted merganser *Mergus serrator* has a circumpolar, holarctic distribution and breeds in Scandinavia, the Baltic countries, northern Russia through Siberia to the Pacific and the northern parts of North America. It also breeds in the southern part of Greenland, Iceland, Ireland and Scotland. Isolated breeding populations are known on islands in the Black Sea and on Lakes Sevan and Issyk-Kul. Wintering areas are the north-western and southern coasts of Europe, south-western and eastern Asia, and ice-free inland and coastal waters of North America.

The size of the world population is very uncertain, but Rose & Scott (1997) estimated a population of 150 000 birds in north-western Europe and Greenland, 50 000 on southern coasts of Europe. Recent surveys have found high wintering numbers in the Baltic Sea (65 000 individuals) (Pihl 1995).

The red-breasted merganser breeds close to inland lakes and the sea. The clutch size is 8-10 (6-14) eggs and brood amalgamation occurs (Bergman 1956). In winter, red-breasted mergansers stay mostly in shallow, inshore marine habitats (Palmer 1976).

Breeding distribution and habitat preferences in the Barents Sea Region

The red-breasted merganser is a common breeder in north Norway, both on the coast and inland. It often breeds on islands in freshwater and marine habitats (Frantzen 1994).

The species is common on the Kola Peninsula, on islands off the Murman coast and on the tundra east of the White Sea. It is also common on the Bol'shezemel'skaya tundra, but rare on the Yugorski Peninsula (Mineev 1987, 1994). A few red-breasted mergansers breed on the south island of Novaya Zemlya (Cramp & Simmons 1977).

In the White Sea, they nest both on treeless islands among tundra and meadow vegetation and on wooded islands. On the Bol'shezemel'skaya tundra, the red-breasted merganser nests under willow bushes on the shores (Mineev 1987).

Population sizes and trends of the red-breasted merganser *Mergus serrator* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	?	-	-1	-	-1	1980-93	1
MC	?	-	(0)	-	(0)	-	
WS	?	-	-2	1980-84	0	1950-80	2, 3
ND	?	-	(0)	-	(0)	-	
NZ	?	-	(0)	-	(0)	-	
FJL	0						
SV	0						
All	?	-	(-1)	-	(-1)	-	

1. Nygård 1994, 2. Bianki *et al.* 1995, 3. V. Bianki, unpubl. data

In north Norway, it winters commonly north of the Arctic Circle (Nygård *et al.* 1988), and a few birds also winter along the Murman coast (Nygård, Jordhøy *et al.* 1995).

Movements

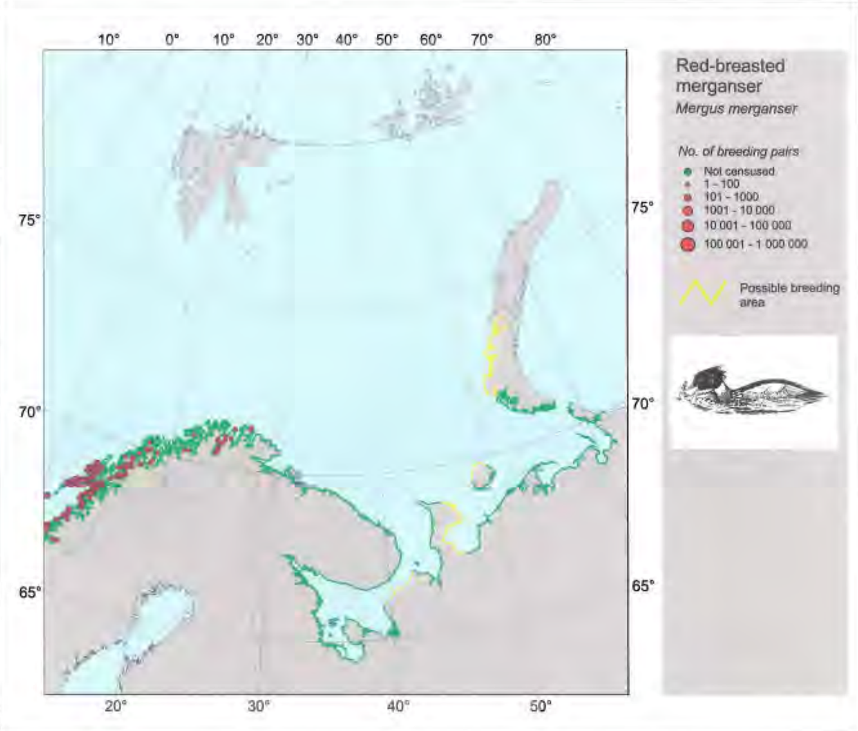
The red-breasted merganser is partly migratory (Cramp & Simmons 1977), and many of the birds wintering along the Norwegian coast probably breed in other parts of northwestern Europe, but also locally (Haftorn 1971, Frantzen 1994, Nygård 1994). In winter, large flocks are seen at the mouth of the River Tana, but their origin is not clear (Frantzen *et al.* 1991).

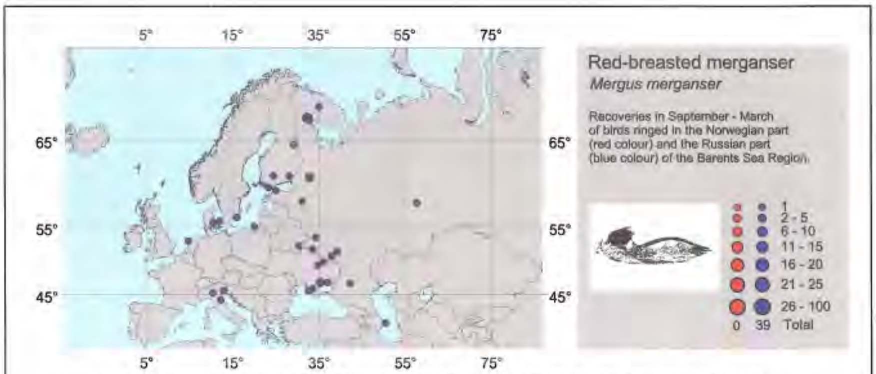
Birds from arctic Russia probably migrate west to the White Sea and from there move in two directions, southwards to the Black Sea and south-westwards to the Baltic and the North Sea where most of the population winters. Recoveries of birds ringed in the Russian part of the Barents Sea Region confirm this pattern. The autumn migration in the White Sea begins in September-October. The birds reach their breeding grounds in May (Cramp & Simmons 1977).

Population status and historical trends

The size of the breeding population in the Barents Sea Region is unknown. The total Norwegian population has been estimated to be between 10 000 and 30 000 pairs (Nygård 1994). About 8000 individuals have been estimated to winter in the Norwegian part of the Barents Sea Region (Nygård *et al.* 1988), and this population seems to have declined significantly between 1980 and 1993 (Nygård 1994). In March 1994, 79 birds were counted in Varangerfjord and on the Murman coast (Nygård, Jordhøy *et al.* 1995).

From the 1950s through the 1970s, about 200 pairs of red-breasted mergansers bred in the White Sea (Bianki *et al.* 1995). In the 1980s, the population was reduced to a half or one third (V. Bianki, unpubl. data). The cause probably lies somewhere on the flyway, or in the wintering areas.





Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Feeding ecology

In the non-breeding season, the red-breasted merganser prefers sheltered marine habitats. Its diet consists mainly of fish (25 species recorded), especially sticklebacks *Gasterosteus aculeatus* and various salmonids, in addition to some polychaetes, molluscs, crustaceans and insects (Lindroth 1955, Aass 1956, Mills 1962, Bengtson 1971a, Cramp & Simmons 1977, Feltham 1990).

Aass (1956) studied the summer and autumn diet of red-breasted mergansers on the River Tana in Finnmark and found a predominance of salmonids. In the White Sea, red-breasted mergansers feed mainly on benthic fish *Myozocephalus scorpius* and *Pholis gunnellus*, and more rarely on other fish and polychaetes (*Nereis* sp.) (Bianki *et al.* 1995). Ducklings mainly feed on sticklebacks (Bengtson 1971a).

Threats

Red-breasted mergansers may be caught in fishing nets (Stempniewicz 1994), but this is probably rare in the Barents Sea Region. Because of their marine habits, oil is a potential threat to local populations of red-breasted mergansers. The exploitation of natural resources on the tundra may become a problem for birds breeding in north-west Russia (Anon. 1995a).

Special studies

The incubation pattern and other aspects of red-breasted merganser biology have been studied in the Lapland Nature Reserve (Semenon-Tyan-Shansky & Gilyazov 1991). Food, nesting and seasonal distribution have been studied in the Kandalaksha State Nature Reserve (Nehls & Ardamatskaya 1989).

Recommendations

It is important to get estimates of the size and trends of the red-breasted merganser population in the Barents Sea Region. Better knowledge of breeding and moulting areas is also important. Monitoring of migration should also continue. Too little is known about the biology of red-breasted mergansers in the Barents Sea Region to be able to suggest management measures to protect the species.

Vitali V. Bianki & Jan Ove Bustnes

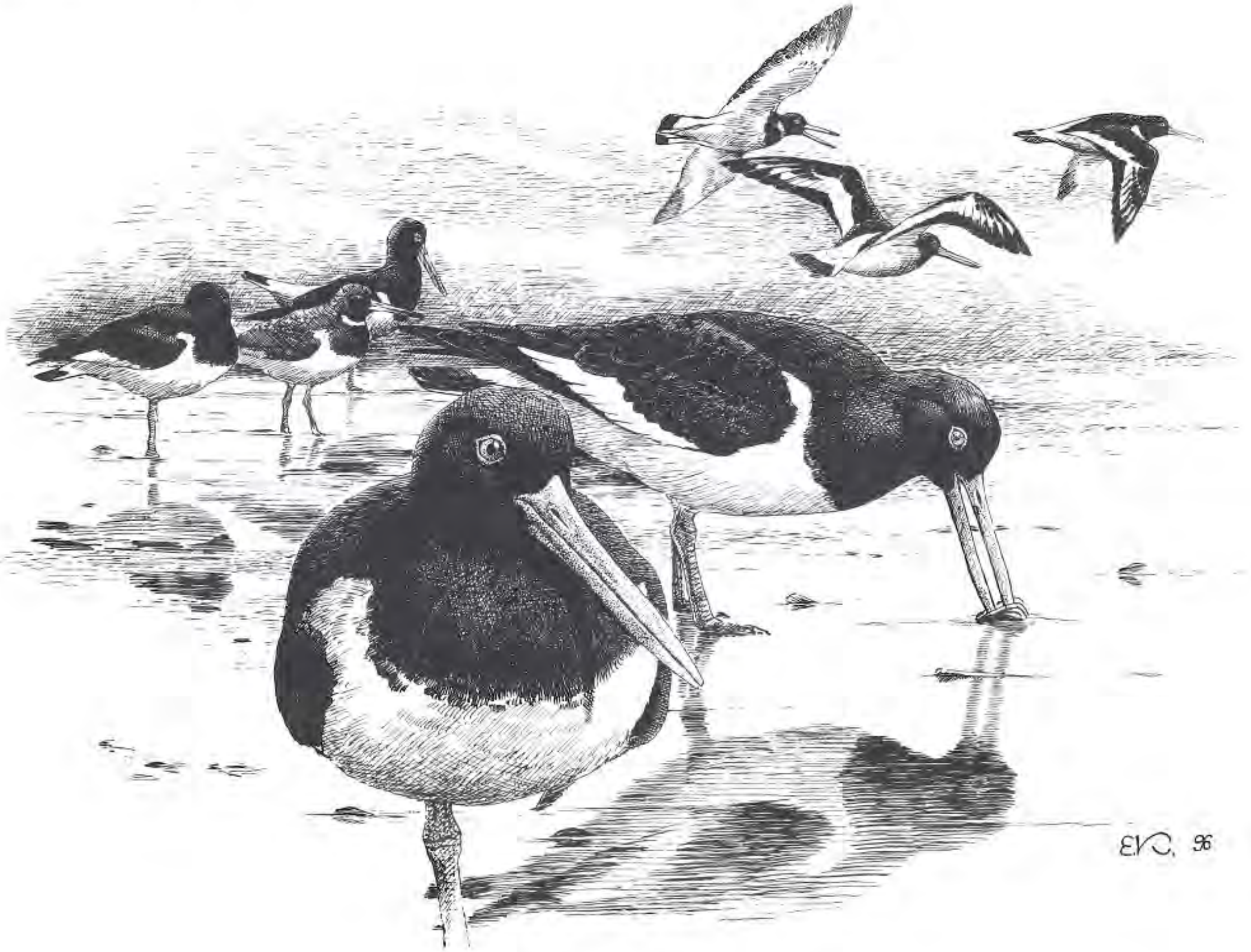
Diet of the red-breasted merganser *Mergus serrator* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Tana river	1956	Salmonids	Adults	1
WS	?	1972, 1984	*Myozocephalus scorpius* and *Pholis gunnellus*, *Neris* spp.	Adults	2, 3

1. Aass 1956, 2. Dementjev & Gladkov 1952, 3. Bianki *et al.* 1995

Eurasian oystercatcher *Haematopus ostralegus*

No: Tjeld Ru: Kulik-soroka



Population size: ?
Population trend: Reasonably stable

General description

Eurasian oystercatchers breed along the coasts of all continents except Antarctica and are divided into 18 sub-species. Only one is found in the Barents Sea Region, the nominate *H. o. ostralegus* (Cramp & Simmons 1983).

Breeding distribution and habitat preferences in the Barents Sea Region

The Eurasian oystercatcher breeds regularly along the coast of north Norway, the Kola Peninsula, the White Sea and on islands in the White Sea. The highest densities are along the Norwegian coast. It has not been found breeding in Svalbard, but a few observations have been made there during the last twenty years. In north Norway, a few pairs also breed along large rivers far inland.

Movements

Eurasian oystercatchers arrive in north Norway in late February and March, reaching the Kola Peninsula and the White Sea somewhat later. They leave their breeding grounds between late July and the beginning of September. A few spend the winter in north Norway. Some ring recoveries show that most of the birds breeding here winter along the coasts of the North Sea, many of them in Great Britain and the Wadden Sea. Some migrate as far south as the Bay of Biscay and even north-west Africa (Lambeck *et al.* in press).

In summer, large flocks of immature birds are found on extensive mud flats along the Norwegian coast and in Kandalaksha Bay and Onezhski Bay.

Population status and historical trends

The population seems to be stable in most of its breeding area, though some local variation occurs.

Feeding ecology

The Eurasian oystercatcher finds most of its food in the littoral zone, molluscs, gammarids and polychaetes forming its main diet. In north Norway, however, many birds largely feed on earthworms *Lumbricus terrestris* on farmland.

Threats

Eurasian oystercatchers are preyed on by ravens *Corvus corax*, gulls *Laridae* and red foxes *Vulpes vulpes* during the breeding season. In some coastal areas, North American mink *Mustela vison* can also do considerable damage, mainly to eggs and chicks.

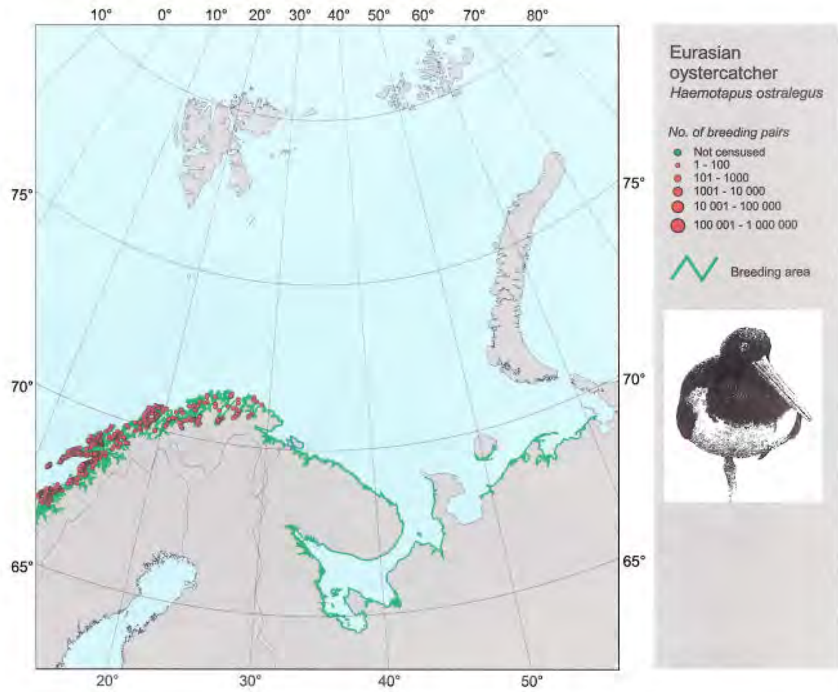
Special studies

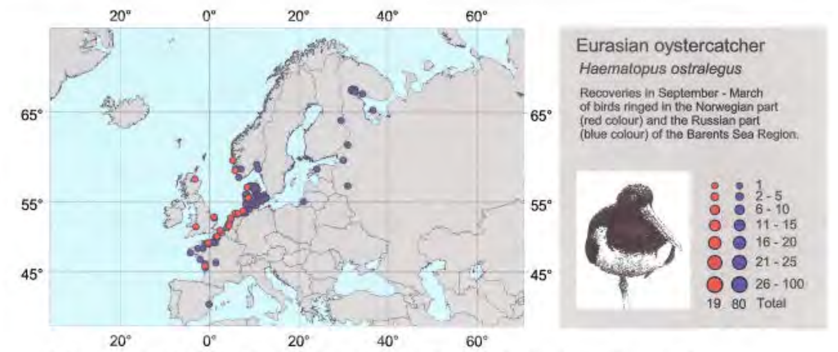
A number of papers have been published on the ecology of the species in Kandalaksha Bay (Bianki 1967, Bianki & Nehls 1985, Lebedeva & Bianki 1992, Lambeck *et al.* in press).

Recommendations

The Eurasian oystercatcher should be included in a monitoring programme for breeding birds. This could be done by counting the number of breeding pairs along given stretches of shoreline, for instance, Balsfjord and Varangerfjord in north Norway and two similar areas on the Kola Peninsula and White Sea coasts.

Karl-Birger Strann &
Ivetta P. Tatarinkova

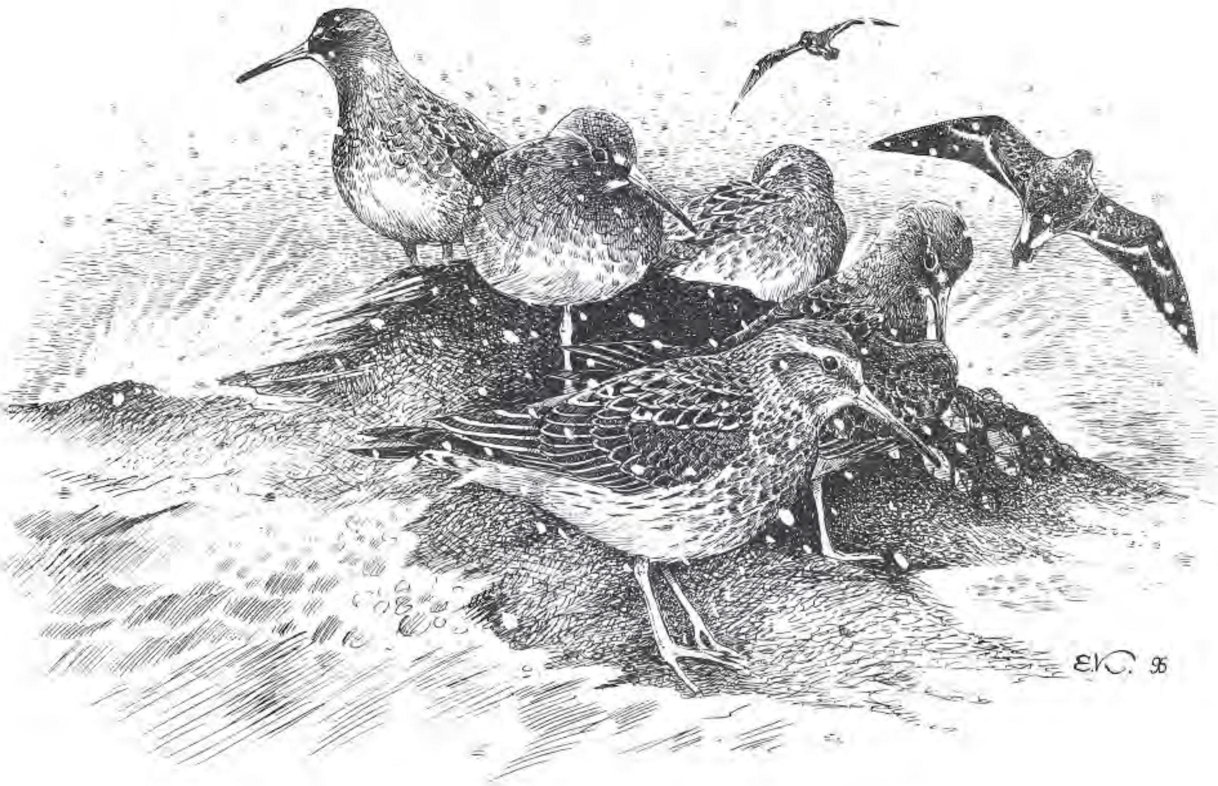




Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Purple sandpiper *Calidris maritima*

No: Fjæreplytt Ru: Morskoy pesochnik



Population size: ?
Population trend: Reasonably stable

General description

The purple sandpiper is a medium-sized wader with dark plumage, mostly in grey and brown colours. Its main breeding distribution is Iceland, northern Scandinavia, Svalbard and the Russian coast from the Kola Peninsula east to at least 91°E in Siberia. It is also found in eastern parts of the Canadian Arctic and in Greenland.

Breeding distribution and habitat preferences in the Barents Sea Region

Throughout its breeding range in the Barents Sea Region, the purple sandpiper is widespread on most of the tundra and along the coasts, and also breeds high in the mountains far from the sea.

Movements

Inland breeders arrive on their breeding grounds as soon as the first bare patches appear from the melting snow (usually on hilltops); in these northern areas this is usually in June. On the coast, where the snow melts earlier, breeding can start in late May. The birds leave the breeding grounds in July and August. The Svalbard population winters on the west coast of Sweden and the west coast of Norway north to Tromsø. Russian birds winter along the ice-free Murman coast and especially in north Norway, as confirmed by several recoveries of ringed birds. It is still not known where the population breeding in north Norway winters, but most likely along the coast of the southern parts of north Norway and in central Norway.

Population status and historical trends

The species breeds commonly in the mountains in north Norway, Kola and all the islands in the Barents Sea. There is no information concerning the status of the breeding population, but winter counts in north Norway suggest that it is fairly stable.

Feeding ecology

In winter, the main prey of the purple sandpiper are small molluscs and periwinkles, but gammarids and some polychaetes are also taken. On the breeding grounds, the food consists mainly of springtails (Collembola), Chironomidae and Tipulids (Bengtson & Fjellberg 1975, Tomkovich 1985).

Threats

During the breeding season there is some predation pressure from long-tailed and arctic skuas, especially on small chicks. Predation pressure on the wintering grounds varies, but the most important raptors are northern goshawks *Accipiter gentilis*, Eurasian sparrow hawks *Accipiter nisus* and gyr falcons *Falco rusticolus*. In some areas, cats *Felis catus* and North American mink *Mustela vison* can also be important predators.

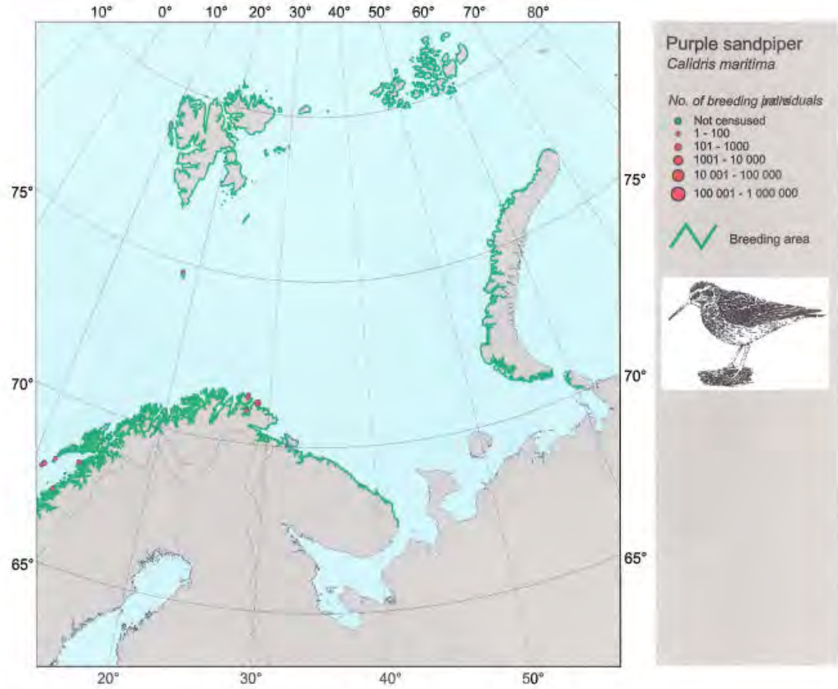
Special studies

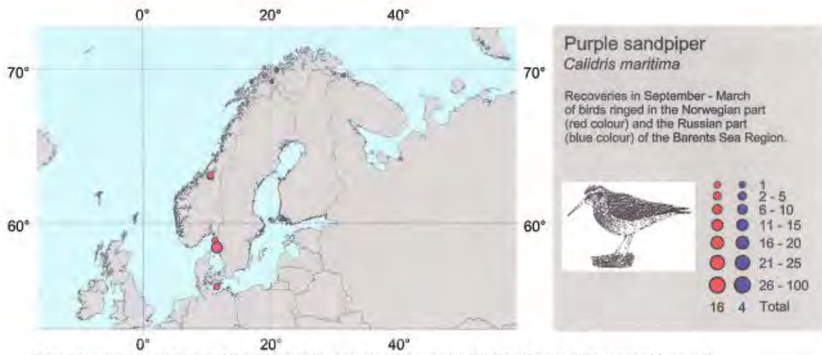
Several studies have taken place on the wintering grounds. In Russia, the numbers, distribution and, to some extent, food have been studied (Belopolski 1941, Tatarinkova 1977, 1980, 1982b). Strann & Summers (1990) and Summers *et al.* (1990) have studied their winter distribution, origin and food in north Norway. During the breeding season, some work has been done on breeding densities, breeding behaviour, moulting and food in Svalbard (Bengtson 1970, 1975a, b, Bengtson & Fjellberg 1975, Pierce 1997).

Recommendations

The purple sandpiper population shows no signs of negative trends. There is therefore no immediate need for a monitoring scheme. However, if a scheme is desirable, the study plots in Adventdalen in Svalbard and at Nordkinn in Finnmark can be used to monitor the breeding population.

Karl-Birger Strann & Ivetta P. Tatarinkova

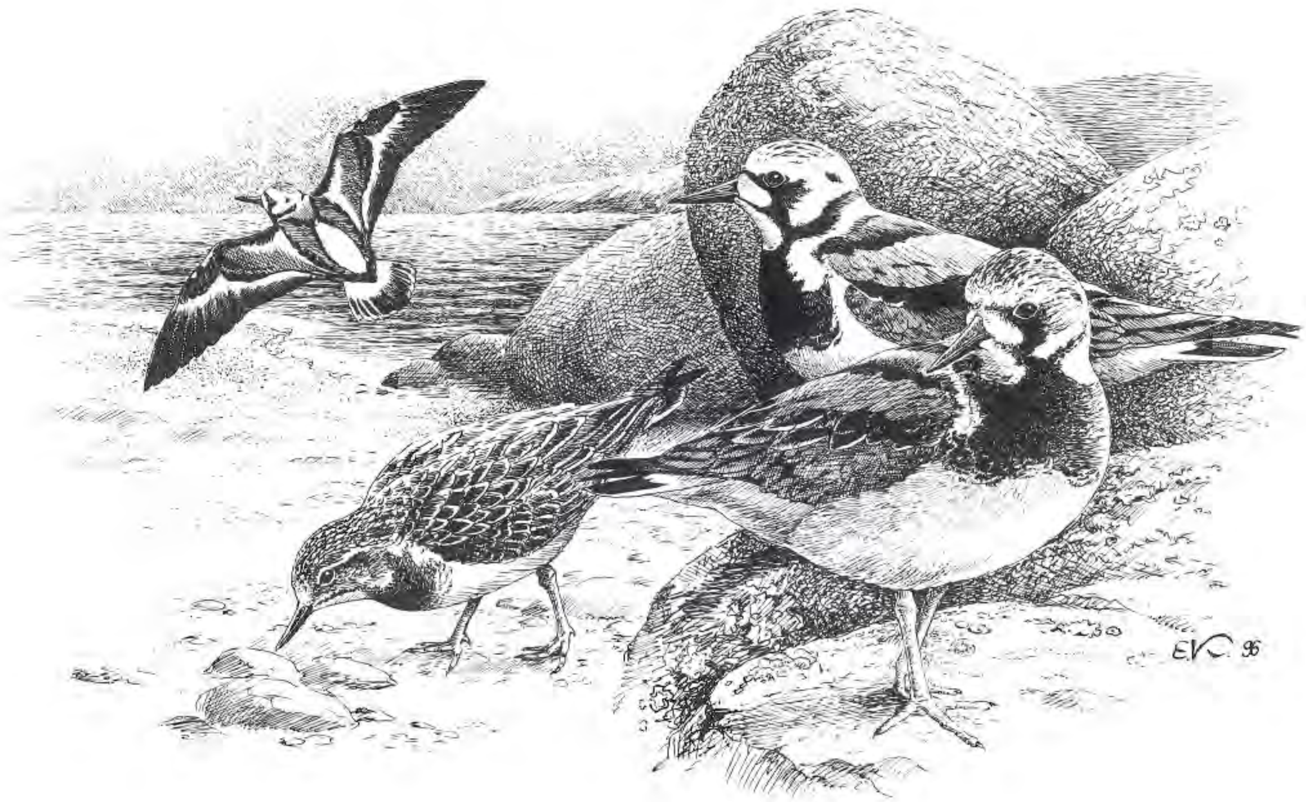




Data sources: Kandalaksha State Nature Reserve, the Norwegian Ringing Centre (Stavanger Museum) and Hake et al. 1997

Ruddy turnstone *Arenaria interpres*

No: Steinvender Ru: Kamnesharka



Population size: ?
Population trend: Reasonably stable

General description

Two sub-species of this colourful, stout wader are recognised. The nominate, *A. i. interpres*, breeds in Greenland, northern Eurasia and northern and western parts of Alaska. The other, *A. i. morinella*, breeds in arctic Canada north to about 74°N (Cramp & Simmons 1983).

Breeding distribution and habitat preferences in the Barents Sea Region

The species breeds commonly along the coast of north Norway, with a particularly high density in Finnmark. It is scarcer on the coasts of the Kola Peninsula and Kanin Peninsula and further east. A few pairs breed on Bjørnøya and the ruddy turnstone is also found scattered along the coasts of the rest of Svalbard.

Movements

The ruddy turnstone arrives at its breeding grounds in late May or the first half of June and leaves during August and early September. It winters mostly on the coast of southwest Europe and the west coast of Africa. A few birds winter along the coast of north Norway, at least as far north as Tromsø and are usually found amid flocks of purple sandpipers and always on skerries far out on the coast, never along fjords like Eurasian oystercatchers and purple sandpipers.

Population status and historical trends

In the 1960s, the breeding population in Kandalaksha Bay and Onezhski Bay was estimated to be around 1000 individuals (Malyshevski 1962), but for some unknown reason it is now decreasing significantly. No corresponding decrease is known in north Norway, and the population in east Finnmark, at least, seems to be stable.

Feeding ecology

The diet of ruddy turnstones consists mainly of small gastropods, crustaceans and some insects. It may also prey upon eggs of terns and other small waders.

Threats

Except for mustelids, few predators threatens the ruddy turnstone at the nest. This is due to a strong anti-predator behaviour from both parents where they manage to chase away most avian predators. However, raptors such as falcons may play an important role where they are present at the breeding grounds.

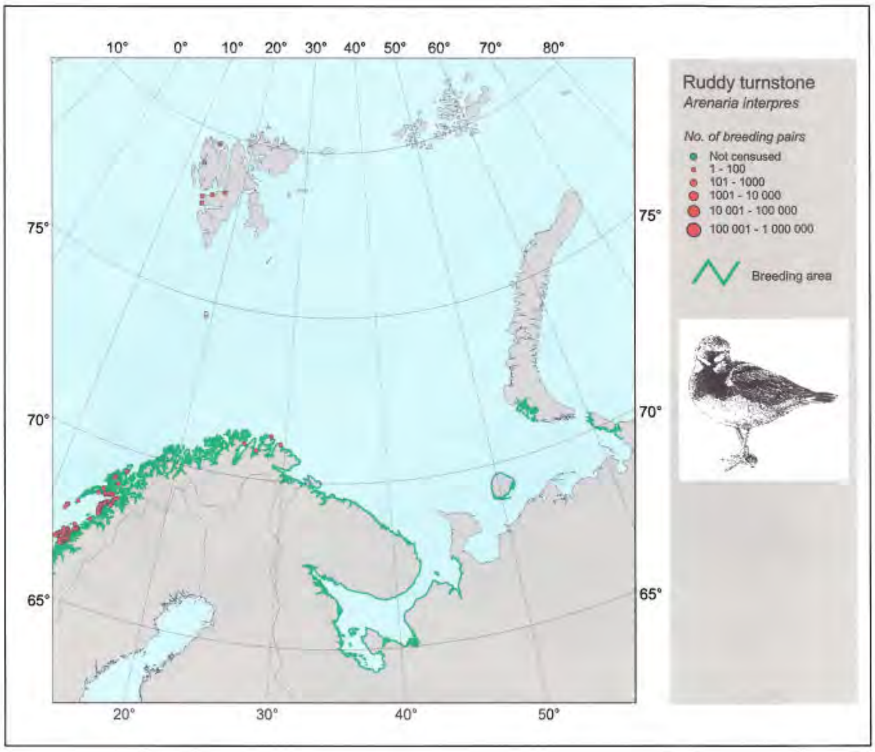
Special studies

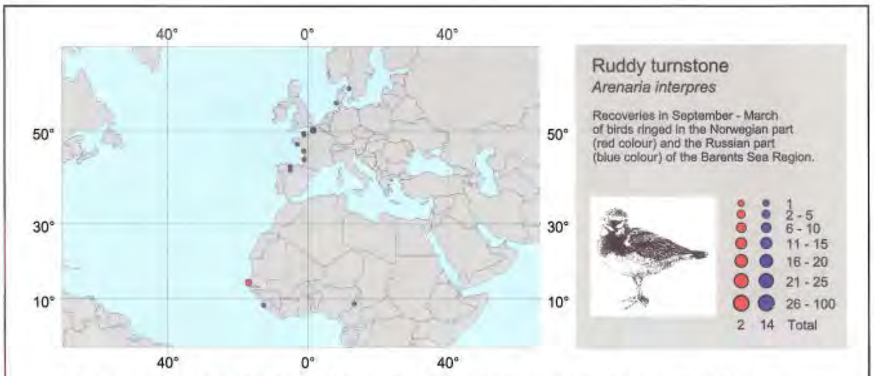
A demographic study was started in 1995 at Gamvik, Finnmark, where the breeding population has been monitored since 1989 (Strann 1996). The breeding biology and migration has been studied by Tatarinkova (1980, 1982b) on the Aynov Islands.

Recommendations

It is recommended that numbers in some breeding areas should be monitored. In North Norway, it would be wise to continue using Gamvik in Finnmark since waders, including the ruddy turnstone, are currently being monitored there. A similar area, if it exists, should be chosen on the Kola coast or in the White Sea. Monitoring of the breeding population is important since the species has been decreasing in numbers in Russia.

Karl-Birger Strann &
Ivetta P. Tatarinkova

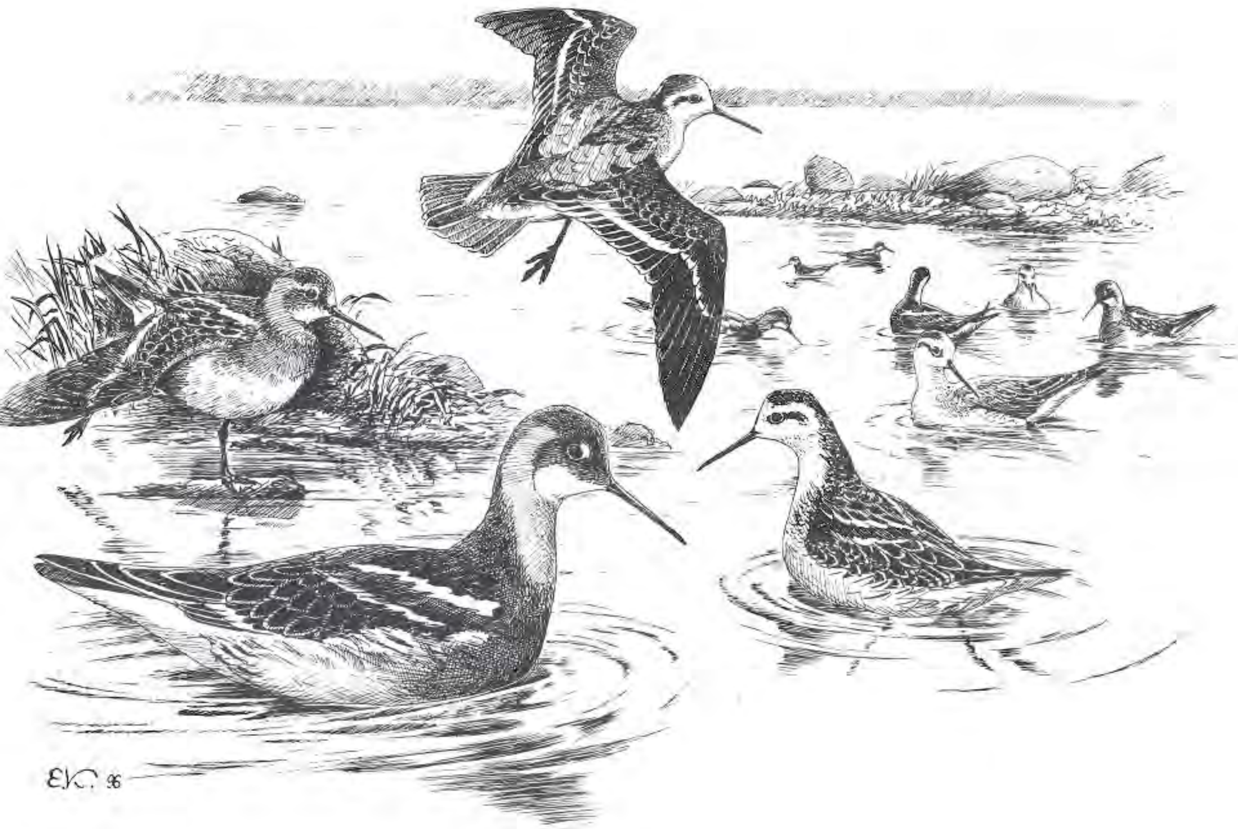




Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Red-necked phalarope *Phalaropus lobatus*

No: Svømmesnipe Ru: Kruglonosy plavunchik



Population size: ?
Population trend: Reasonably stable

General description

This small, colourful wader has a circumpolar distribution. The breeding plumage of both sexes is grey and brown with a red patch on the side of the neck. The female has the strongest colours. The species has a long, thin bill.

Breeding distribution and habitat preferences in the Barents Sea Region

The red-necked phalarope breeds in Svalbard, on wetlands in north Norway, on the Kola Peninsula and islands in the White Sea, and eastwards from the White Sea. It is unevenly distributed in southern parts of north Norway, but very common in Finnmark. It is rare on Bjørnøya and has a patchy distribution on Spitsbergen. It is not common in the western part of Russia, but becomes more common towards the east (Dementjev & Gladkov 1951b, Kozlova 1961) .

Movements

During the breeding season, the red-necked phalarope is strongly associated with fresh water, especially ponds and lakes, but in winter it is found at sea, often far off the coast. The wintering grounds of the Fennoscandian population are believed to be mainly in the Arabian Sea, but also in the Gulf of Aden and the Persian Gulf (Cramp & Simmons 1983, Kishchinski 1985). A number of recoveries of birds ringed in northern Scandinavia show a clear southeasterly route during the autumn migration.

Population status and historical trends

There is no information concerning the status of the breeding population. However, studies at several places in the Barents Sea Region, e.g. Gamvik in Finnmark between 1989-1996 (Strann 1996), show no signs of negative trends.

Feeding ecology

The main food of the red-necked phalarope in the breeding season consists of small insects and crustaceans, which are taken on the surface of open water. Insects are also taken on the wetter parts of marshes.

Threats

During the breeding season, red-necked phalarope eggs and chicks are vulnerable to predation, mainly by skuas *Stercorariidae* and mew gulls *Larus canus*.

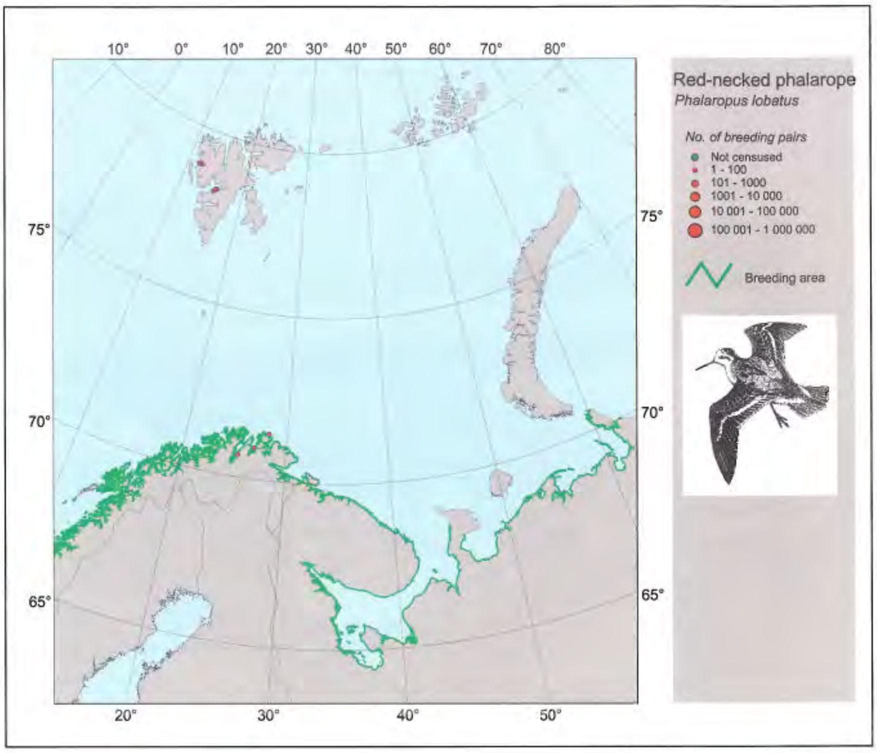
Special studies

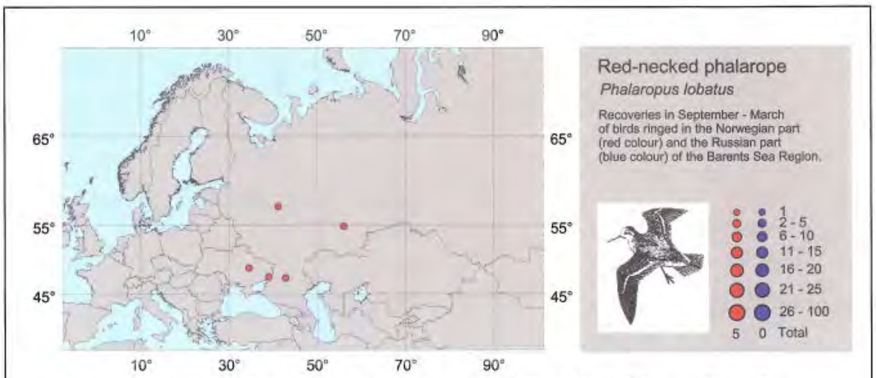
Tatarinkova (1980, 1982b) studied the breeding ecology and migration of the species on Aynov Island in Russia. Red-necked phalaropes are also included in the current monitoring programme for breeding waders at Slettnes, Gamvik in Finnmark since 1989 (Strann 1996).

Recommendations

The breeding population seems stable, but compared to other waders, like the purple sandpiper, we do not know very much about this species. It is therefore wise to establish a monitoring scheme at some breeding localities, and it is suggested that one site in north Norway (Gamvik, Finnmark), one in Svalbard and one in Russia should be monitored.

Karl-Birger Strann &
Ivetta P. Tatarinkova

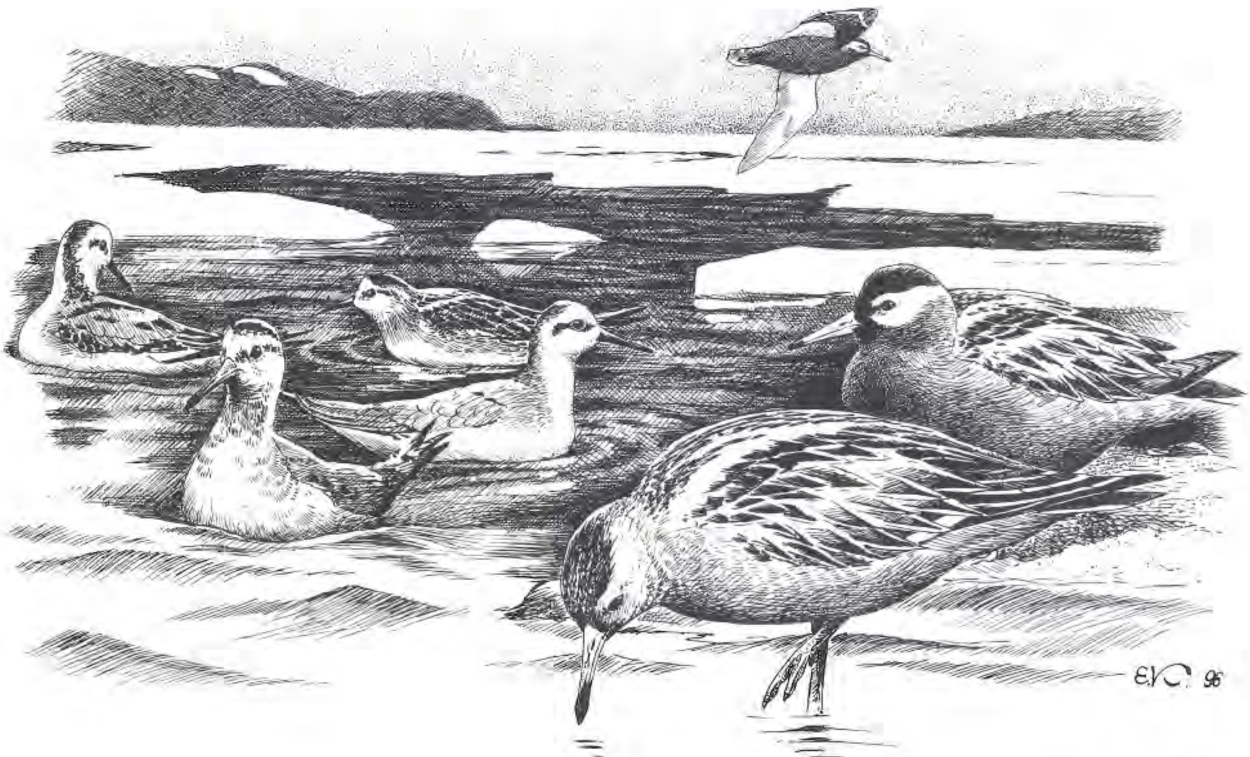




Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Grey phalarope *Phalaropus fulicarius*

No: Polarsvømmesnipe Ru: Ploskonosyi plavunchik



Population size: ?
Population trend: ?

General description

The grey phalarope has a circumpolar, high-arctic breeding distribution.

Breeding distribution and habitat preferences in the Barents Sea Region

The breeding distribution in the Barents Sea Region is confined to Svalbard, including Bjørnøya, and Novaya Zemlya. The breeding habitat is tundra with small pools or marshy areas near the sea. The nests are concealed in grass tussocks or in short vegetation. When the birds arrive to breed, the tundra may still be snow-covered, and the phalaropes are then seen foraging in the intertidal zone or other coastal waters. The grey phalarope is distributed widely in Svalbard, but in low numbers. In some areas, it occurs widely spread in small colonies during the breeding season, such as at several locations along the west coast of Spitsbergen, in Tusenøyane in south-eastern Svalbard, and on Bjørnøya. Nests are often located in colonies of arctic terns *Sterna paradisaea*, which provide some protection against arctic fox *Alopex lagopus* predation.

Movements

The grey phalarope is migratory and winters at sea, mainly in areas where plankton-rich water wells up. The migration route of birds inhabiting the Barents Sea Region is not well known, but an important wintering area is probably the upwelling zone off western Africa. Most of the migration probably takes place offshore, and the species is seldom seen along the coasts and inland in northern Europe. One bird ringed in Svalbard was shot in December in the Gironde delta in western France.

Most grey phalaropes arrive in Svalbard in early June. After laying their eggs, the females leave their mates in charge of incubation and chick rearing. Autumn migration starts early, and some females may start to leave their breeding grounds in mid-July. Most phalaropes have left Svalbard by mid-August.

Population status and historical trends

The breeding population in Svalbard has been estimated to be about 150-300 pairs (Kålås & Byrkjedal 1981). A local decline in the numbers has been noted at Ny-Ålesund in recent decades. About 20-25 pairs bred there in the early 1980s, but fewer than five pairs breed there now (F. Mehlum, unpubl. data). A similar dramatic decline has been recorded on Bjørnøya since the 1950s and 1960s. Lütken (1969) estimated the numbers breeding there in 1965 to be 50 pairs or more, whereas Strann (1998) found 11 breeding pairs in 1996. It is not known whether the decline recorded at Ny-Ålesund and on Bjørnøya is representative for the rest of the Svalbard population.

Feeding ecology

Grey phalaropes feed mainly on invertebrates which are taken while the birds are swimming, wading or walking. They feed on marshy ground and in freshwater ponds as well as in the intertidal and shallow coastal areas. A study from Svalbard showed that small crustaceans (Ostracoda) and molluscs predominated, while dipteran larvae, mites, annelid worms, beetle larvae, algae and moss were less frequent (Koenig 1911). Other, more recent, studies from Svalbard emphasise the importance of chironomids and springtails (Collembola), and also spiders and the freshwater crustacean *Lepidurus arcticus* (Bengtson 1968, Ridley 1980).

Threats

The decline in the number of breeding grey phalaropes at Ny-Ålesund, Svalbard, is probably associated with habitat deterioration. There was a local oil spill in 1985, which flooded the streams, ponds and wet tundra with oil. Oil contamination is still a problem in this area and may have made it less attractive to the phalaropes. Another potential explanation for the decline in phalaropes at Ny-Ålesund is the loss of suitable nesting sites due to intensive grazing by reindeer. Most of the tussocks used as nesting sites in the early 1980s have disappeared because of grazing.

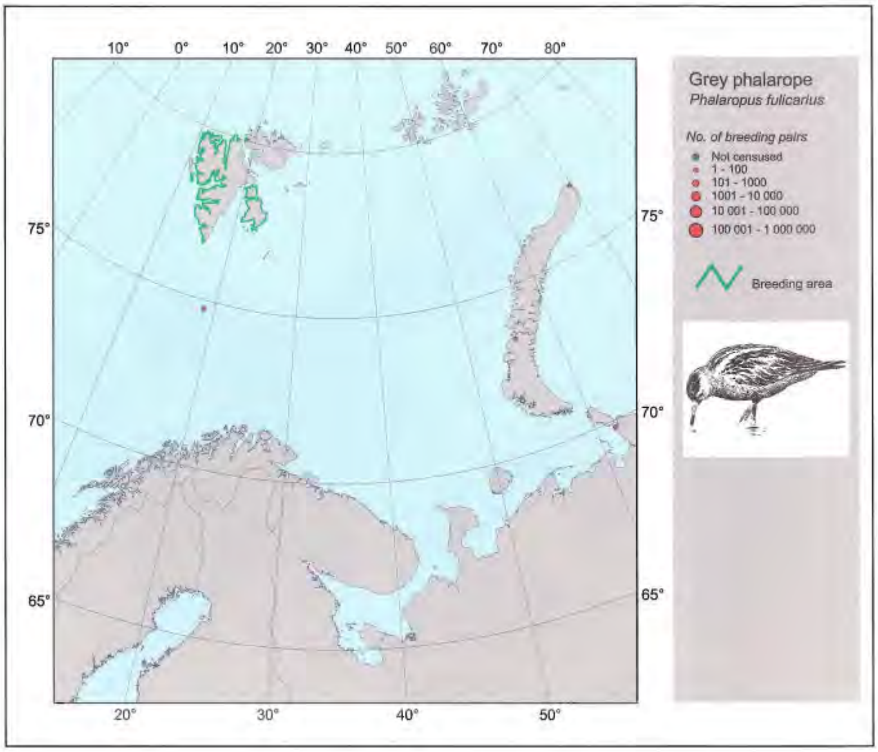
Special studies

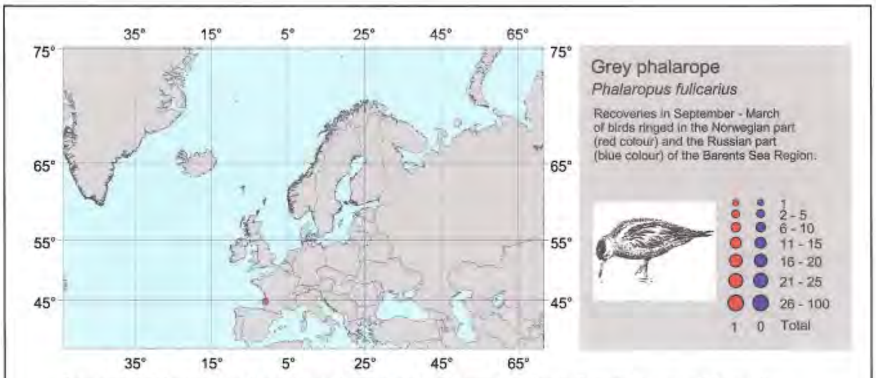
Various aspects of the breeding biology of the grey phalarope have been studied at Ny-Ålesund (Mehlum 1991c, unpubl. data) and Reindalen (Ridley 1980). A high degree of breeding site fidelity was recorded at Ny-Ålesund with 14 of 24 (58%) ringed adults being resighted at the same locality in later years. However, one ringed male moved from Ny-Ålesund to breed in Reindalen (about 140 km away) the following year (F. Mehlum, unpubl. data).

Recommendations

A new survey of the size of the Svalbard population is needed, and important breeding habitats should be identified. A programme should be initiated to monitor the population.

Fridtjof Mehlum

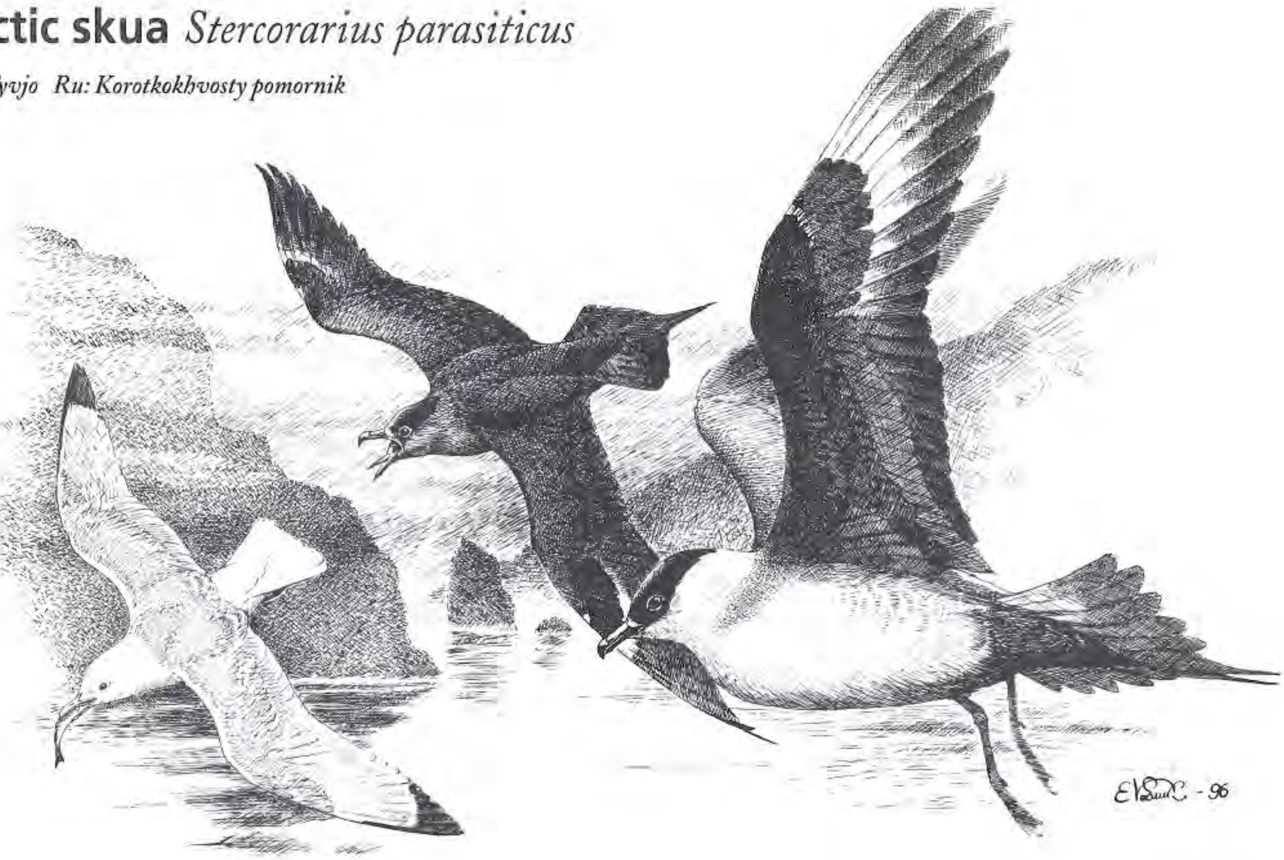




Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Arctic skua *Stercorarius parasiticus*

No: Tyvjo Ru: Korotkokhvosty pomornik



Population size: 25 000-39 000 pairs
Percent of world population: ca. 10%
Population trend: Reasonably stable

General description

The arctic skua has a circumpolar distribution in the arctic and boreal zones, breeding along the coast and on the tundra around both the northern Pacific and northern Atlantic Oceans. In the eastern Atlantic it breeds in Iceland, the Faeroes, northern Scotland, along the Norwegian coast, in Svalbard, along the Russian coast and on the islands of the Barents Sea and in the Gulf of Bothnia.

The arctic skua is probably the most abundant skua in the world (Furness 1987). The huge concentrations breeding in Canada, Alaska and Russia have, however, never been censused. The size of the world population is therefore not known, but is estimated to be between 100 000 and 300 000 pairs (Lloyd *et al.* 1991).

The arctic skua is a medium-sized *Stercorarius* skua with a fast, strong and agile flight. It resembles the long-tailed skua, but its central tail feathers only extend 3-4 cm behind the other tail feathers. It is monotypic, but occurs in two more or less overlapping morphs. The dark morph predominates in the southern parts of its range, whereas the light morph predominates in the northern parts.

Population sizes and trends of the Arctic skua *Stercorarius parasiticus* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	4000-8000	1995	0	1989-95	0	1970-74	1, 2, 3
MC	?	?	-1	1992-95	+1	1960-91	4
WS	?						
ND	?						
NZ	?						
FJL	?						
SV	1000	1994	-	-	-	-	5
All	25 000-39 000	-	-	-	-	-	

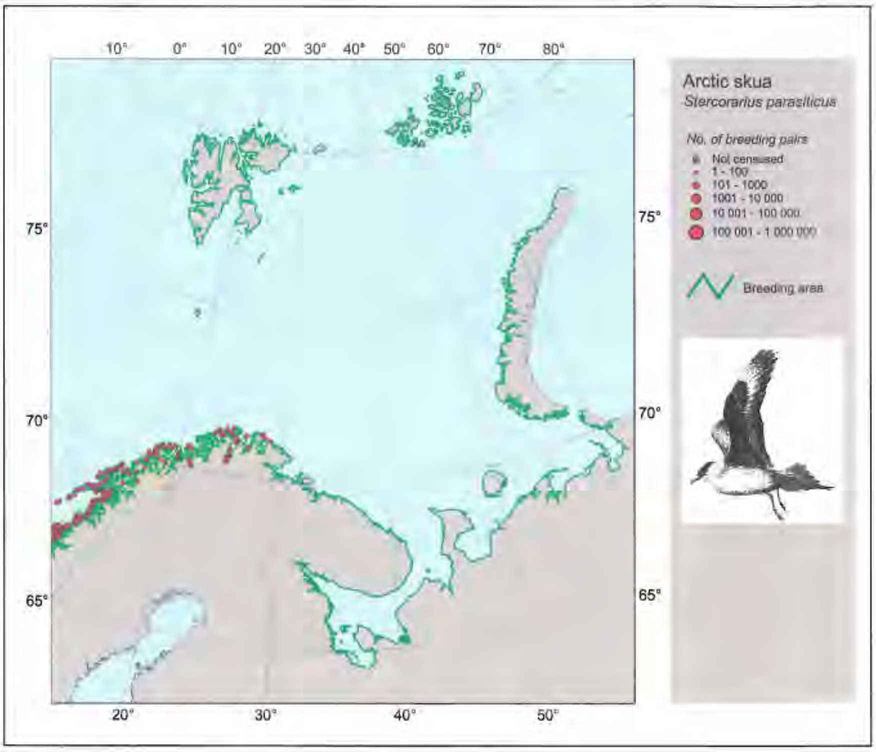
1. K.-B. Strann, pers. comm., 2. Gjershaug *et al.* 1994., 3. Brun 1979, 4. Krasnov *et al.* 1995, 5. Isaksen & Bakken 1995

Breeding distribution and habitat preferences in the Barents Sea Region

The arctic skua breeds all over the Barents Sea Region as far north as northern Svalbard and Franz Josef Land. It is common in the coastal zone, but also extends inland in some parts of its range. It breeds either solitarily or in colonies numbering a few hundred pairs. The nest, which is a shallow depression on the ground sparsely lined with vegetation (Cramp & Simmons 1983), is most often found in marshy areas on coastal tundra or moorland. It generally breeds in small numbers near tern or gull colonies whereas larger colonies are often associated with large colonies of auks Alcidae or black-legged kittiwakes *Rissa tridactyla* (Furness 1987).

Movements

Arctic skuas leave their breeding grounds between August and October. Russian birds migrate westwards along the Murman coast or through the White Sea and Baltic Sea to the Atlantic Ocean (Flint 1988) where they fly along the coasts of



France and Spain southwards to South African or South American waters (Cramp & Simmons 1983). Some individuals may be observed as far north as British waters in winter. The arctic skua lives pelagically or in coastal waters in winter. It returns to the breeding grounds in north Norway (Vader 1994) and along the Murman coast (Belopolski 1957a) from the middle of May and in Svalbard from early June (Isaksen & Bakken 1995b).

Population status and historical trends

An estimated 25 000-39 000 pairs of arctic skuas breed in the Barents Sea Region. Of these, about 5000 pairs breed along the Norwegian coast and about 1000 pairs in Svalbard.

There are very few data concerning the historical trends in the populations of this species. Hundreds of pairs are known to have nested on islands along the Murman coast in the 1920s and 1930s (Ruthke 1939). A colony also existed on Kharlov Island in this period (Krasnov *et al.* 1995) and has been censused regularly since 1929 (Ruthke 1939, Krasnov *et al.* 1995) when 120 pairs nested there. The population has since decreased and reached its lowest level between 1960 and 1979, probably due to direct persecution and intensification of the fishing industry (Krasnov *et al.* 1995). Since the beginning of the 1980s, the number of arctic skuas nesting on Kharlov Island has increased, although the breeding population is still only a quarter of its size in the early 1920s (Fig. 1).

In Norway, the colony on Slettnes at Gamvik in Finnmark, is increasing, whereas that on Hjelmsøy has decreased slightly since 1989 (K.-B. Strann, pers. comm.). Few data exist from Troms, but several small colonies have decreased. In other colonies the population is stable (K.-B. Strann, pers. comm.).

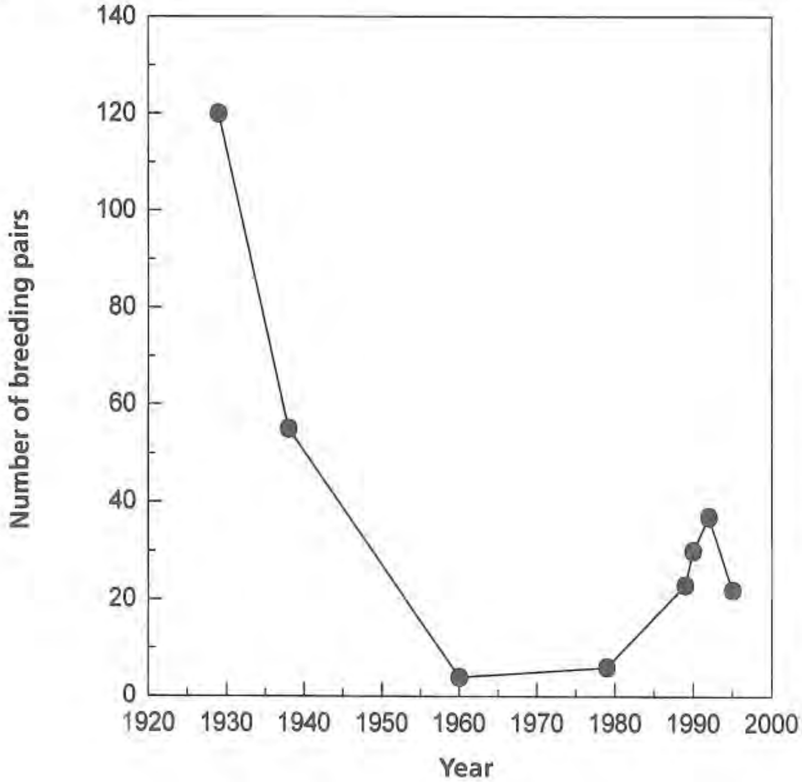
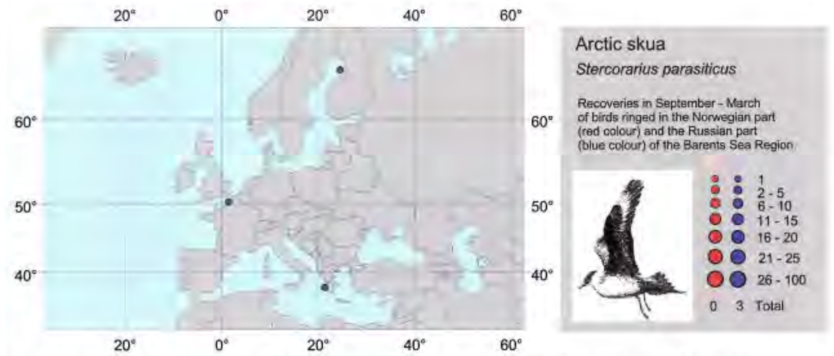


Figure 1. Trend of the arctic skua population on Kharlov Island, Seven Islands, on the Murman coast 1929-95.

Feeding ecology

The arctic skua uses two foraging strategies, depending on its breeding habitat. On inland (and some coastal) localities, it is predatory, eating rodents and passerines (Belopolski 1957b), eggs and berries (Furness 1987). In coastal colonies, it is kleptoparasitic, most often stealing food from terns, gulls and auks (Belopolski 1957b, R. T. Barrett pers comm.).

Three detailed studies of the food choice of the arctic skua in the Russian part of the Barents Sea Region have been carried out since the mid-1950s by Belopolski (1957b, 1971) and Krasnov *et al.* (1995). Belopolski (1957b) investigated the diet on three islands on the Murman coast (Aynov, Litskie and Kharlov) in 1939-42 and found that fish was the dominant food item. Since arctic skuas steal their prey from other seabirds (e.g. black-legged kittiwakes, auks, mew gulls *Larus canus* and terns *Sterna* spp.), the fish species eaten are those taken by those seabirds. After the over-fishing of herring *Clupea harengus* in the Barents and Norwegian Seas, the proportion of herring in the diet of arctic skuas has decreased and that of sandeels *Ammodytes spp* and capelin *Mallotus villosus* increased (J. Krasnov pers. obs.).



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Diet of the Arctic skua *Stercorarius parasiticus* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
MC	Aynov, Litskie and Kharlov Islands	1939-41	Fish (40%), berries (25%), eggs (17%), insects (13%)	Adults	1
	Aynov and Seven Islands	1935, '41, '46-49	Sandeels (10%), capelin (23%), herring (47%), polar cod (20%)	Adults	2
	Seven Islands	1985-92	Sandeels (36%), capelin (36%), herring (28%)	Adults Chicks	3

1. Belopolski 1957b, 2. Belopolski 1971, 3. Krasnov *et al.* 1995

Threats

Apart from fishery activities and direct persecution there are probably no serious threats to breeding populations of arctic skuas in the Barents Sea Region. Reduced availability of sandeels and herring *Clupea harengus* is known to have affected the population of arctic skuas in the Shetland Isles (Lloyd *et al.* 1991) and on the Murman coast.

Special studies

The only study of the arctic skua taking place in the Norwegian part of the Barents Sea is population monitoring and demography at Slettnes (K.-B. Strann, pers. comm.).

In Russia, studies have been carried out on feeding ecology (Belopolski 1957b, 1971, Krasnov 1982, 1987, Krasnov *et al.* 1982, 1995) and habitat structure, chick growth and daily energy budgets (Y. Krasnov & N.G. Nikolaeva, unpubl. data). Population censuses have been carried out in Seven Islands since the late 1920s (e.g. Krasnov *et al.* 1995). The status and distribution patterns of the arctic skua in the White Sea area were studied during the 1960s by Bianki (1980).

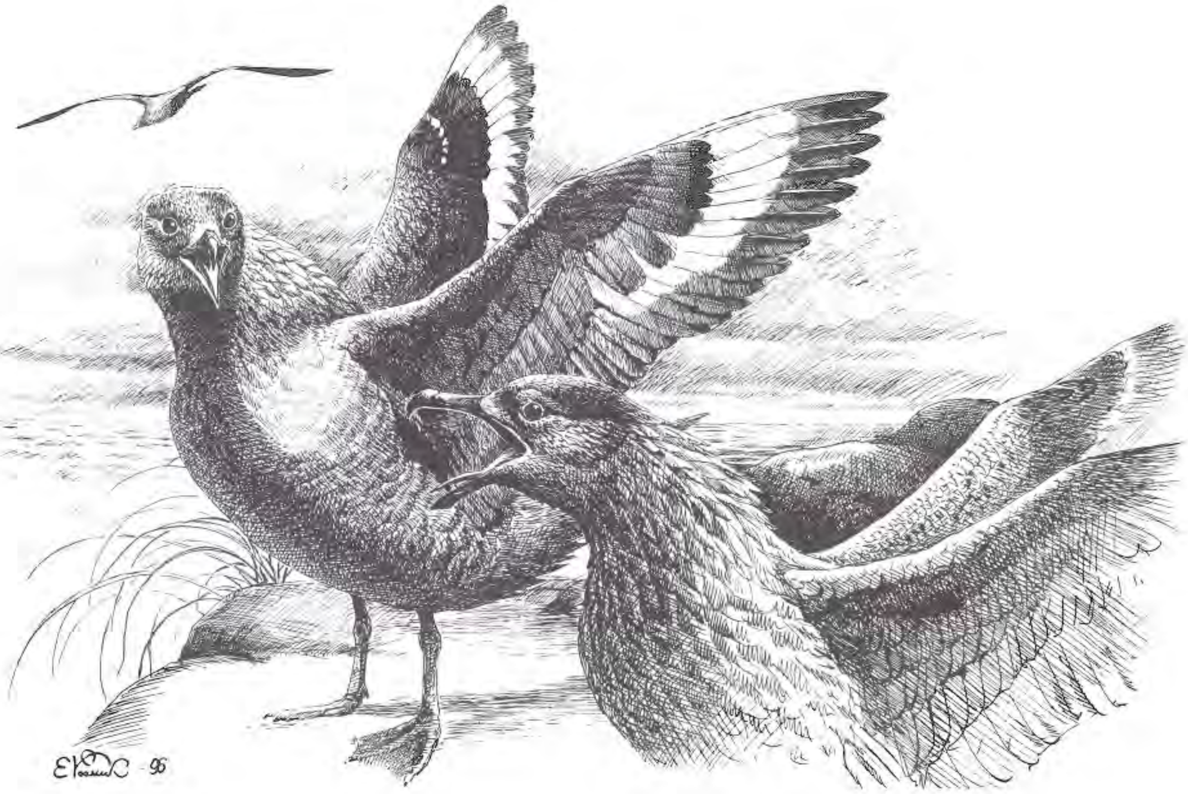
Recommendations

Monitoring of population development, demography and breeding success should be carried out at selected sites in the whole Barents Sea Region. Studies of food choice and environmental contamination should also be carried out.

Juri V. Krasnov & Svein-Håkon Lorentsen

Great skua *Catharacta skua*

No: Storjo Ru: Bol'shoy pomornik



Population size: 230-390 pairs
Percent of world population: 2%
Population trend: Large increase

General description

The great skua *Catharacta skua* is the largest of the skuas. The genus is mainly confined to the southern hemisphere. In the North Atlantic, it breeds from Iceland, the Faeroes and Shetlands to Novaya Zemlya. The world population is estimated to be about 14 000 pairs (Furness 1987, Lloyd *et al.* 1991; updated with data from this report).

The great skua resembles a large, dark, immature *Larus* gull having a long bill, relatively broad wings and a short tail. The plumage is dark brown with characteristic large white patches along the base of the primaries. In normal flight it resembles a large gull, but it is fast and agile when chasing seabirds (Cramp & Simmons 1983).

The genus *Catharacta* consists of five species with a complex taxonomy (Sibley & Monroe 1990). There is no geographical variation in the *Catharacta skua* in the northern hemisphere.

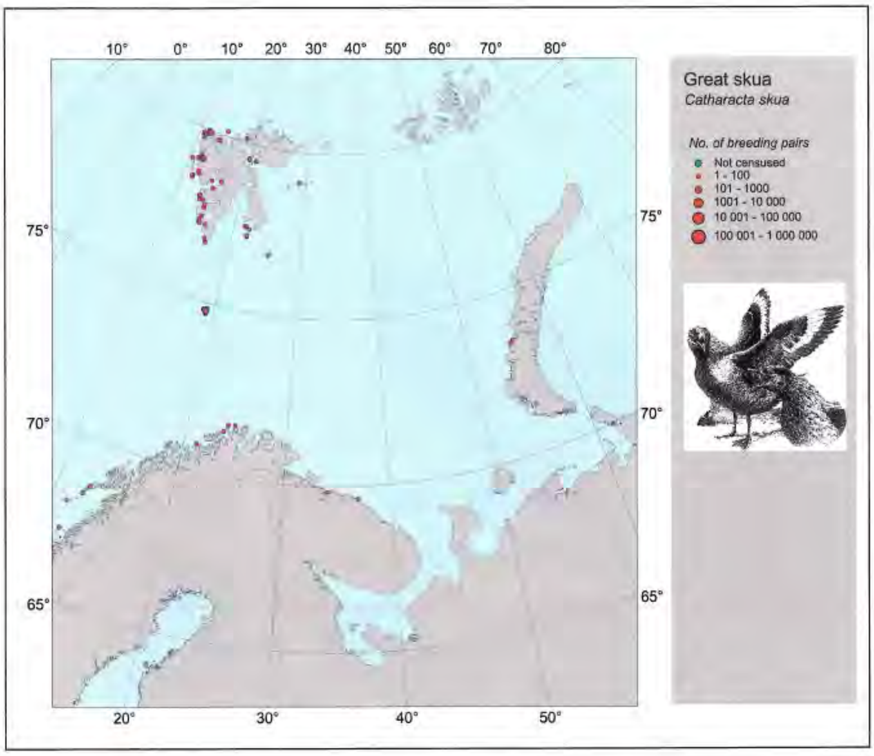
Population sizes and trends of the great skua *Catharacta skua* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	20-30	1990-95	+2	1986-95	+2	1978-85	1
MC	4	1995	+1/0	1988-95	?	-	
WS	0						
ND	2	1991	?	-	?	-	2
NZ	1	1992	?	-	?	-	3
FJL	0						
SV	200-350	1995	+2	1989-95	-	-	4, 5
All	230-390	-	-	-	-	-	

1. K.-B. Strann, pers. comm., 2. Kalyakin 1995b, 3. Krasnov 1995, 4. V. Bakken, pers. comm., 5. G. Bangjord, pers. comm.

Breeding distribution and habitat preferences in the Barents Sea Region

Small numbers of the great skua breed throughout the Barents Sea Region except the White Sea and Franz Josef Land. The largest concentrations are on Bjørnøya and Spitsbergen (Krasnov 1990, Isaksen & Bakken 1995b, K.-B. Strann, pers. comm.). It breeds near the coast, usually in the vicinity of a bird cliff or gull colony, but also further inland as on Vaygach Island and Novaya Zemlya. The nest is a shallow scrape lined with small blades of grass and/or other vegetation.



Diet of the great skua *Catharacta skua* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
MC	All colonies	1988-95	Fish, common eider females, other ducks, gull chicks	Adults/ chicks	1
ND	Vaygach	1991	Lemmings, birds (in small quantities)	Unkown	2
SV	Bjørnøya	1978	Common eider, kittiwake	Adults	3

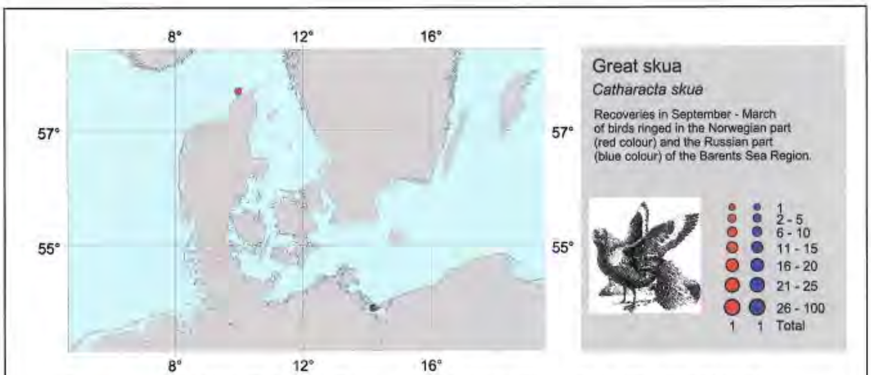
1. Krasnov *et al.* 1995, 2. Kalyakin 1995b, 3. Vader 1980

Movements

Adult great skuas winter off the coasts of Europe, whereas immature birds are more pelagic (Furness 1987). A chick ringed in Seven Islands was found on the German Baltic coast.

Population status and historical trends

In the Barents Sea Region, the great skua first became established on Bjørnøya in 1970 and then on Loppa in west Finnmark, Norway, in 1975. In 1976, several pairs were found breeding on Spitsbergen (Vader 1980). The first pair of great skuas found breeding in Russia was on Bol'shoy Zelents Island (Seven Islands) in 1988 (Krasnov & Nikolaeva 1995). The first great skuas in the Barents Sea Region probably came from Shetland colonies (e.g. Vader 1980). Those breeding in Seven Islands originated from both British and Norwegian colonies (Krasnov *et al.* 1995). Since 1988, the population has increased considerably. In 1991, two pairs were found on Vaygach Island (Kalyakin 1995b). The following year, six pairs were found breeding on the Murman coast (Y. Krasnov, unpubl. data, T.D. Panyeva, unpubl. data) and one pair was found in Bezmyannaya Bay, Novaya Zemlya (Krasnov 1995). The breeding population along the Norwegian coast was estimated to be 20-30 pairs in 1995 (K.-B. Strann, pers. comm.). In Svalbard, the breeding population is now 200-350 pairs, approximately 50 of them being on Bjørnøya (Isaksen & Bakken 1995b, V. Bakken, pers. comm., G. Bangjord, pers. comm.). The total population in the Barents Sea Region is estimated to be 230-390 pairs.



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Feeding ecology

Little information exists about the feeding ecology and food preference of the great skua in the Barents Sea Region. On the Murman coast, fish taken from other seabirds seem to form a significant part of the diet. Eider *Somateria mollissima* females, other ducks and gull chicks also constitute important food items (Krasnov *et al.* 1995). On Vaygach Island, lemmings and birds, the latter in small quantities, are important (Kalyakin 1995b). Vader (1980) reported that great skuas on Bjørnøya take adults of both eiders and black-legged kittiwakes *Rissa tridactyla*.

Threats

There are probably no serious threats to the breeding populations of great skuas in the Barents Sea Region. In some Russian colonies, some birds are shot by local inhabitants because of their aggressive behaviour on the nest. The main breeding area in Russia (Seven Islands) is within the Kandalaksha State Nature Reserve. Some Norwegian colonies are also in protected areas. The great skua is protected in Norway.

Special studies

In Russia, great skua populations have been monitored since their establishment. Detailed studies of breeding success, feeding ecology and interactions with other bird species are also being carried out. In Norway, including Svalbard, no research is carried out on this species.

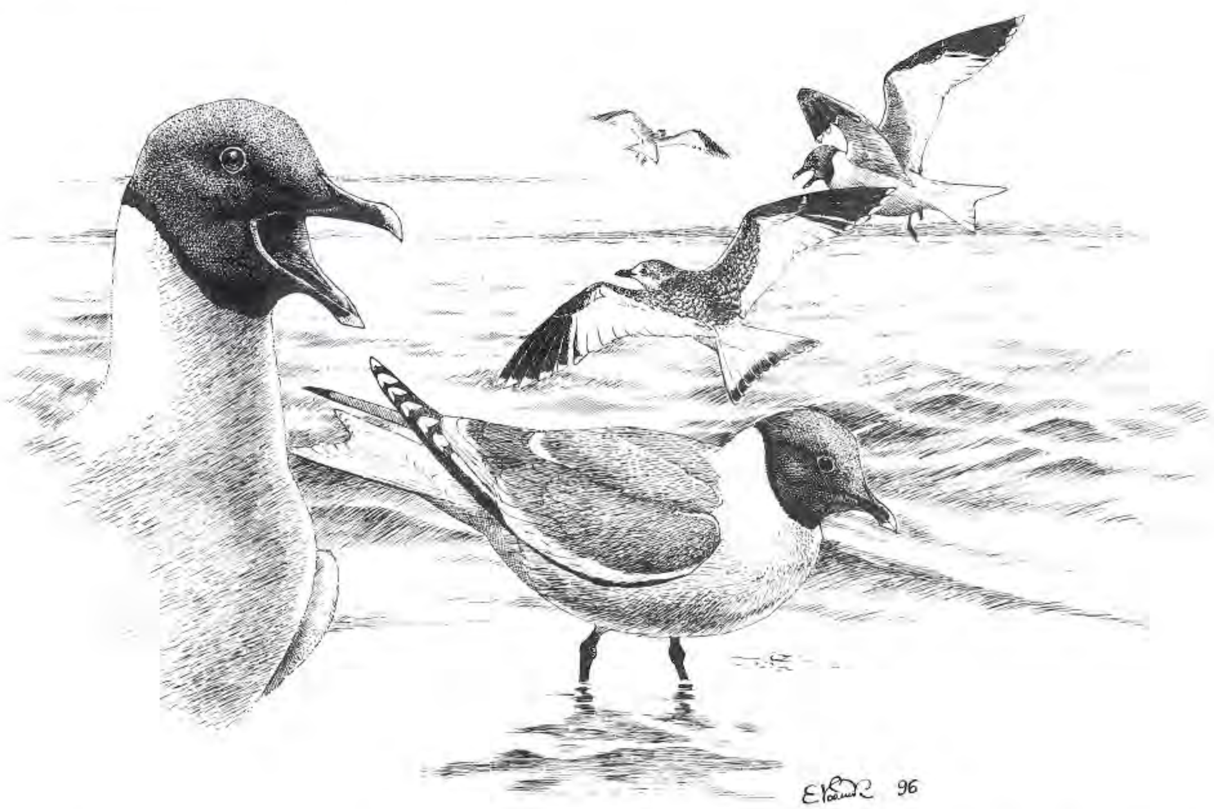
Recommendations

The studies carried out at present in Russia should continue. Other nesting places should also be located on the Rybachi Peninsula, Kolguev Island, Vaygach Island and Franz Josef Land. Monitoring should be initiated in Norway. The breeding population should be mapped in more detail.

Juri V. Krasnov & Svein-Håkon Lorentsen

Sabine's gull *Xema sabini*

No: Sabinemåke Ru: Vilokhvostaya chayka



Population size: 2-6 pairs
Percent of world population: <0.1%
Population trend: Reasonably stable?

General description

Sabine's gull is a small gull whose shape and flight are more like a tern than any other gull (Cramp & Simmons 1983). It is often considered as monotypic, but four sub-species are recognised. *X. s. palaearctica* breeds in the Barents Sea Region and Russia (del Hoyo *et al.* 1996). Sabine's gulls often breed together with arctic terns *Sterna paradisaea* close to fresh water, often on islets, but become more marine after the chicks have hatched (Cramp & Simmons 1983).

Sabine's gulls breed from the sub-Arctic to the high-Arctic (Cramp & Simmons 1983). In Europe, they breed in Svalbard (Løvenskiold 1964), and in Russia, on the Taymyr Peninsula and on the New Siberian Islands, in the deltas of the Indigirka, Khroma, Kolyma and Chauna rivers, Aion and Wrangel islands, north-eastern part of Chukotka and Kanchalan River (near Anadyr Bay) (Yudin & Firsova 1988a). The world population is probably less than 10 000 pairs (del Hoyo *et al.* 1996). The most common breeding biotope is marshy wetland in sub-alpine and boreal areas (Blomqvist & Elander 1981).

Population sizes and trends of the Sabine's gull *Xema sabini* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	0						
MC	0						
WS	0						
ND	0						
NZ	0						
FJL	0						
SV	2-6?	1993-96	(0)	1993-96	-1	1907-95	1, 2, 3
All	2-6?	-	-	-	-	-	

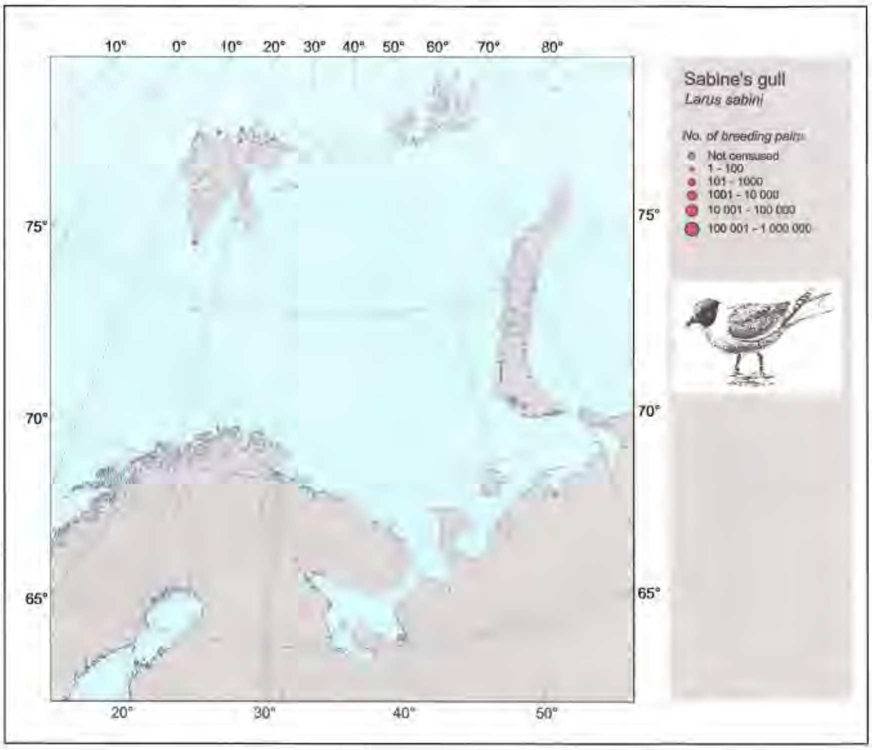
1. Løvenskiold 1964, 2. Isaksen & Bakken 1995b, 3. Bangjord 1999

Breeding distribution and habitat preferences in the Barents Sea Region

A probable instance of breeding on Storøya, east of Nordaustlandet (Svalbard), was reported by Kolthoff & Jägerskiold (1898). Eight pairs were observed among arctic terns *Sterna paradisaea*, but probably because of dense fog no nests were found. This was the first confirmed observation of Sabine's gull in Svalbard (Løvenskiold 1964).

The species has been observed on several occasions in Kongsfjorden, where it used to breed more or less regularly (le Roi 1911, Longstaff 1924, Binney 1925, Montague 1926, Løvenskiold 1964). The first confirmed breeding in this area was in 1907 when a nest with two eggs was found (Koenig 1908). The last confirmed breeding here is from 1924 when Elton (1925) found a nest with one egg.

Two breeding localities are confirmed in Svalbard during the last two decades. In 1986, 1993, 1994, 1995 and 1996



Sabine's gulls were found breeding on Moffen, an island nature reserve situated north of Spitsbergen (Isaksen & Bakken 1995b, Bangjord 1999). Four pairs probably bred there in 1993 (Isaksen & Bakken 1995b) and six pairs in 1996 (Bangjord 1999). Camphuysen (1993) observed adult Sabine's gulls at sea off Moffen in 1989, 1990 and 1991, and suggested that the species bred annually on the island. In 1998 one pair was found breeding on Lågøya situated north off Nordaustlandet (I. Gjertz, pers. comm.). In 1986, 1992 and 1996, a pair was observed at another locality, on Sørkappøya (Spitsbergen). Even though their behaviour was aggressive, no nests were found (E. Person and E. Soglo, pers. comm.). Additional breeding sites may well exist in Svalbard, but the number of breeding pairs is nonetheless very low.

Sabine's gulls are observed regularly in Svalbard, especially on the north-eastern part of Spitsbergen and at sea east off Nordaustlandet (Løvenskiold 1964, Norwegian Polar Institute Fauna Register). There are no records of them breeding on the Norwegian coast or in the Russian part of the Barents Sea Region.

Movements

The Sabine's gull migrates to oceanic waters in the southern hemisphere (Blomqvist & Elander 1981). No ringing recoveries from the Barents Sea Region exist. A westward movement from Siberian colonies is unlikely as very few Sabine's gulls have been observed in the Barents Sea, Norwegian Sea and Scottish waters (Dementjev & Gladkov 1951b, Haftorn 1971, Sharrock 1971). Birds breeding in Svalbard probably belong to the East Greenland population (Cramp & Simmons 1983). Siberian and Alaskan birds pass through the Bering Strait in autumn (Cogswell 1977).

Population status and historical trends

Very few data exist concerning the Barents Sea Region population. Sabine's gulls no longer breed in the Kongsfjorden area, but the population was never large (le Roi 1911, Binney 1925, Montague 1926, Løvenskiold 1964). The species has not been found breeding on Storøya since 1898. No one knows when it started to breed on Moffen, but it has probably bred there for many years. All told, it is difficult to suggest any clear population trend for the breeding population of Sabine's gulls in the Barents Sea Region, although there are indications that the population was larger at the beginning of this century.

Feeding ecology

The main food of the Sabine's gull is thought to consist of small fish and very small invertebrates (Blomqvist & Elander 1981). It occasionally takes small birds, eggs of arctic terns and carrion (del Hoyo *et al.* 1996). Very few data exist from the Barents Sea Region. In the summer of 1907, le Roi (1911) found small stones and remains of molluscs in the stomachs of two birds that were shot. Römer & Schaudinn (1900) found some crustaceans, bristles of annelids and small stones in the stomachs of two females shot on Storøya (Svalbard) in 1898.

Threats

The Sabine's gull is not globally threatened. Nothing is considered to currently threaten the Sabine's gulls that are breeding in Svalbard. Moffen, one of the two known breeding localities in the Barents Sea Region at present, is a nature reserve and landing is prohibited during the breeding season. If the breeding population is as small as is indicated, the species is vulnerable insofar as there are so few breeding birds.

A potential threat is an oil spill in the breeding area, and the summer population in Svalbard is classified as vulnerable to oil spills (Isaksen & Bakken 1995c). In December 1995, a prawn trawler was wrecked only 9 km south-east of Moffen, but so far no oil spills have been found in the area.

Special studies

Apart from occasional dietary investigations of the stomach contents and egg biometry early in the last century, no special studies have been undertaken in the Barents Sea Region.

Recommendations

The breeding population on Moffen should be regularly monitored and an investigation should be carried out to find out how the Sabine's gulls exploit the sea around the island in order to evaluate the vulnerability of the Svalbard population to oil spills.

Vidar Bakken

Black-headed gull *Larus ridibundus*

No: Hettemåke Ru: Ozernaya chayka

Population size: ca. 1100 pairs
Percent of world population: <1%
Population status: Small decrease

General description

The black-headed gull is a medium-sized gull with a nearly circumpolar distribution, breeding mostly in the boreal zone and into the sub-Arctic (Cramp & Simmons 1983). It breeds in large numbers along the coast of SE Norway, and in small numbers on inland lakes, also in the three northernmost counties. In Russia, it is widespread, normally breeding on lakes and usually only visiting the seashore outside the breeding season, but increasing numbers of observations in the White Sea and the establishment of new colonies on the Kola Peninsula in the 1980s suggest that the species is spreading northwards (Cherenkov & Semashko 1991). The black-headed gull is monotypic according to Cramp & Simmons (1983), although some authors argue that the birds occurring in the far east are somewhat different and may be regarded as a sub-species *L. r. sibiricus* (Witherby *et al.* 1941).

It is not easy to find a correct estimate for the world population, but according to Cramp & Simmons (1983) there were well over 500 000 pairs in the early 1980s. The Norwegian population is estimated to be between 20 000 and 30 000 pairs (Gjershaug *et al.* 1994) and Russia has well over 100 000 pairs (Cramp & Simmons 1983).

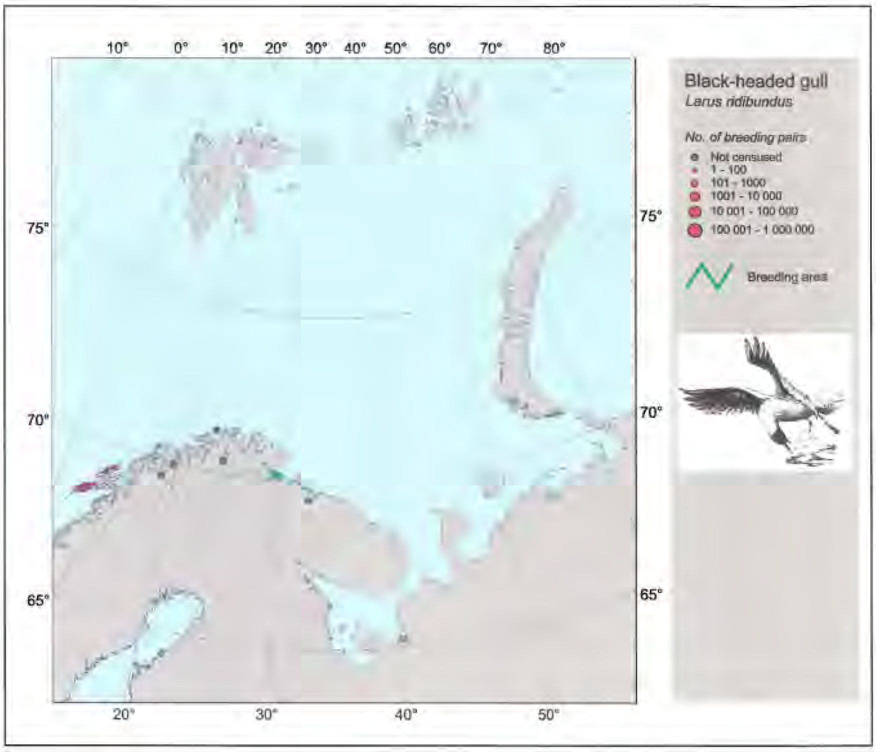
Population sizes and trends of the black-headed gull *Larus ridibundus* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	1000	1990s	0	1985-95	+1	1960s-1990s	1
MC	100	1990s	+1	-	-	-	1
WS	0						
ND	0						
NZ	0						
FJL	0						
SV	0						
All	ca. 1100	-	-	-	-	-	

1. K.-B. Strann, unpubl. data

Breeding distribution and habitat preferences in the Barents Sea Region

The black-headed gull breeds on rivers and lakes in the inner part of north Norway and at several places along the outer coast of Lofoten, Vesterålen and Finnmark, usually on ponds or lakes close to the seashore. The colonies are normally found in areas with rich vegetation, or on islets in lakes. More rarely, single nests or



small colonies can be found on small islands in sheltered fjords. In Russia, the black-headed gull is a rare breeder on the coast (Kokhanov 1981b). It has also recently established new colonies in the inner part of the Kola Peninsula (Paneva 1989). The colonies in Russia are always located in rich vegetation close to bodies of fresh water.

Movements

The black-headed gull is migratory and reaches its breeding grounds during April or May and leaves in August to the end of September. When migrating, it is commonly observed along the whole coastline, and strays may even reach Svalbard. Groups of gulls can aggregate in certain coastal areas waiting for the ice to melt on the lakes where they breed. In Russia, such places are found near Murmansk and in the inner part of Kola Bay (Paneva 1989). In Norway, they aggregate on several large mud flats along fjords. All the birds seem to disappear from the Russian areas during September (Paneva 1989). However, many remain on the coast of north Norway, some even wintering there, at least as far north as Tromsø.

Population status and historical trends

Bianki (1922) found that the black-headed gull was an irregular breeder at least north to Kandalaksha Bay on the White Sea, which is about two degrees of latitude north of what other claimed as the northern limit (Dementjev & Gladkov 1951b, Viksne 1988, Flint *et al.* 1989). Since the beginning of the 1970s, it has established new breeding colonies on the Kola Peninsula (Kokhanov 1981b) and may breed on the Solovetskie Islands in the White Sea (Kokhanov 1981b). One of the Kola colonies is on Lake Imandra, which is in the middle of the peninsula, and the other is close to the settlement of Murmanshi. In 1996, a colony of seven nests was found on Zhizhgin Island in Onezhski Bay in the White Sea (A. Cherenkov, A. Semashko and G. Tertistski, pers. comm.).

The black-headed gull has become more common in north Norway after the Second World War. During the last twenty years, the breeding population has been stable or increased slightly. However, small colonies often tend to exist for some years, before the birds disappear, only to turn up again at a different site.

Feeding ecology

No special studies have been carried out on the feeding ecology of the black-headed gull in the Barents Sea Region. From our own observations, the species feeds on small fish and invertebrates at sea and on mud flats, and grain and offal in towns. Birds in Russia have been observed eating waste at fox farms, but not at rubbish dumps (Paneva 1989).

Diet of the black-headed gull *Larus ridibundus* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Lofoten	1990	Insects, earthworms	Adults	1
MC		1980s	Various, at fox farms	Adults	2

1. K.-B. Strann, unpubl. data. 2. Paneva 1989

Threats

There are no obvious threats to the species in north Norway. In Russia, oil pollution in Kola Bay and pollution from various chemicals in Lake Imandra may cause problems for the individuals breeding and feeding there.

Special studies

No special studies of the species have been carried out in Norway, but Paneva (1989) studied some aspects of its biology and distribution near Murmansk.

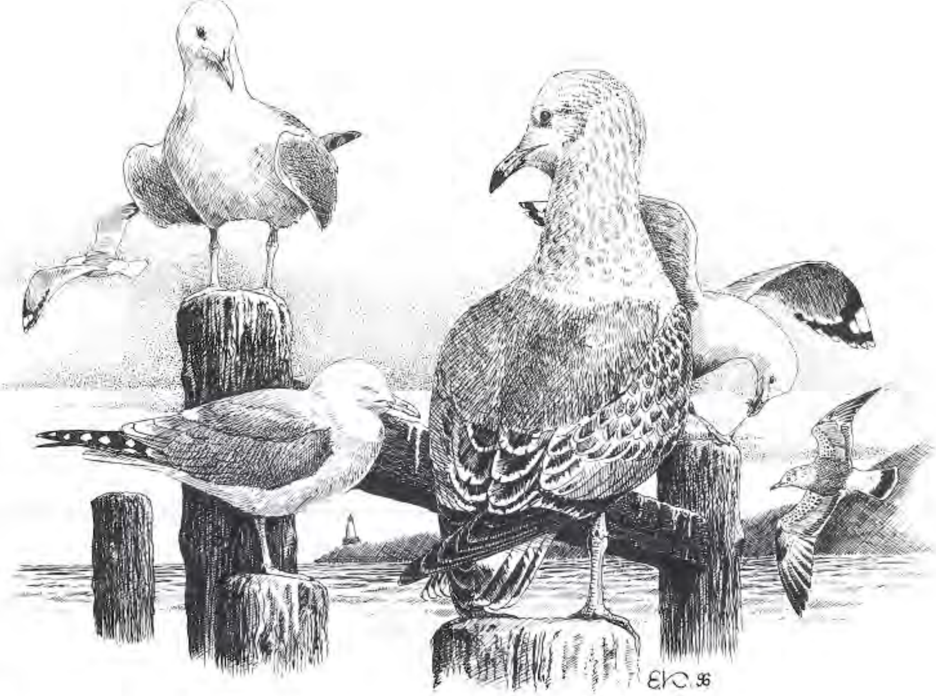
Recommendations

The breeding sites of the black-headed gull in North Norway should be mapped since no such work has been done so far and consequently we have little information concerning the status of the species. A number of colonies from Lofoten to Finnmark are suitable for monitoring and this work should start as soon as possible because the species shows a negative trend in much of northern Europe. The colony near the River Tuloma in Russia should also be included in this monitoring programme.

Karl-Birger Strann &
Alexander N. Golovkin

Mew gull *Larus canus*

No: Fiskemåke Ru: Sizaya chayka



Population size: >28 500 pairs
Percent of world population: <1%
Population status: Small decrease

General description

The mew gull inhabits mainland water bodies on the northern taiga in Europe, Asia and North America.

The southern border of the breeding area runs through Northern Ireland, Scotland, the south coast of the North and Baltic Seas, Belarus, northern Kazakhstan, Lake Baikal, the northern coast of the Okhotsk Sea, the Kamchatka Peninsula and between 40 and 50°N in North America. The species is a common breeder both inland and along the Norwegian coast and is also numerous on the Murman coast and in the White Sea. Four sub-species are recognised, two of which breed in the Barents Sea Region. *L. c. canus* breeds in Scandinavia, the White Sea, Karelia and the Baltic (Stepanyan 1990), and *L. c. heinei* breeds from the east coast of the White Sea eastwards to the River Lena and Aldan. The population of *L. c. canus* is estimated to be ca. 1 600 000 individuals and that of *L. c. heinei* ca. 10 000 (Rose & Scott 1994).

Breeding distribution and habitat preferences in the Barents Sea Region

The mew gull is widely distributed and breeds regularly along the Norwegian coast. The colonies are normally located in rich vegetation, but can also be found in areas with little vegetation. The species is also very common in Russia, especially in the White Sea. Low numbers breed along the Murman coast, but none have been found breeding in the Nenets district. In the White Sea, the mew gull breeds mainly on islands near the seashore where *Empetrum nigrum* grows, and on salt-marshes.

Movements

Most of the birds migrate from their breeding area in August and September and return in April and May. Most of those from north Norway migrate to the North Sea coasts, but many winter along the Norwegian west coast as far north as 70°N and can be found in flocks of up to 200 (K.-B. Strann, unpubl. data). Most of the Russian birds migrate south through Finland and Karelia to winter in the southern Baltic and on the North Sea coast (Cramp & Simmons 1983). Some birds from the western part of the Kola Peninsula may migrate along the Norwegian coast and join the population wintering in north Norway.

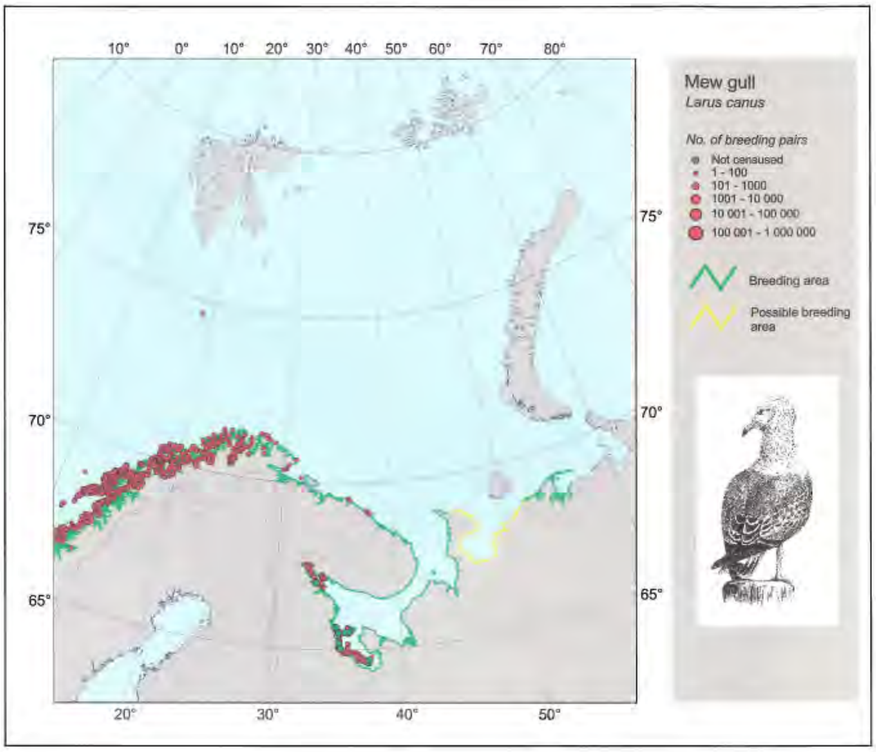
Population sizes and trends of the mew gull *Larus canus* within the Barents Sea Region.

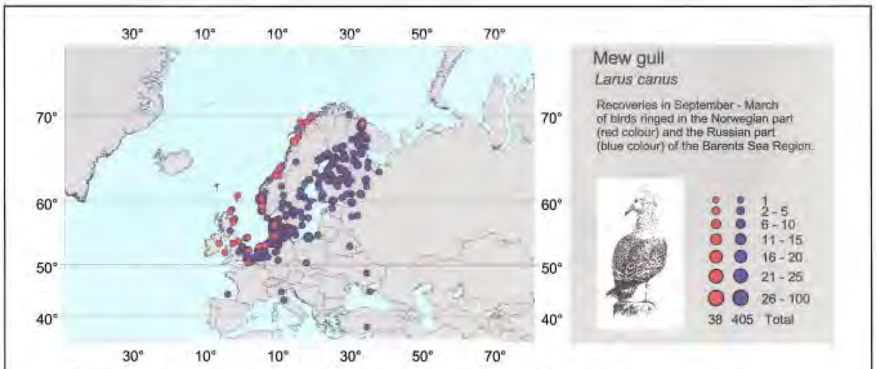
Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	>20 000	1990s	0	1981-95	(0)	1930-1982	1,6
MC	500	1990s	0	1980s-90s	-	-	2
WS	8000	1990s	+1	1983-95	+2	1960-1976	2, 3 4
ND							
NZ							
FJL							
SV	5	1996	(0)	-	-	-	5
All	>28 500	-	-	-	-	-	

1. K.-B. Strann, unpubl. data, 2. V. Bianki, unpubl. data, 3. Bianki 1963, 4. A. Cherenkov & V. Semashko, unpubl. data, 5. Strann 1998, 6. Soot-Ryen 1941a

Population status and historical trends

There has been a change in the distribution of the breeding sites of the mew gull in north Norway. Prior to the Second World War, it was very common on the outermost coast, but has since decreased there and increased on the inner parts of the coast, especially in the fjords. It has also increased markedly on many inland waters. No specific information on the size of the breeding population exists, but there are at least 20 000 pairs in north Norway (K.-B. Strann, unpubl. data). Hence, the species has not decreased, but rather shown a slight increase. In the White Sea, the breeding population has increased from ca. 3700 pairs in the 1960s (Bianki 1963) to about 8000 pairs at the beginning of the 1990s (A. Cherenkov & V. Semashko, pers. obs). There is no information on the status of *L. c. heinei*. In 1977, it was estimated (V. Bianki, unpubl. data) that there were some 6000 non-breeding birds on the Kanin Peninsula and in Mezenski Bay.





Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Feeding ecology

In north Norway, the mew gull feeds both on land and at sea. On land, it takes invertebrates and berries, on the seashore mainly invertebrates such as amphipods and worms, and at sea it takes copepods and small fish. It also feeds regularly on garbage in towns and at dumps, and takes eggs and chicks from birds such as waders and terns (Strann 1985).

In Russia the species also feeds on both land and at sea. In the White Sea Region, it feeds mainly on blue mussels *Mytilus edulis* and also some fish (e.g. *Gasterosteus aculeatus*), but in the Barents Sea it takes mainly fish such as herring *Clupea harengus* and cod *Gadus* spp., sandeels *Ammodytes tobianus* and some mussels. On land, insects and berries are the main diet (Gorchakovskaya 1948, Belopolski 1957b, Bianki 1967, Krasnov *et al.* 1995).

Threats

There are no known threats to the species except for predation on eggs and chicks by large gulls, and some adults are killed by raptors such as the peregrine falcon *Falco peregrinus* and northern goshawk *Accipiter gentilis*. Large numbers of eggs used to be harvested, but this is no longer a threat.

Special studies

Studies on the general biology of the mew gull have been carried out on Seven Islands (Gorchakovskaya 1948, Belopolski 1957a), in Kandalaksha Bay (Bianki 1967) and in the Solovetskie archipelago (Cherenkov, in press). In north Norway, Strann (1985) studied the choice of feeding habitat and feeding methods.

Recommendations

It is important that monitoring continues in the Kandalaksha State Nature Reserve in the White Sea and in the Solovetskie archipelago. Since the mew gull is declining in southern Norway (Gjershaug *et al.* 1994), a monitoring programme should be initiated in north Norway. A number of colonies from Helgeland in the south to Varanger in the north should be added to the ongoing monitoring programme of breeding seabirds. We recommend that additional information such as egg production and breeding success should also be noted in all the monitoring areas. This would show whether the problems found further south also occur on the breeding grounds in the north.

Karl-Birger Strann & Vitali V. Bianki

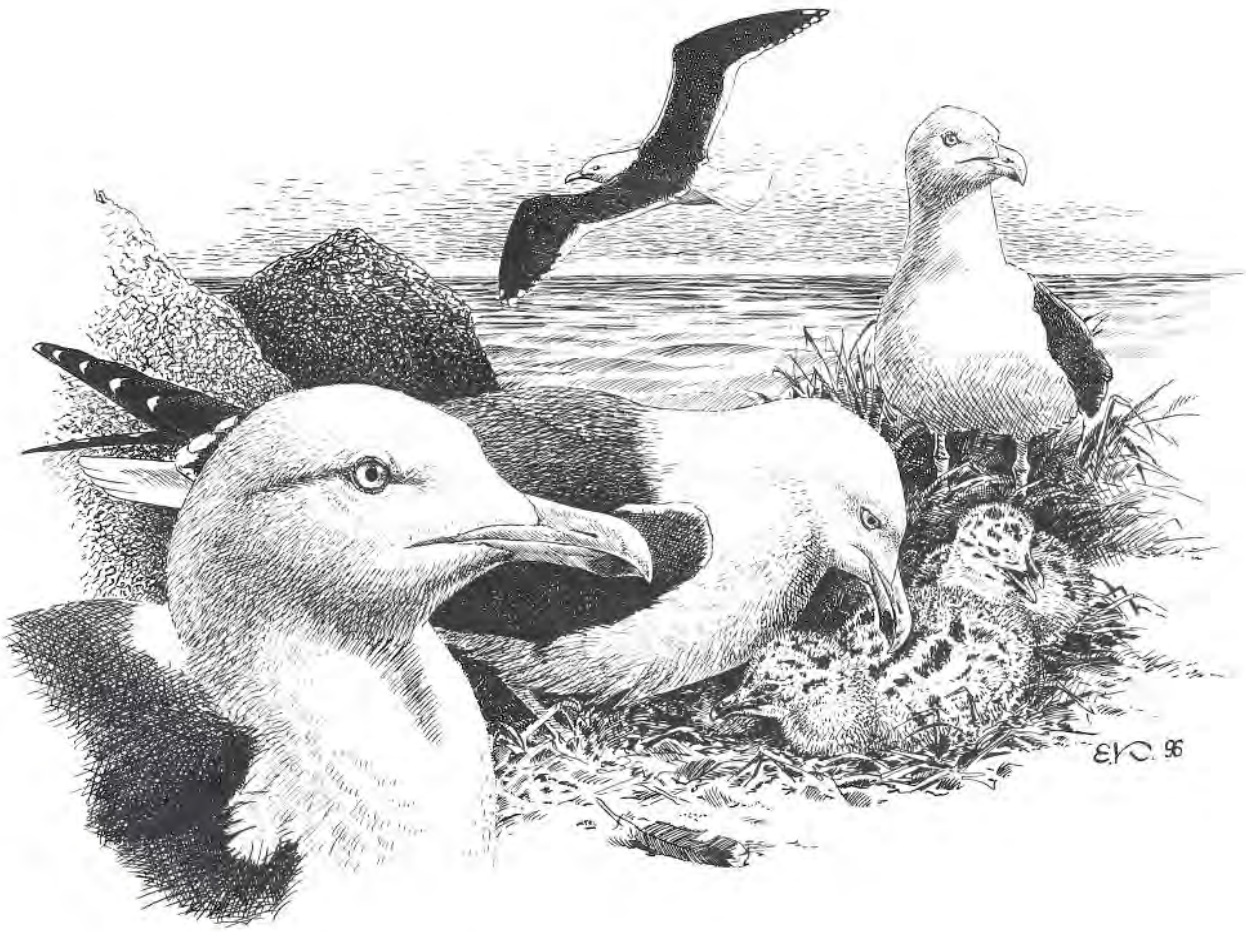
Diet of the mew gull *Larus canus* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Tromsø	1978-80	fish, amphipods, worms, insects, garbage, birds eggs	Adults	1
MC	Several	1948, 1957, 1967, 1995	fish, mussels, insects, berries	Adults	2, 3, 4, 5
WS	Several	1948, 1957, 1967, 1995	fish, mussels, insects, berries	Adults	2, 3, 4, 5,

1. Strann 1985, 2. Gorchakovskaya 1948, 3. Belopolski 1957b, 4. Bianki 1967, 5. Krasnov *et al.* 1995

Lesser black-backed gull *Larus fuscus*

No: Sildemåke Ru: Klusha



Population size: <2500 pairs
Percent of world population: ca. 1%
Population status: Large decrease

General description

The lesser black-backed gull *Larus fuscus* is a medium-sized gull, slightly smaller than the herring gull. It breeds along the coasts of north-west Europe, in the Baltic Sea and along the coasts of Norway and Russia east to the White Sea, as well as in Karelia. The species has a complicated systematics which has been studied by a number of people over many years. The sub-species *L. f. graellsii* breeds in north-west Spain, France, Britain, Ireland and Iceland, *L. f. intermedius* breeds in the Netherlands, Germany, Denmark and southern Norway and the nominate *L. f. fuscus* breeds in Sweden and northern Norway to the western part of the Kola Peninsula and the western White Sea in Russia (Barth 1968, Cramp & Simmons 1983, Stepanyan 1990) and accidentally on Bjørnøya. Cramp & Simmons (1983) and other writers have also recognised a fourth sub-species, *L. f. heuglini*, that breeds in southern parts of the Kola Peninsula and east to the River Yenisey. However, Filchagov *et al.* (1992) claimed that *L. f. heuglini* is an independent species, the western Siberian gull, readily distinguished from *L. f. fuscus*. We follow Cramp & Simmons (1983) and consider *L. f. heuglini* to be a lesser black-backed gull.

There are no recent data giving a proper estimate of the total population of the species, but the south-western populations (*graellsii, intermedius* and *heuglini*) probably do not exceed 200 000 pairs (Cramp & Simmons 1983). The *fuscus* population is under 15 000 pairs (Renno 1978, Kilpi *et al.* 1980, Cherenkov & Semashko 1992, Strann & Vader 1992).

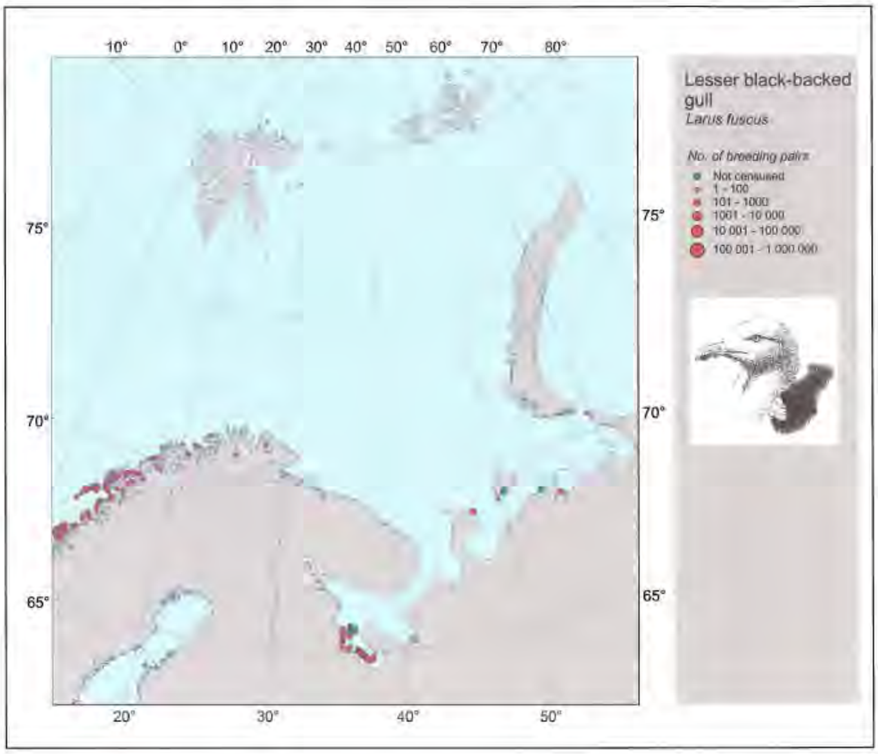
Population sizes and trends of the lesser black-backed gull *Larus fuscus* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	<600	1995	-2	1985-95	-2	1935-85	1, 2
MC	0	1990	-	-	-2	1970-95	3, 4
WS	1600	1992	-	-	+1	1960-90	3, 4
ND	333	?	-	-	-	-	5
NZ	0						
FJL	0						
SV	0						
All	<2500	-	-	-	-	-	

1. Strann & Vader 1992, 2. Vader *et al.* 1990, 3. Bianki 1963, 4. Cherenkov & Semashko 1991, 5. SCRIB 1998

Breeding distribution and habitat preferences in the Barents Sea Region

The lesser black-backed gull *fuscus* breeds in scattered colonies along the Norwegian coast and the northern parts of Russia east to Taimyr except on the Kola coast. Many of the colonies are situated many kilometers from the shoreline, often on bogs or other flat areas with rich vegetation. Some colonies are on small islands on the outermost parts of the coast, nearly always in an area with rich, dense vegetation. In Onega Bay, the species breeds in well-developed meadow or tundra-like areas (Filchagov *et al.* 1992).



Movements

L. f. fuscus is migratory and leaves the breeding areas as early as August-September, following a south-easterly route to the Black Sea and eastern parts of the Mediterranean where a few are known to winter. However, most birds continue to eastern Africa where they winter between the Rift Valley lakes and south to Malawi and Zambia. Some winter on the coasts of the Arabian Sea and the Persian Gulf (Dementjev & Gladkov 1951b, Cramp & Simmons 1983). The immatures remain in the wintering areas through the summer, apart from a limited northward migration. Young birds are only exceptionally found on the breeding grounds during the breeding season. The adults arrive on the breeding grounds in late May and early June.

Population status and historical trends

Fewer than 35 000 pairs of lesser black-backed gulls breed along the Norwegian coast (Gjershaug *et al.* 1994). In Norway north of the Arctic Circle, no more than 600 pairs breed regularly, following a marked decline during this century. The species has also disappeared from the Murman coast and the north-western part of the White Sea, but still breeds in Onezhski Bay in the southern part of the White Sea. In this region, the number of breeding pairs has increased and in the early 1990s it was estimated to be ca. 1600 pairs. However, the distribution pattern had changed; in the 1960s Bianki (1963) found many small colonies on a number of islands, but in the 1990s there were only a few relatively large colonies (Cherenkov & Semashko 1991).

Feeding ecology

There is limited information on the feeding biology of the lesser black-backed gull in this region. Strann (1985) and Strann & Vader (1992) showed that in northern Norway the species is a typical offshore feeder with a very limited terrestrial diet. It was unlikely to feed on rubbish dumps, although this is seen to a certain extent in Finland (Bergman 1960, 1982). In the White Sea Region, the species feeds a great deal at sea, but also takes a significant amount of terrestrial food, such as insects and berries, and feeds on rubbish dumps (Bianki 1967).

Threats

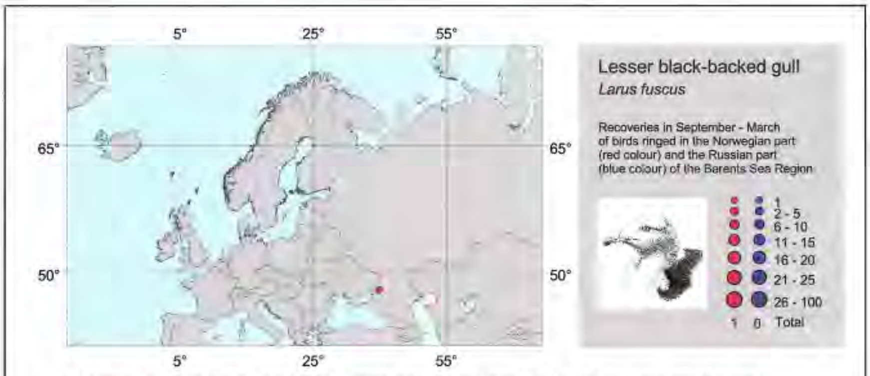
Very little information is available regarding the cause of the decrease of the species in Norway, the Murman coast and the north-western part of the White Sea. Myrberget (1985) and Strann & Vader (1992) suggested that a change in the food resources during the breeding season was the main reason for the decrease in local populations in Troms and Finnmark. At least for the southern part of the Norwegian coast, the near total collapse of the huge stock of Atlanto-Scandic herring *Clupea harengus* in the late 1960s was a possible explanation for the decrease found here. The post-larvae of the herring are an important food source for many fish-eating seabirds in the region, such as the black-legged kittiwake *Rissa tridactyla*, Atlantic puffin *Fratercula arctica* and the common guillemot *Uria aalge* (Vader *et al.* 1990, Anker-Nilssen *et al.* 1997). A lack of sufficient post-larvae herring results in starvation and large-scale mortality of the chicks shortly after hatching. This hypothesis is supported by the fact that in 1989 the herring had a good spawning season, and all the fish-eating birds, including the lesser black-backed gull, had a high breeding success (Lorentsen 1990, pers. comm.).

Very little is known about why the species has disappeared from large areas of Russia, but the change may again be explained by local reductions in food supply as a result of human impact on the environment, inter-specific competition, or less food being available in the breeding or wintering areas (Bianki 1967, Bergman 1982, Bevanger & Thingstad 1990).

Diet of the lesser black-backed gull *Larus fuscus* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Meløy	1977-80	Fish	Adults	1, 2
WS	White Sea	1960s	Fish, berries, insects	Adults	3

1. Strann 1985, 2. Strann & Vader 1992, 3. Bianki 1967



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Special studies

In Norway, Thingstad (1986) and Bevanger & Thingstad (1990) found indications that the decline in the population was related to feeding conditions on the breeding grounds, whereas Myrberget (1985) and Strann & Vader (1992) concluded that the collapse in the herring stock, resulting in the disappearance of post-larvae, which are an important food item for the chicks, was the main reason for the decline. Some colonies in central Norway and in the Solovetskie State Nature Reserve in the White Sea are being monitored.

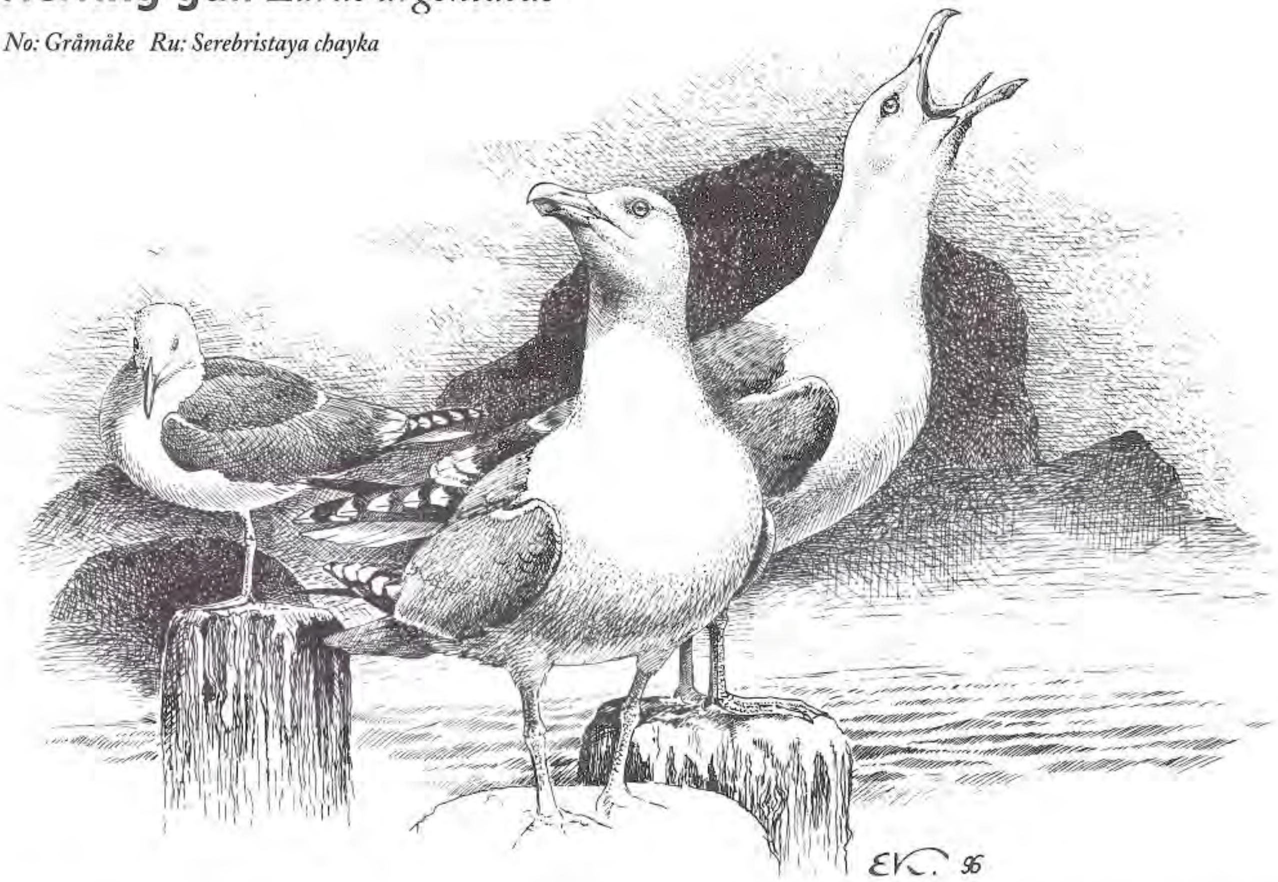
Recommendations

The population monitoring in Norway and in the Solovetskie State Nature Reserve should continue and be expanded to include demographic parameters. A new monitoring site should be established in Lofoten and another elsewhere north of the Arctic Circle. A study concerning the food of the chicks should begin in both Helgeland and Lofoten to clarify whether food shortage is the main reason why young are not being produced. Since another sub-species (probably *L. f. intermedius*) is now becoming established in the former *L. f. fuscus* breeding range north to at least Loppa in Finnmark, a study should commence to find out the effect of the resulting increased intra-subspecific competition.

Karl-Birger Strann, Vladimir Yu. Semashko & Alexander E. Cherenkov

Herring gull *Larus argentatus*

No: Gråmåke Ru: Serebristaya chayka



Population size: ca. 126 000 pairs
Percent of world population: ca. 7%
Population trend: Reasonably stable

General description

The herring gull, which has the typical characters of the genus *Larus*, has a circumpolar distribution. It breeds along the coast from 30-70°N, but may also breed far inland (e.g. in Switzerland) (Cramp & Simmons 1983). The world population is estimated to be 1.75-2 million pairs (Lloyd *et al.* 1991). The largest breeding concentrations are found in the North Atlantic.

Its size is variable. Small females may overlap with lesser black-backed gulls *Larus fuscus*, and large males may approach the size of a great black-backed gull *L. marinus* (Cramp & Simmons 1983). It has long, broad wings and relatively short, pink legs. Adults are grey over the back and wings, and the primaries have a black tip. The rest of the body is white. Immatures are grey and black, their body and wing feathers gradually fading into the adult colour as they grow older. They reach adult plumage during their fourth winter/summer (Grant 1989). Several sub-species of the herring gull are recognised, and these are often arranged in three groups, the *argentatus* group in Europe north of France and in America, the *cachinnans* group in Europe south of France and in the Mediterranean, and the *armenicus* group in eastern Turkey and western Iran (Grant 1989). The taxonomy of the species is very complex. Adult birds from the *argentatus* group are mainly pink-legged, adults from the *cachinnans* group are mainly yellow-legged, and birds from the *armenicus* group have a smaller body and a more rounded head (Grant 1989).

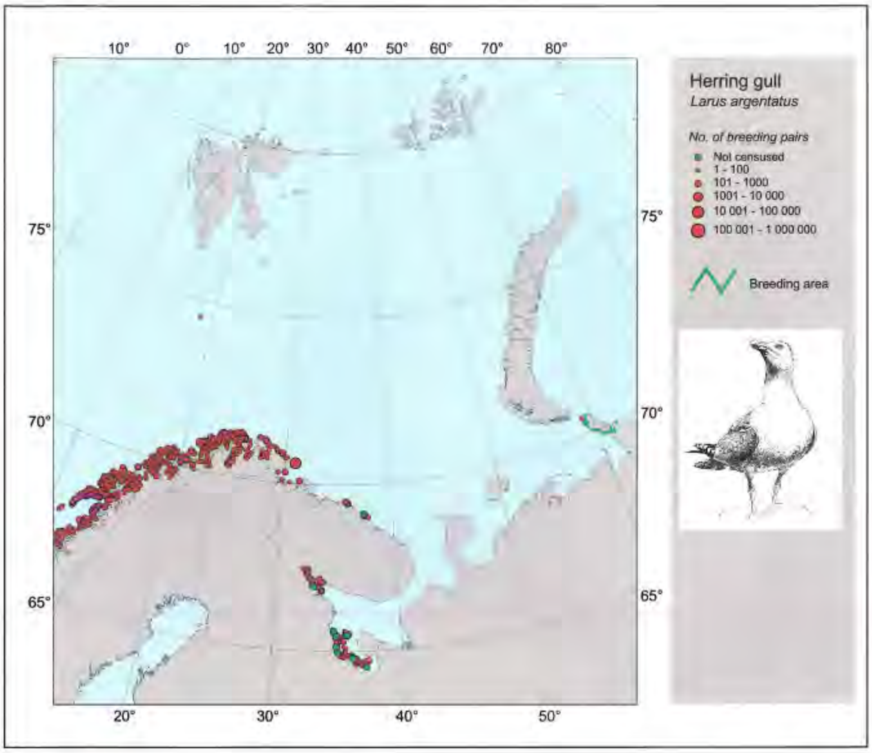
Population sizes and trends of the herring gull *Larus argentatus* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	100 000	1990-95	-	-	-	-	1
MC	17 500	1985	-	-	-	-	2
WS	8700	1995	-	-	-	-	3, 4
ND	0						
NZ	0						
FJL	0						
SV	0						
All	126 200	-	-	-	-	-	

1. K.-B. Strann, S.-H. Lorentsen, pers. comm, Norwegian Seabird Registry 1998, 2. Tatarinkova 1991, 3. Bianki & Paneva, in press, 4. Cherenkov & Semashko, pers. comm.

Breeding distribution and habitat preferences in the Barents Sea Region

The herring gull is common in the Barents Sea Region. It breeds along the whole Norwegian coast, on islands off the Murman coast and in Kandalaksha Bay and Onezhski Bay in the White Sea. Some pairs also nest in the entrance to the White Sea and single pairs are known to breed on Vaygach Island (Karpovich & Kokhanov 1967). Most colonies are situated on grassy islands, preferably away from human settlement. Nests may also be found far inland on lakes or moorland. The nests are built on the ground or on ledges on bird cliffs.



Movements

The herring gull is a partial migrant in northern Norway and Russia (Cramp & Simmons 1983). In the period between breeding and the onset of migration in late September to early October, large flocks of gulls may be observed at rubbish dumps, fur farms and in harbours. These flocks include both immatures and adults. Many Norwegian birds follow the coastline to Britain and France to winter around the North Sea and English Channel. Birds from northern Norway generally winter further south than birds from southern Norway (Haftorn 1971).

Herring gulls from the Murman coast use two routes to their wintering grounds; along the Scandinavian coastline or across the Kola Peninsula and the White Sea to the Bay of Bothnia (I. Tatarinkova, unpubl. data). The latter route may also be used by Norwegian birds, which have been observed migrating southwards along Pasvikdalen possibly on their way to the Bay of Bothnia (S.-H. Lorentsen, unpubl. data). Haftorn (1971) also suggested that Norwegian birds migrate from the Norwegian coast to the Bay of Bothnia across the Fennoscandian mainland. Russian birds are sometimes found along the Norwegian coast during the winter (Haftorn 1971).

Most herring gulls from the White Sea move to the North Sea through the Baltic Sea. The Onega population, however, first moves to Dvinski Bay and the mouth of the River Severnaya Dvina before migrating to the same wintering quarters as other Barents Sea birds, using a more easterly flyway along the eastern coast of the Baltic Sea. Several autumn ring recoveries of juveniles from the White Sea have been made in the Barents Sea and the Adriatic Sea (Dementjev & Vuchetich 1947, Bianki 1967, Tatarinkova 1970).

Diet of the herring gull *Larus argentatus* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Hornøy	1983	Capelin, sandeel. offal, crabs, seabird chicks and eggs	Chicks	1
MC	Aynov Island	1949-51	Fish, molluscs, crustacea	Chicks/adults	2
		1966-68	Fish (herring, capelin), crustacea	Chicks/adults	3
		1984-85	Garbage, fish, insects	Chicks/adults	3
		1991-95	Fish, molluscs, echinodermata Fish, molluscs	Chicks/adults	4
	Seven Islands	1935-49	Fish, garbage	Chicks/adults	5
		1982-85		Chicks/adults	6
WS	Kandalaksha Bay	1957-59	Molluscs *(Mytulis edulis)*, berries, fish	Chicks/adults	7
		1981-84	Molluscs *(Mytulis edulis)*, fish, garbage	Chicks/adults	8

1. Furness & Barrett 1985, 2. Belopolski 1957b, 3. Tatarinkova 1989, 4. I. Tatarinkova, unpubl. data, 5. Belopolski 1971, 6. Krasnov *et al.* 1995, 7. Bianki 1967, 8. V. Bianki, pers. comm.

Population status and historical trends

It is estimated that 126 000 pairs of herring gulls breed in the Barents Sea Region, most of them along the Norwegian coast, but considerable uncertainty surrounds this figure. The breeding population has grown in the whole region since the 1960s. For instance, about 6700 pairs bred on the Murman coast in the early 1960s (Gerasimova 1961). An extensive trawler fishery in the 1960s created extremely favourable feeding conditions and herring gull numbers began to increase. In 1985, the Murman coast population totalled more than 35 000 individuals (Tatarinkova 1991). A deterioration in food resources in the late 1970s caused mass non-breeding, chick deaths from starvation and predation, and poor breeding success. As a consequence, the number of herring gulls decreased. Since the early 1990s, the food situation has improved to a certain extent and the number of gulls is stabilising. The number of birds breeding on Bol'shoy Aynov Island increased from the late 1950s to the late 1970s. The population has since decreased. (I. Tatarinkova, pers.comm.).

Only 300 pairs of herring gulls bred in the White Sea in 1953-1956 (Bianki 1975). In the 1960s, there were around 1300 pairs. The food supply has been more stable there and the population now numbers 3700 pairs (Bianki & Paneva, in press). In Onezhski Bay, the number of herring gulls has increased five times since 1965 and in 1995 the breeding population was approximately 5000 pairs (A. Cherenkov & V. Semashko, pers. comm.).

Feeding ecology

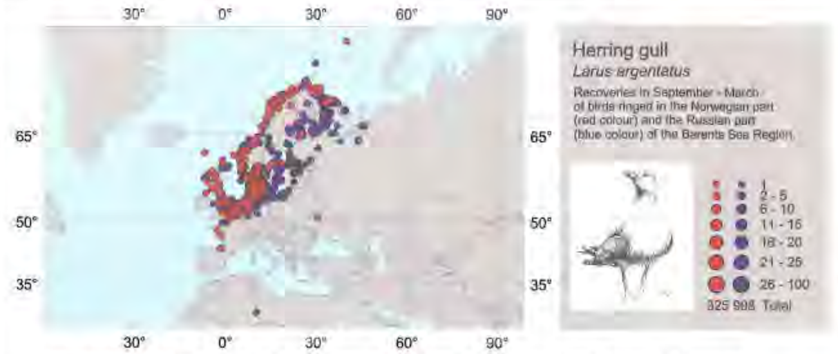
The herring gull is flexible in its food choice, taking a variety of food (Cramp & Simmons 1983) obtained in many different ways, including scavenging, piracy, predation, surface dipping and plunging, surface seizing and, sometimes shallow diving (Cramp & Simmons 1983).

Strann (1985) found that herring gulls near Ørnes and Tromsø ate small prey caught on the surface of the sea to a greater extent than great black-backed gulls. Both species were commonly associated with fish factories and fishing boats and located food on beaches by flying over them. The herring gull seemed more successful than the great black-backed gull at rubbish dumps because it moved objects and searched below them more frequently. The herring gull was also more successful on hard beaches than the great black-backed gull because it was better at digging in the gravel to seek food. At Hornøy herring gulls took capelin, crabs, seabird chicks and eggs, and offal (Furness & Barrett 1985).

On the Murman coast, the main food of the herring gulls is fish that they either catch themselves or pick up as waste from the fishery. Other food items (molluscs, crustaceans, echinoderms, insects and berries) are normally of less importance. Eggs and chicks are also rare in the diet on the west Murman coast. On the east Murman coast, however, herring gulls prey on cliff-nesting birds. The proportion of fish in the diet is lower here than on the Aynov Islands, but changes in the fish stocks are still of decisive significance (I. Tatarinkova, pers. obs.).

When fish are less accessible, consumption of food originating from humans increases. When this happens, the number of herring gulls on the breeding islands drops and large flocks gather in towns, at open dumps and fur farms. This tendency is more common in the herring gull than in the great black-backed gull (Tatarinkova & Krasnov 1984, Paneva 1989).

In the White Sea, the main food consists of molluscs (mainly *Mytilus edulis*), berries and insects and the proportion of fish in the diet is lower than on the Murman coast. Here, the herring gull preys on eggs and chicks to a much greater extent than in the Barents Sea. The role of food originating from humans has increased in recent years (Bianki 1967, Bianki & Paneva, in press).



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Threats

There are probably no serious threats to the breeding population of herring gulls in the Barents Sea Region, although both egg harvesting and depletion of the fish stocks may cause some local populations to decline. There is practically no harvesting of eggs on the Murman coast at present as half the colonies are in protected areas. Along the Norwegian coast, some colonies are heavily harvested early in the egg-laying period (e.g. at Hornøya), but the birds are allowed to relay and incubate in peace later in the season (after 14 June).

As the herring gull is at the highest trophical level, environmental contaminants may be a problem, at least locally. The main organochlorines found in herring gull eggs from east Finnmark (Hornøya), west Finnmark (Hjelmsøy and Gjesvær), south Troms and north Nordland (Hekkingen, Bleiksøy and Skarvklakken) and Lofoten (Røst) were PCB, p,p'-DDE and HCB. The levels, however, were well below those that are expected to affect breeding (Barrett, Skaare *et al.* 1985). Mercury levels were also low. No significant changes in the levels of these contaminants were found between 1972 and 1983 (Barrett, Skaare *et al.* 1985), but the levels have decreased since (Barrett *et al.* 1996). The level of chlorinated hydrocarbons in seabirds from the Barents Sea has decreased since the 1980s (Savinova, Gabrielsen *et al.* 1995).

Special studies

In Norway, including Svalbard, there have been few special studies of the herring gull, except a study on habitat choice and feeding methods by Strann (1985). In Russia, however, several studies have been made during the last 50 years. Tatarinkova (1975) studied its morphology, and migration patterns and wintering distribution were studied by Dementjev & Vuchetich (1947) and Tatarinkova (1970). Food needs were studied by Belopolski (1957a) and Krasnov *et al.* (1995), and food and foraging ecology by Belopolski (1957a), Tatarinkova (1989), Krasnov (1989) and Krasnov *et al.* (1995). Breeding ecology was studied by Tatarinkova (1982a), sex identification by Tatarinkova & Shklyarevich (1978) and nesting behaviour by Tatarinkova (1990a).

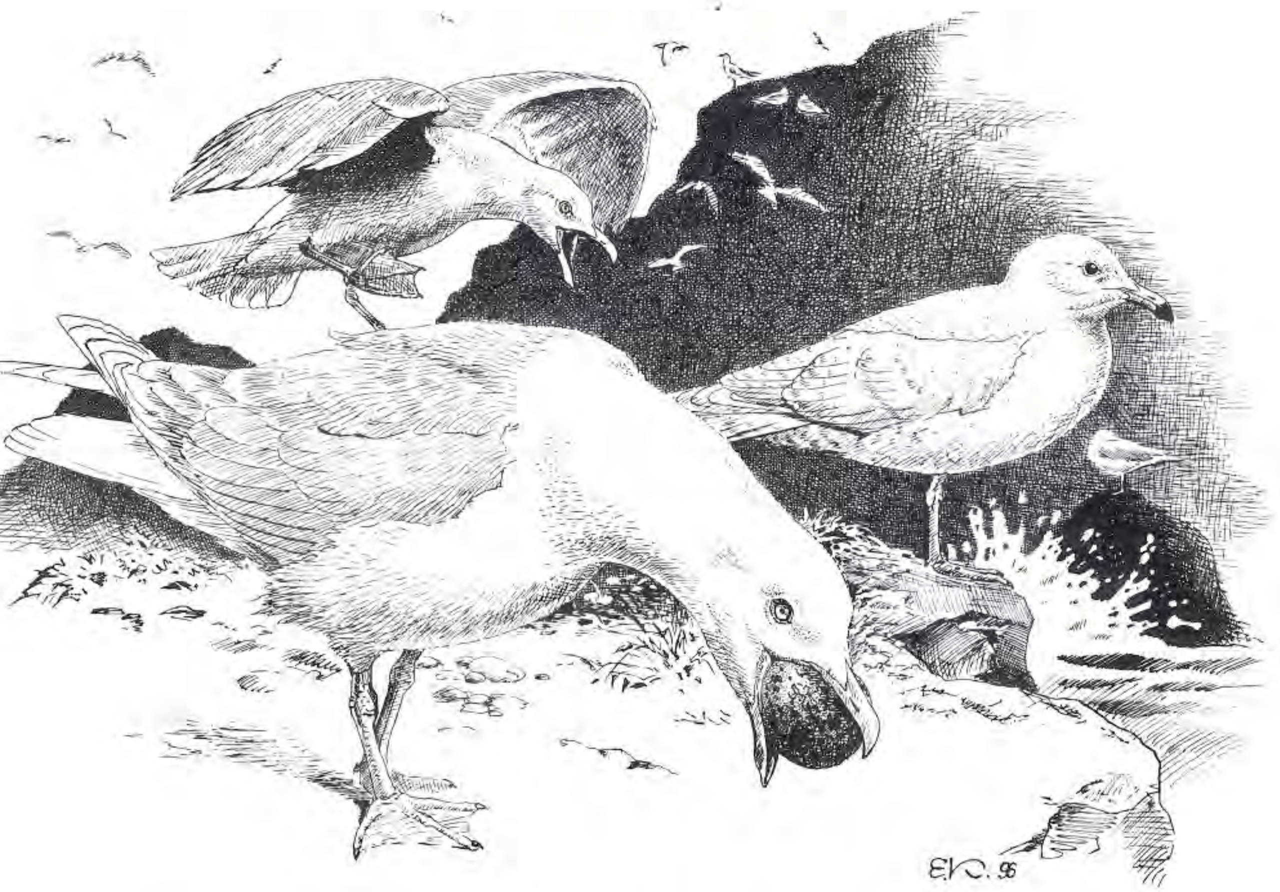
Recommendations

A more accurate estimate of the breeding population in the whole Barents Sea Region should be obtained. Monitoring should be initiated throughout the region. The level of environmental pollutants should be monitored at regular intervals.

Svein-Håkon Lorentsen &
Ivetta P. Tatarinkova

Glaucous gull *Larus hyperboreus*

No: Polarmåke Ru: Burgomistr



Population size: 7000-17 000 pairs
Percent of world population: 7-17%
Population trend: Reasonably stable

General description

The glaucous gull is one of the largest gulls breeding in the Arctic and the only numerous avian predator in Svalbard, Franz Josef Land and Novaya Zemlya. It nests along the coasts and on the open tundra, dispersed or in colonies, often near other seabird colonies. It is the only white-winged gull breeding in the Barents Sea Region.

The glaucous gull has a circumpolar distribution in the Arctic. It is variously considered to be monotypic or polytypic (del Hoyo *et al.* 1996). Four sub-species are normally recognised, and the nominate race *L. h. gunnerus* breeds in the Barents Sea Region (del Hoyo *et al.* 1996). The total world population is probably over 100 000 pairs (del Hoyo *et al.* 1996).

Population sizes and trends of the glaucous gull *Larus hyperboreus* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	0						
MC	0						
WS	0						
ND	ca. 1500	1960-94	+	1980-90	(0)	(?)	1
NZ	ca.1000	1936-96	(?)	-	-	-	1
FJL	ca. 500	1991-96	(?)	-	-	-	1
SV	4000-10 000	1970-96	(0)	1986-97	-	-	1
All	7000-17 000	1936-97	(0)	-	-	-	1

1. SCRIB 1998

Breeding distribution and habitat preferences in the Barents Sea Region

The glaucous gull has never been found breeding on the Norwegian coast or in the White Sea (Kokhanov 1981b, Gjershaug *et al.* 1994, Rogacheva *et al.* 1995). Nesting is only known to have taken place at one locality on the Kola Peninsula, near the mouth of the River Ponoy (Kokhanov 1981b, Rogacheva *et al.* 1995). The species breeds along the coast from the Kanin Peninsula eastwards (Yudin & Firsova 1988b) and is a common breeder on Novaya Zemlya, Franz Josef Land (Yudin & Firsova 1988b) and Svalbard (Løvenskiold 1964).

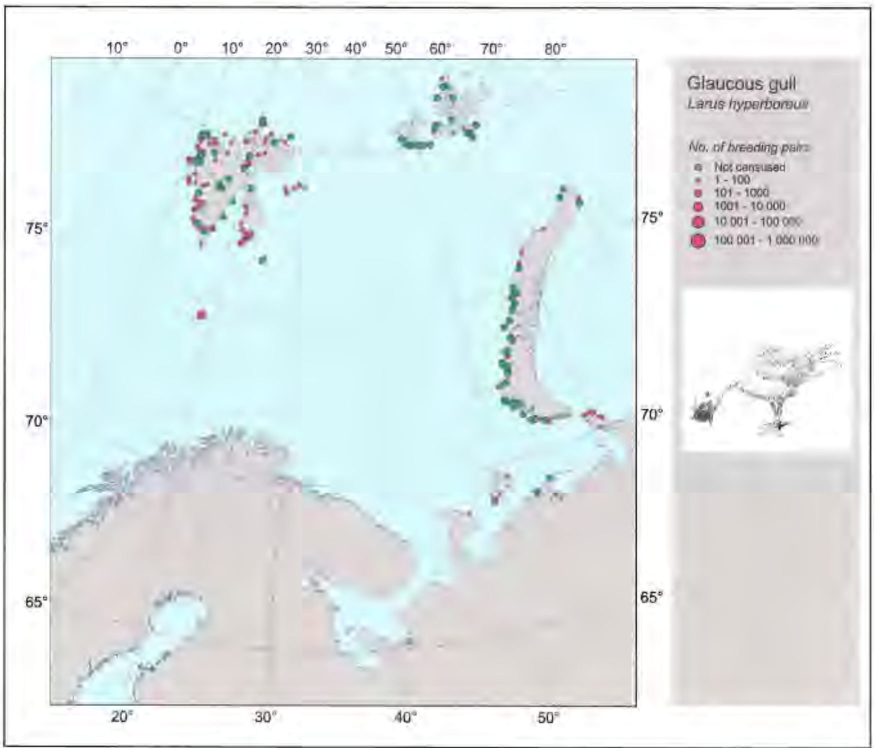
Most colonies in the Barents Sea Region are rather small and are often close to other seabird colonies. The largest colony is on Bjørnøya where the total population is estimated to be about 2000 pairs (Mehlum & Bakken 1994). Glaucous gulls breed in flat areas or on ledges on steep cliffs.

Movements

The glaucous gulls breeding in the Barents Sea Region winter mainly in the northern part of the Atlantic Ocean and remain there from November-December to February-March (Yudin & Firsova 1988b). Uspenski (1969b) reported that glaucous gulls left the northern island of Novaya Zemlya in October-November, and the last observations were in late December (1948/1949 and 1949/1950). The first spring arrivals were observed on 8 March. Dubrovski (1937) reported that glaucous gulls were seen all winter in Matochkin Shar Strait on Novaya Zemlya.

The majority of adult birds migrate from Franz Josef Land in mid-September, and immature birds leave about two weeks later (Gorbunov 1932). In spring, birds arrive in March and new birds arrive until mid-May (Gorbunov 1932). In Svalbard, most birds arrive in March-April and leave from mid-September. In autumn most birds have left the area by 15 October (Løvenskiold 1964).

During the migration period, glaucous gulls have been observed in the Ukraine (Gavrilenko 1960), southern Russia (Barabash-Nikiforov & Semago 1963) and Latvia (Viksne 1983). There are 84 reported recoveries of glaucous gulls ringed in Svalbard (data from the Norwegian Ringing Centre). Most of them are from Greenland (28%), the Faeroes (25%) and Iceland (8%). Others are from the Atlantic Ocean, Norwegian and Russian coasts, Germany and Great Britain. Most of these birds were ringed as chicks and were recovered during the first few years after ringing.



Population status and historical trends

Several large colonies are known along the coast and on islets off Kolguev Island. The largest, with 330 pairs, is on Tonkie Koshki off the south-west coast of the island (Ponamareva 1995). The largest colony on Vaygach Island used to be at Cape Stakan, where Uspenski (1965) reported 150 pairs. Karpovich & Kokhanov (1967) described another 35 colonies with a total of 220 pairs on small islands around Vaygach Island (about 108 islands were investigated). The number of glaucous gulls increased during the 1980s (Kalyakin 1989). The present population on Vaygach Island and the small islands in Khaipudyrskaya Bay is estimated at about 1000 pairs (Kalyakin 1993).

Novaya Zemlya is known to have 55 colonies (SCRIB 1998). The largest, with about 200 pairs, is in the Gribovaya and Bezymyannaya bays (Uspenski 1957). Uspenski (1969b) reported about 17 000 breeding individuals in 1950. Glaucous gulls are distributed over the whole of Franz Josef Land (28 colonies) (Gorbunov 1932, Uspenski & Tomkovich 1986, Pokrovskaya & Tertitski 1993, Frantzen *et al.* 1993), but the total number of individuals is not known. In Svalbard, glaucous gulls breed in at least 203 colonies (SCRIB 1998) and the breeding population is estimated to be 4000-10 000 pairs. There are no data to show any population trend. The population has remained relatively stable on Bjørnøya in 1986-1997 (V. Bakken, pers. obs.).

Feeding ecology

The glaucous gull is a typical predator and generalist, feeding on fish, molluscs, crustaceans, rodents, birds, eggs and chicks, insects, berries, carrion, refuse and offal (del Hoyo *et al.* 1996). Belopolski (1957b) reported that, compared to other large gulls, a larger proportion of its food was obtained on land and this proportion increased considerably with the distance between the nesting area and the sea.

On Vaygach Island, small mammals and birds dominated the diet of glaucous gulls which nested about 2.5 km from the sea, whereas crustaceans, fish and molluscs dominated the food of birds nesting on the small islands (Karpovich & Kokhanov 1967). In the breeding period, glaucous gulls took eggs and chicks from birds nesting on the tundra. Small mammals, especially in years with high numbers, made up a considerable part of the diet in some regions where seabirds were absent (Morozov 1991). Outside the breeding season, polar cod *Boreogadus saida*, arctic char *Salvelinus alpinus* and marine invertebrates were the main food of the glaucous gull (Belopolski 1957b, Karpovich & Kokhanov 1967, Kalyakin 1989). Garbage and waste from fish processing are typical food items of the glaucous gull. In autumn, berries make up a considerable part of its diet in the southern parts of its distribution area (Belopolski 1957b). In western Murman in 1949-1951, Belopolski (1957b) found that fish (39%) and garbage (33%) dominated the diet, whereas on Novaya Zemlya glaucous gulls ate mainly crustaceans (43%) and avian prey (29%).

In Svalbard, the glaucous gull is both a predator and a scavenger (Løvenskiold 1964). On Bjørnøya, its diet consists mainly of eggs and chicks of guillemots, great spider crabs *Hyas araneus* and offal from fishing boats (Bertram & Lack 1933, Duffey & Sergeant 1950, V. Bakken, pers. obs.). A glaucous gull foraging at a glacier face on Spitsbergen had eaten *Thysanoessa* sp. (Hartley & Fisher 1936). In Svalbard in 1966-1969, de Korte (1972) found plants (36%), birds (32%), crustacea (16%), and offal (12%) in 25 stomachs. The stomach contents from two glaucous gulls collected at sea

Diet of the glaucous gull *Larus hyperboreus* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
ND	?	?	Crustaceans, fish, molluscs, eggs and chicks	Adults	1
SV	Bjørnøya	1933-96	Eggs, chicks, great spider crabs, offal	Adults and chicks	2, 3, 4
	Spitsbergen	1933	*Thysanoessa* sp.	Adults	5
	Spitsbergen	1966-69	Plants (36%), birds (32%), Crustacea (16%), offal (12%)	Adults	6
	Hornsund	1980	Little auks (adults)	Adults	7
	At sea	1982	*Gammarus wilkitzkii*, blubber, polar cod	Adults	8
	Spitsbergen	1987-90	Goslings	Adults	9

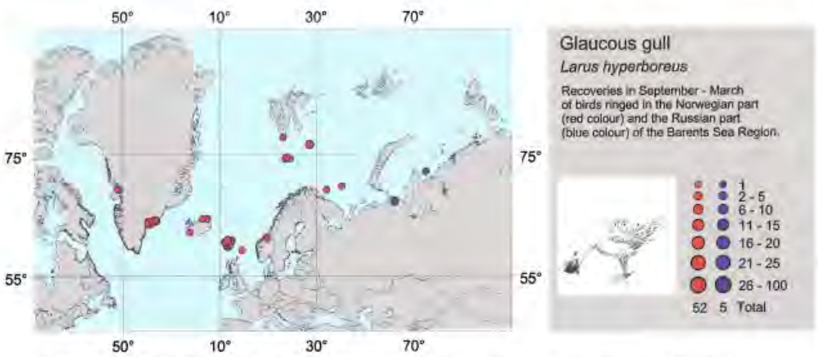
1. Karpovich & Kokhanov 1967, 2. Bertram & Lack 1933, 3. Duffey & Sergeant 1950, 5. Hartley & Fisher 1936, 6. de Korte 1972, 7. Dunin-Kwinta *et al.* 1992, 8. Mehlum & Gjertz 1984, 9. Camphuysen 1993

in 1982 contained *Gammarus wilkitzkii*, blubber, polar cod and *Parathemisto libellula* (Mehlum & Gjertz 1984). Lydersen *et al.* (1985) found a varied menu, including algae, tundra plants, species from several marine phyla and seabirds in 18 birds shot in Hornsund, Spitsbergen, in September-October 1984. Dunin-Kwinta *et al.* (1992) observed that glaucous gulls caught adult little auks *Alle alle* near a breeding colony in Hornsund in 1980. On Spitsbergen in 1987-1990, glaucous gulls fed on barnacle goose *Branta leucopsis* goslings (Camphuysen 1993).

Special studies

Except for the diet studies, no other special studies have been carried out in Russia during the last 40 years. In Svalbard, several investigations have been made on the contents of organochlorines and PCB in glaucous gulls (Bourne & Bogan 1972, Bourne 1976, Carlberg & Böhler 1985, Edelstam *et al.* 1987, Savinova, Gabrielsen *et al.* 1995). As early as 1971, Bourne & Bogan (1972) found high PCB concentrations in glaucous gulls on Bjørnøya.

In 1997, the Norwegian Polar Institute and the Norwegian Institute for Nature Research started a three-year project on Bjørnøya to study the effects of PCB on selected population parameters. The main objective is to study how a sub-lethal PCB load may influence the population development of the glaucous gull.



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Threats

Unfavourable weather conditions and food shortage can negatively effect the breeding success of glaucous gulls (Yudin & Firsova 1988b). In Svalbard, the high levels of PCB may threaten the population (Gabrielsen *et al.* 1995). So far this is not verified, but ongoing research will hopefully clarify the situation.

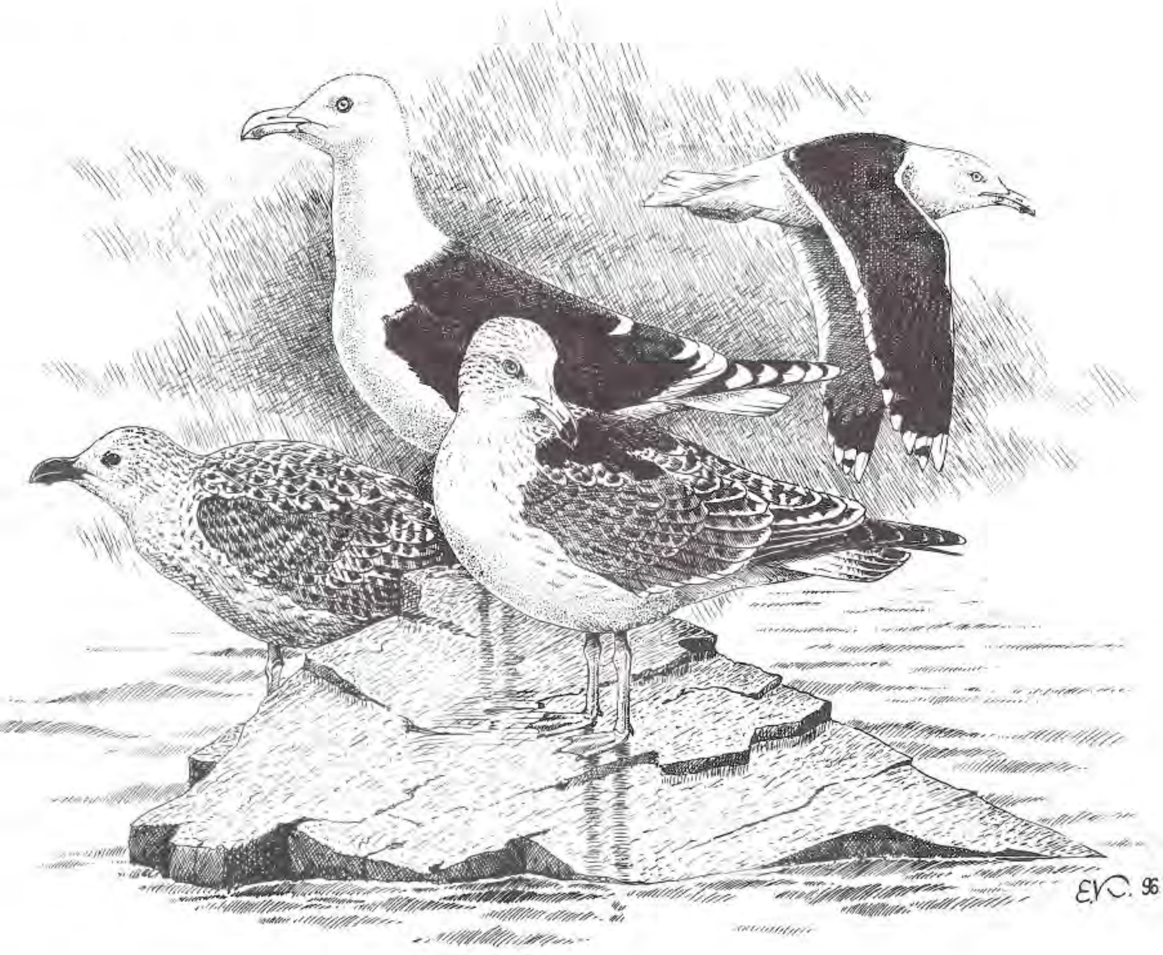
Recommendations

The effort to clarify the possible effects of PCB on the populations of glaucous gulls in the Barents Sea Region should continue. The glaucous gull should be included in the seabird monitoring programme in the Barents Sea Region. The wintering areas of adult birds should be mapped, probably with the help of satellite transmitters as well as ordinary ringing.

Vidar Bakken & Grigori M. Tertitski

Great black-backed gull *Larus marinus*

No: Svartbak Ru: Morskaya chayka



Population size: 33 000 pairs
Percent of world population: 14-28%
Population trend: Reasonably stable?

General description

The great black-backed gull is the largest gull species breeding in the Barents Sea Region. It is distributed from the east coast of North America, from 40°N to 60°N, westwards via Greenland and Iceland to the Norwegian coast, Svalbard and the Murman coast. In Europe, its breeding range extends south to northern France.

The world population is probably between 120 000 and 240 000 pairs (Lloyd *et al.* 1991), most of this uncertainty being due to limited knowledge about Russian populations.

Population sizes and trends of the great black-backed gull *Larus marinus* within the Barents Sea Region.

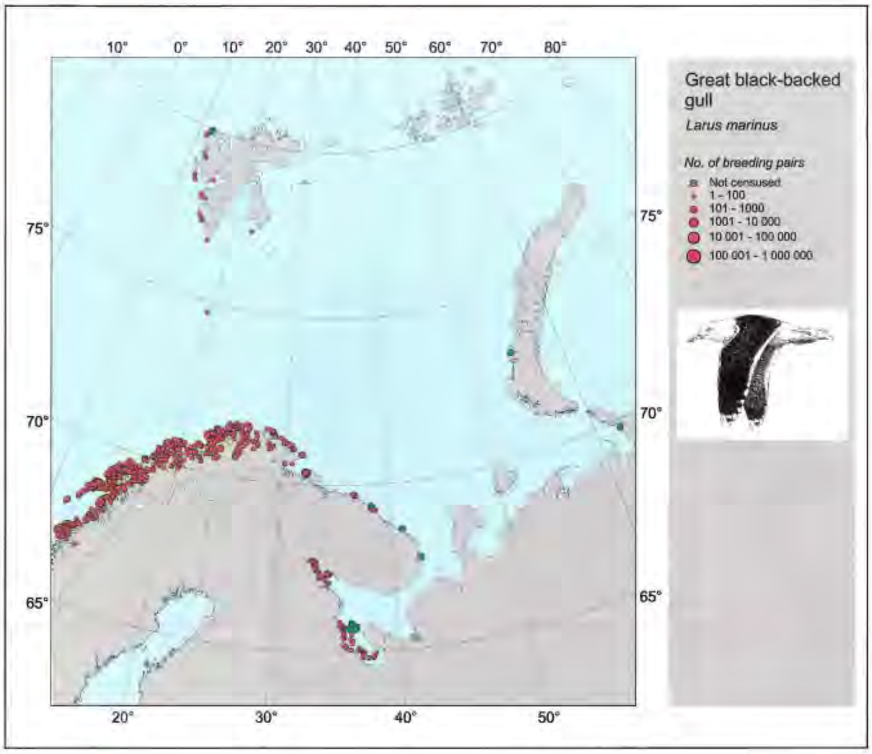
Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	25 000	1995	-	-	-	-	1
MC	7500	1985	-	-	-	-	2
WS	400	-	-	-	-	-	3
ND	1	-	-	-	-	-	
NZ	1	-	-	-	-	-	
FJL	0						
SV	100	1995	-	-	-	-	4
All	33 000	-	-	-	-	-	

1. K.-B. Strann & S.-H. Lorentsen, pers. comm, Norwegian Seabird Registry 1998, 2. Tatarinkova 1991, 3. Bianki & Paneva, in press, 4. Isaksen & Bakken 1995b

The monotypic great black-backed gull has a wingspan of about 1.5 m. The black back and upper side of the wing is very characteristic for the adults. Immatures are grey and black during their first year. The body and wing feathers gradually change during successive moults into the adult colour as they grow older. They reach adult plumage during their fourth winter and the following summer (Grant 1989). The species is an opportunistic predator, scavenger and pirate which obtains its food at sea, in the intertidal zone or by scavenging behind fishing boats, in fields, at rubbish tips or at fish-processing plants (Lloyd *et al.* 1991).

Breeding distribution and habitat preferences in the Barents Sea Region

The great black-backed gull is very common in the Barents Sea Region. It breeds along the whole Norwegian coast, Svalbard and on the Murman coast from Varangerfjord to the mouth of the River Ponoy as well as in Kandalaksha Bay and



Onezhski Bay. Single breeding pairs have been recorded near Vaygach Island (Karpovich & Kokhanov 1967) and on Novaya Zemlya (Belopolski 1957a). The number of breeding pairs decreases to the east, but the species is still quite numerous on the islands of the Kandalaksha State Nature Reserve on the east Murman coast. The easternmost large breeding concentrations are on the islands in Svyatoy Nos Bay. Small colonies are found on coastal islands along the eastern part of the Kola Peninsula at the border between the Barents and the White Seas.

Most colonies are situated on grassy islands along the coast and the fjords, but single nests may also be found far inland on lakes or moorland (e.g. on Finnmarksvidda (G. Bangjord & K.-B. Strann, pers. comm.)). On islands, the nests are situated on the ground or on ledges on bird cliffs.

Movements

The great black-backed gull is a partial migrant in the northern part of its range (Cramp & Simmons 1983), but many individuals winter within the Barents Sea Region. After leaving the breeding islands from the middle of August, birds often visit harbours on the Murman coast and the coast of north Norway to feed on food derived from humans. In autumn (September-October), a general southward migration takes place along the Norwegian coast and very few individuals are recovered north of their initial ringing place in winter (Haftorn 1971). The distance moved by individual birds is, however, variable; some move only a few kilometres, whereas others may travel 400-500 km or more. Many spend the winter along the coasts of the North Sea, and as far south as Spain. Young birds generally move farther south in winter than older ones (Haftorn 1971).

The Barents Sea populations migrate along at least three routes. Most of the birds move west and south around the Norwegian coast to their wintering grounds mainly around the North Sea (Dementjev & Vuchetich 1947, Kokhanov & Skokova 1967, Haftorn 1971). Another migration route is to the entrance of the White Sea, then along the rivers to the Volga delta to the Caspian and Black Seas (Menzbir 1895, Khlebnikov & Yakovlev 1872, 1928, 1930 cited in Lugovoy 1958; Lugovoy 1958, 1963, Tatarinkova 1970). Some birds cross the mainland between the White and Baltic Seas (Tatarinkova 1970, S.-H. Lorentsen, unpubl. data).

Adult great black-backed gulls arrive at their breeding grounds in March-April.

Population status and historical trends

An estimated 33 000 pairs of great black-backed gulls breed in the Barents Sea Region, although considerable uncertainty surrounds this figure. Most nest along the Norwegian coast. The population has grown in the whole region since the 1960s. On the Murman coast (and probably also elsewhere), fluctuations in the number of breeding birds are to a great extent connected with human activity. For a long time, people have eaten the eggs, but after the Seven and Aynov Islands were protected in 1938 and 1947 respectively, the population has increased. In 1960, about 4100 pairs of great black-backed gulls bred on the Murman coast (Gerasimova 1961), whereas in June 1985 more than 15 000 individuals were counted in the same area (Tatarinkova 1991). On Bol'shoy Aynov Island, the number of breeding birds increased from the late-1950s to the late-1970s, since then the population has decreased. (I. Tatarinkova, pers.comm.).

The rise in gull populations since the 1960s may also have been caused by the development of the Barents Sea fishery industry, which supplies the gulls with a permanent food source in the form of waste and offal. The over-harvesting of the fish resources in the Barents Sea in the late-1970s practically deprived large gulls in Russian colonies of their main food source. In subsequent years, there was mass non-breeding and many chicks died of predation and starvation. A partial redistribution of colonies between islands also took place. The number of breeding birds began to drop on islands

Diet of the great black-backed gull *Larus marinus* in the breeding season within the Barents Sea Region.

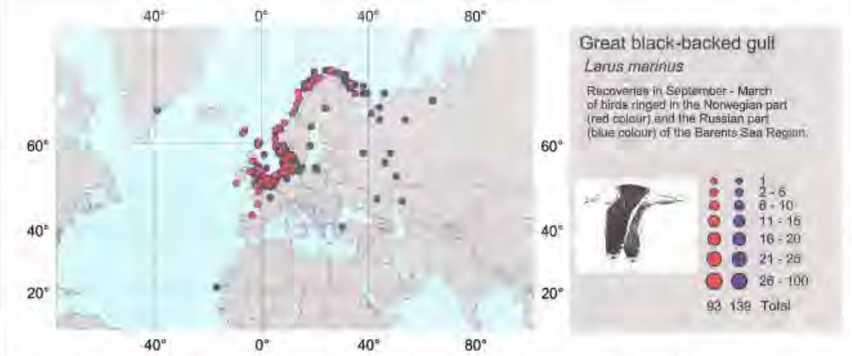
Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
MC	Aynov Islands	1935-49	Herring, cod	Chicks/adults	1
		1966-68	Herring, capelin	Chicks/adults	2
		1971-75	Capelin, cod	Chicks/adults	2
		1981-85	Garbage, haddock, capelin	Chicks/adults	2
		1990-95	Cod, capelin	Chicks/adults	2
		1935-49	Cod, herring	Chicks/adults	1
	Seven Islands	1970	Sandeel	Chicks/adults	3
		1982-85	Cod, sandeel	Chicks/adults	3

1. Belopolski 1957b, 2. Tatarinkova 1989, unpubl. data, 3. Krasnov 1989, Krasnov *et al.* 1995

located far from human-related sources of food, whereas large colonies were established near human settlements. However, the total number of birds remained high (Tatarinkova 1991).

In the second half of the 1980s, the fish resources of the Barents Sea recovered slightly and the gulls largely returned to their earlier way of feeding. The number of breeding pairs, however, continued to drop for some time, possibly as a consequence of the low productivity in years with food deficiency.

The number of great black-backed gulls breeding in the White Sea is small. During the 1960s, only single pairs nested in Kandalaksha Bay and Onezhski Bay. The numbers have since increased significantly, and about 400 pairs now nest in the whole White Sea area (Bianki & Paneva, in press), including 100 pairs in Kandalaksha Bay and Onezhski Bay (A.E. Cherenkov & V.Yu. Semashko, pers. comm.).



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Feeding ecology

The great black-backed gull is flexible in its food choice (Cramp & Simmons 1983), including various fish species, mollusca, crustacea, echinodermata, polychaeta, insects, berries, eggs, nestlings and adult birds of various species, rodentia and human garbage. The proportions of these food items vary between years, seasons and regions, but the basic food is probably always fish.

Strann (1985) found that, near Ørnes and Tromsø, great black-backed gulls ate small prey caught on the surface to a lesser extent than herring gulls. Both species were commonly associated with fish factories and fishing boats and located food on beaches by flying over them. The great black-backed gull seemed to be less successful than the herring gull at rubbish dumps because it moved away items and searched below them less frequently. It was also less successful on hard-bottom beaches than the herring gull because it was less capable of digging into the gravel for food. The great black-backed gull preyed on other birds and ate more carcasses than other gull species. Atlantic puffins *Fratercula arctica* may be caught in the air by the neck or knocked down from behind while sitting on the ground (Cramp & Simmons 1983). Seabird chicks are commonly taken.

Threats

There are probably no serious threats to the breeding population of the great black-backed gull in the Barents Sea Region although egg harvesting and depletion of fish stocks may have caused some local populations to decline. Fewer eggs are harvested on the Murman coast at present as half of the gull colonies are situated within protected areas. Along the Norwegian coast, some colonies are heavily harvested early in the egg-laying period, but the birds may be allowed to relay and incubate later in the season.

As the great black-backed gull is at the highest trophical level, environmental contaminants may be a problem, at least for local populations. The level of chlorinated hydrocarbons in seabirds from the Barents Sea has, however, decreased since the 1980s (Savinova, Gabrielsen *et al.* 1995).

Special studies

In Norway, including Svalbard, there have been few special studies of the great black-backed gull except a study on habitat choice and feeding methods by Strann (1985). In Russia, however, several studies have been carried out over the last 50 years. Tatarinkova (1975) studied its morphology, and migration patterns and winter distribution were studied by Dementjev & Vuchetich (1947) and Tatarinkova (1970). Its food requirements were studied by Belopolski (1957a) and Krasnov *et al.* (1995) and its food and foraging ecology by Belopolski (1957a), Tatarinkova (1989), Krasnov (1989) and Krasnov *et al.* (1995). Breeding ecology was studied by Tatarinkova (1982a), sex identification by Tatarinkova & Shklyarevich (1978) and nesting behaviour by Tatarinkova (1990a).

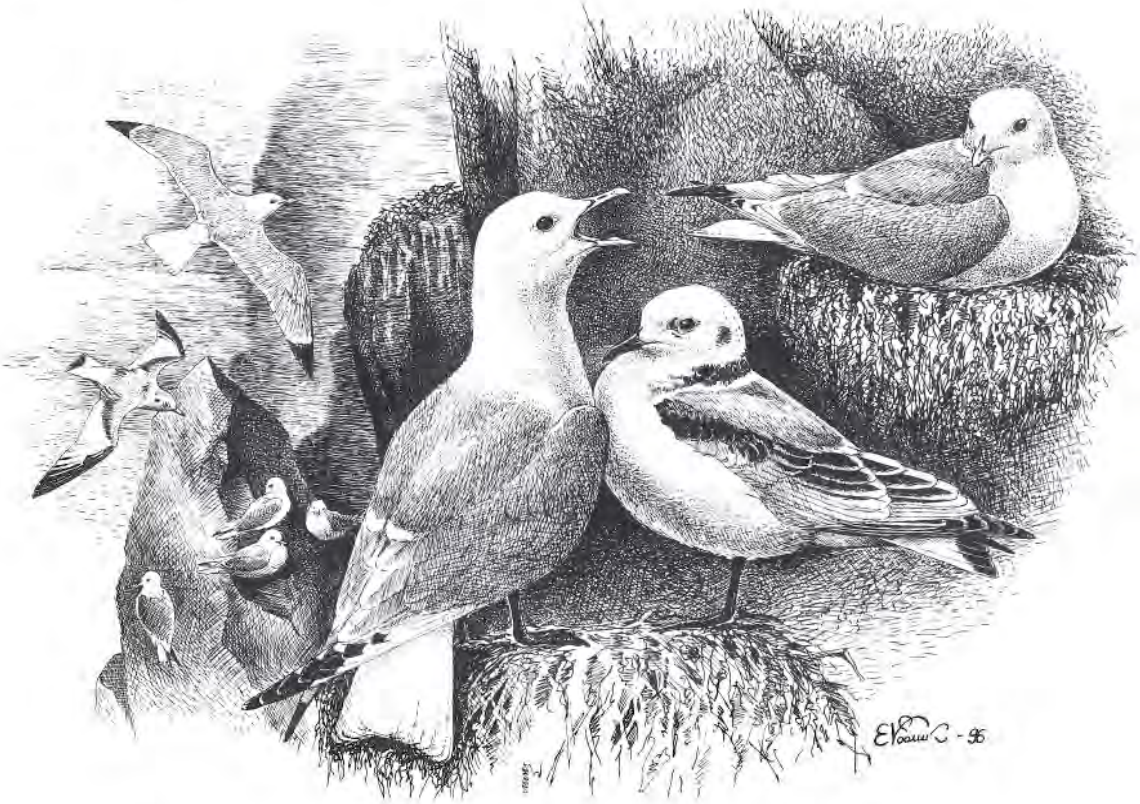
Recommendations

A more accurate estimate of the breeding population should be obtained, and monitoring should be initiated throughout the Barents Sea Region. The level of environmental pollutants should be monitored at regular intervals.

Svein-Håkon Lorentsen & Ivetta P. Tatarinkova

Black-legged kittiwake *Rissa tridactyla*

No: Krykkje Ru: Moevka



Population size: ca. 900 000 pairs
Percent of world population: 11-15%
Population trend: Reasonably stable

General description

The black-legged kittiwake is a small gull and the most pelagic of those that breed in the Barents Sea Region. It has a circumpolar distribution, breeding in the arctic and boreal zones of the northern hemisphere. It breeds in the western Atlantic from Nova Scotia, Newfoundland, Gulf of St. Lawrence, Labrador, Lancaster Sound and Greenland east to Iceland, Jan Mayen, the Faeroe Islands, the British Isles, France and Spain, and north-east to Helgoland, Skagerrak, Kattegat, Norway and the Barents Sea. In Russia, it breeds along the coast to the Pacific and south to Kamchatka (Kuril Islands and Sakhalin). Black-legged kittiwakes also breed on the coast of Alaska and on the Aleutian Islands (Cramp & Simmons 1983, Lloyd *et al.* 1991).

The world population of black-legged kittiwakes is very large and totals ca. 6-8 million pairs (Lloyd *et al.* 1991). However, exact numbers in many regions are unknown. According to Lloyd *et al.* (1991), about half the world population breeds in the Barents Sea, on Iceland and the Faeroe Islands. The total population has probably increased in all parts of its range this century (Lloyd *et al.* 1991).

Most of the population is of the nominate *Rissa tridactyla*, and there is very little geographical variation. An extra-limital sub-species *R. t. pollicaris*, which is slightly larger and darker, has been described in the North Pacific (Cramp & Simmons 1983).

Population sizes and trends of the black-legged kittiwake *Rissa tridactyla* within the Barents Sea Region.

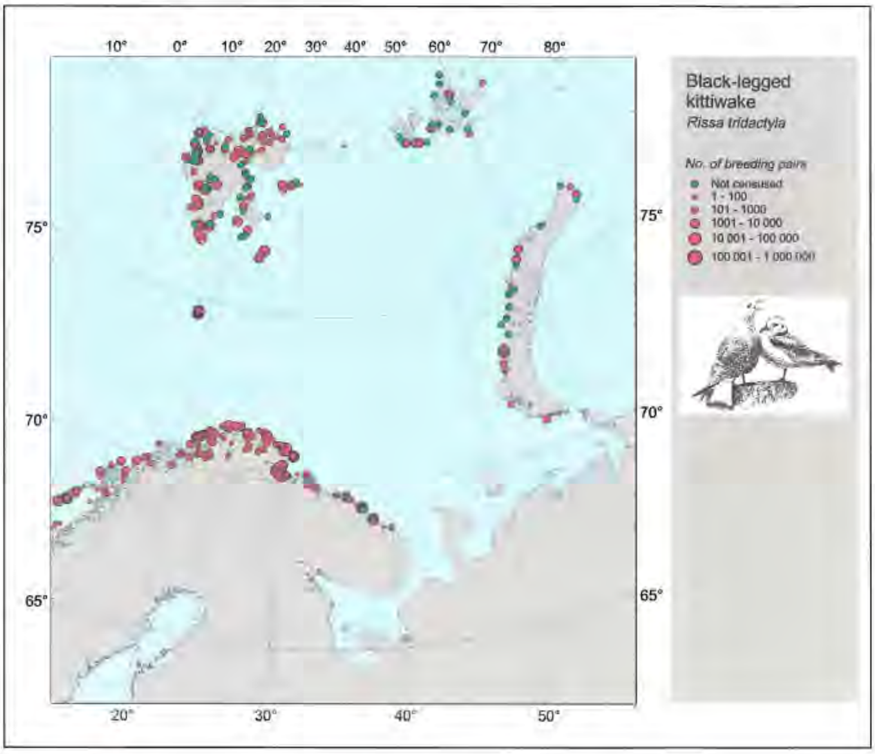
Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	487 000	1980-90	-	-	+1	1970-80	1-10
MC	66 900	1980?	0	1980-95	+1	1960-80	1, 11
WS	<50	1990	-	-	-	-	12
ND	10?	1960	-	-	-	-	13
NZ	40-50 000	1950-96	-	-	-	-	14-20
FJL	>30 000	1991-92	-	-	-	-	21, 22, 23
SV	270 000	1980-94	-	-	0	1981-85	24
All	ca. 900 000	-	-	-	-	-	

1. Krasnov & Barrett 1995, 2. Lorentsen 1994, 3. Strann & Vader 1986, 4. Norderhaug *et al.* 1977, 5. Bustnes 1991, 6. Stougie *et al.* 1986, 7. Iversen & Iversen 1989, 8. R.T. Barrett, unpubl. data, 9. Norwegian Seabird Registry 1998, 10. Tromsø Museum, unpubl. data, 11. Golovkin 1984, 12. Shklyarevich 1991, 13. Karpovich & Kohanov 1967, 14. Krasnov 1995, 15. Uspenski 1956, 16. Kalyakin 1993, 17. Pokrovskaya & Tertitski 1993, 18. Strøm *et al.* 1994, 19. Strøm *et al.* 1995, 20. Strøm *et al.* 1997, 21. Frantzen *et al.* 1993, 22. Skakuj 1992, 23. Gavrilo *et al.* 1993, 24. Mehlum & Bakken 1994

Breeding distribution and habitat preferences in the Barents Sea Region

The black-legged kittiwake breeds throughout the Barents Sea Region with large colonies on Bjørnøya, Spitsbergen, Hopen, Franz Josef Land, Novaya Zemlya, the north coast of the Kola Peninsula and northern Norway. Of the roughly 900 000 pairs which breed in the region, about 60% (>550 000 pairs) breed in some 200 colonies spread along the coast of Norway and the Kola Peninsula. The largest colony (150 000 pairs) is at Syltefjord, east Finnmark. Around 270 000 pairs breed in about 200 colonies in Svalbard, about a third of them on Bjørnøya. Twenty-eight colonies have been recorded on Novaya Zemlya, some as long ago as the turn of the present century (Bilkevich 1904, Sosnovsky 1911). Several have never been censused fully and others have not been visited since 1950 (Uspenski 1956). There are thus recent (1990-1996) counts for eight colonies only, totalling a little more than 40 000 pairs. Twenty-five colonies have been documented in Franz Josef Land (mainly in the south and south-western parts of the archipelago), but only 12 have been censused recently (to ca. 30 000 pairs, Gavrilo *et al.* 1993). There was one colony in the White Sea (in Por'ya Bay, 42 pairs in 1990, but now abandoned (M. Gavrilov, pers. comm.)) and there is one on Vaygach Island (10 pairs in 1960) (Karpovich & Kohanov 1967, Shklyarevich 1991).

Most colonies are on steep, often high cliffs very close to the sea on islands and the mainland. Very few breed on buildings. Black-legged kittiwakes often breed in association with guillemots *Uria* spp. and other cliff-breeding species, but some colonies consist almost exclusively of black-legged kittiwakes. Their sometimes substantial nests are built on small ledges and protrusions from just above the splash zone to several hundred metres above the ground.



Movements

Black-legged kittiwakes are pelagic outside the breeding season and as immatures (Norderhaug *et al.* 1977, Brown 1984). Birds breeding in north Norway, Franz Josef Land and on Novaya Zemlya disperse from the colonies in late August/early September and do not return until the following April (Dementjev 1955, Holgersen 1961, Yudin & Firsova 1988c, Barrett & Bakken 1997).

Ring recoveries and observations of birds at sea have shown that black-legged kittiwakes are not true migrants, but disperse widely over most of the North Atlantic outside the breeding season. Immatures ringed in Norway and Murman have been recovered particularly far from the natal colony (Barrett & Bakken 1997, Nikolaeva *et al.* 1997a). Some move westwards to, for example, Iceland, Greenland, Newfoundland and the eastern USA while others disperse southwards to the western seaboards of Europe (the Faeroes, UK, North Sea and Bay of Biscay) and south to the waters off north-west Africa. Some have been recovered far inland, but these are exceptions. Ring recovery patterns give a biased picture of their dispersal as very few ringed birds are recovered at sea. They also reflect the hunting habits of some societies, for example in Greenland and Newfoundland. Having once dispersed, many immature birds do not return to natal waters until their third summer. Adults do not generally move as far as immatures, but some have been recovered as far afield as Newfoundland. There is a tendency for birds from the northern colonies to winter further north and east than those from southern colonies.

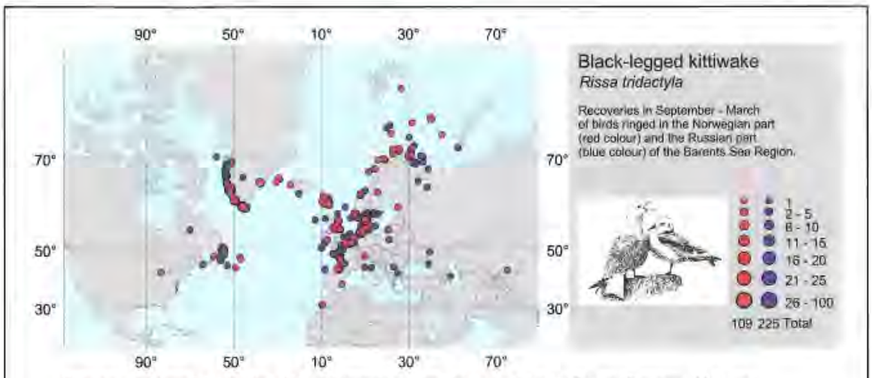
Birds from Novaya Zemlya seem to move eastwards and southwards. Of four recoveries of birds ringed in Bezymyannaya Bay, one was in the Urals, two in western Siberia and one on the Kamchatka Peninsula (Dementjev 1955). There are also records of black-legged kittiwakes wintering in the Black Sea (Bernatski 1954, Nikolaeva *et al.* 1997a).

Population status and historical trends

Although recent, detailed counts are lacking for many colonies in the Barents Sea Region, marked increases have been documented in several areas. For example, 12 000 pairs were counted on Bjørnøya in 1932 (Bertram & Lack 1933), but in 1970, Williams (1971a) estimated the population to be 100 000 pairs. Today's estimate is about 90 000 pairs (Mehlum & Bakken 1994). Although some colonies have declined on Spitsbergen, the Svalbard population is probably increasing (Mehlum & Bakken 1994, Isaksen & Bakken 1995b).

Little is known concerning the trends on Franz Josef Land, although repeat counts in one of the largest colonies, Rubini Rock on Hooker Island in 1931 (7000 individuals), 1981 (5000 pairs) and 1991 (5000 pairs) (Demme 1934, Belikov & Randla 1984, Skakuj 1992) suggest small changes.

No black-legged kittiwakes were recorded in Bezymyannaya Bay on southern Novaya Zemlya in 1923, but 1800 pairs were counted a decade later. This population has steadily increased to become one of the largest colonies on Novaya Zemlya (ca. 11 000 pairs in 1992, Krasnov & Barrett 1995). Counting plots have been established in Bezymyannaya Bay, Gribovaya Bay, Arkhangel'skaya Bay and Vil'kitski Bay for future population monitoring (Strøm *et al.* 1994, 1995, 1997). A decline from 2200 pairs in 1967 to 200 pairs in 1992 was registered in Arkhangel'skaya Bay (Golovkin 1972, Pokrovskaya & Tertitski 1993), but 3150 pairs were counted there in 1996 (Strøm *et al.* 1997). In 1967, Vil'kitski Bay was apparently the largest colony on Novaya Zemlya with 54 000 individuals



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

(Golovkin 1972), but in 1996, only 4300 pairs were recorded (Strøm *et al.* 1997). Otherwise little is known about population trends on Novaya Zemlya.

There has been a general increase along the Kola Peninsula from about 45 000 pairs in 1960 to >60 000 pairs in the 1980s (Gerasimova 1962, Belopolski *et al.* 1976, Golovkin 1984). Despite an almost 50% drop in 1976-1977, the numbers on Kharlov Island increased between 1958 and 1986 by about 7% p.a. (from ca. 5000 pairs to >28 000 pairs). This was followed by a decrease of about 4% p.a. between 1987-1994 (Krasnov & Barrett 1995).

Similarly, black-legged kittiwakes in north Norway increased in numbers at a rate of about 1% p.a. in the 1960s and early 1970s (Pethon 1966, Brun 1971a, 1979), and this increase continued in at least east Finnmark into the early 1980s (Barrett & Schei 1977, Barrett 1985a, Krasnov & Barrett 1995). Monitoring counts have since revealed a slight decrease (ca. 2% p.a.) on Hornøya in east Finnmark (1982-1994) (Anker-Nilssen *et al.* 1996). There is also a suggestion of a decline in the population in Røst during the same period (Anker-Nilssen *et al.* 1996), while that on Bleiksøy increased (R.T. Barrett, unpubl. data). The survival rate of breeding adults on Hornøya in 1990-1994 has been estimated at 92.2% p.a. (Erikstad *et al.* 1995). This is similar to the 93% recorded by Hatch *et al.* (1993) over three years in Alaska, but higher than the 60-89% given by Aebischer & Coulson (1990) for a 31-year study and Danchin & Monnat (1992) for a 5-year study in north-east England and France, respectively.

Feeding ecology

Black-legged kittiwakes feed, often in flocks, on or just under the surface of the sea when either flying or swimming. They feed mainly on invertebrates and small fish (up to ca. 15-20 cm), but also scavenge offal or discarded fish behind fishing boats or in harbours. Chicks are fed regurgitated food and most of our knowledge concerning food choice is based on analyses of such regurgitations or stomach contents collected using the water off-load technique (stomach pumping).

In the southern Barents Sea (Seven Islands and Hornøya), capelin *Mallotus villosus*, herring *Clupea harengus*, sandeels *Ammodytes* spp., cod *Gadus morhua* and euphausiids make up most of the diet during the breeding season (Belopolski 1957a, Barrett & Krasnov 1996). There are, however, large seasonal and annual fluctuations in prey composition due to changes in the availability of prey species (Belopolski 1957a, Krasnov *et al.* 1995, Barrett & Krasnov 1996). Small differences in the diet of male and female black-legged kittiwakes have also been documented (Belopolski 1957a). A 3-year study on Bleiksøy, off the coast of northern Nordland, showed that black-legged kittiwakes ate mainly glacial lantern fish *Benthosema glaciale*, a mesopelagic myctophid which was probably forced to the sea surface by an upwelling, and euphausiids (Barrett 1996a). A close correlation between breeding success and levels of 0-group herring suggests that herring is also an important constituent of black-legged kittiwake chick food at Røst (Anker-Nilssen *et al.* 1997). In the north and east (Franz Josef Land, Novaya Zemlya and Svalbard), polar cod *Boreogadus saida*, amphipods and euphausiids are common components of the diet (Uspenski 1956, Mehlum & Gabrielsen 1993, Weslawski *et al.* 1994, Barrett 1996b).

Few studies have been made outside the breeding season. One from the central Barents Sea in March 1987 showed that black-legged kittiwakes fed on polar cod, cod and redfish *Sebastes* sp. during a winter when capelin stocks were at an absolute minimum (Erikstad 1990). A second study from Hornsund, Svalbard in September-October 1984 showed polar cod and the amphipod *Parathemisto libellula* to be the dominant prey species, closely followed by polychaetes and pteropods (Lydersen *et al.* 1989). In March/April 1985, black-legged kittiwakes ate mainly polar cod, myctophids, cod and snail fish (Liparidae) in the same fjord (Mehlum & Gabrielsen 1993). Polar cod, amphipods, euphausiids and polychaetes were otherwise frequently found in stomachs of birds sampled in the marginal ice zone and coastal waters around Svalbard during the spring, summer and autumn (Lønne & Gabrielsen 1992, Mehlum & Gabrielsen 1993).

Threats

Among kleptoparasites and predators of eggs, chicks and adults noted in the field and in the literature are herring gulls *Larus argentatus*, great black-backed gulls *L. marinus*, glaucous gulls *L. hyperboreus*, arctic skuas *Stercorarius parasiticus*, ravens *Corvus corax*, gyr falcons *Falco rusticolus*, peregrine falcons *F. peregrinus*, snowy owls *Nyctea scandiaca* and northern goshawks *Accipiter gentilis* (Nordgaard 1894, Dementjev & Gorchakovskaya 1945, Jensen 1973, Thieme 1978, Krasnov 1982, 1983, Krasnov *et al.* 1982, Stempniewicz 1983a, Burger & Gochfeld 1984, Eidam 1992, Tella *et al.* 1995, R.T. Barrett, pers. obs.), but none of them is considered to be a serious threat in any part of the Barents Sea population.

Earlier this century, the human harvest of eggs was considerable and probably had significant impacts on local populations (Krasnov & Barrett 1995). Such harvesting is now negligible and no activities directly threaten black-legged kittiwakes in the Barents Sea. However, recent studies suggest that black-legged kittiwakes breeding in the southern Barents Sea Region may face difficulties in finding enough food for successful breeding as long as capelin stocks remain low and less available to surface feeders (Jacobsen 1993, Lund 1987, Vader *et al.* 1987, Barrett & Krasnov 1996). In the long term, this may have negative effects on regional breeding populations. Similarly, the periodic shortage of herring off Røst seems to have caused reduced breeding success, at least since 1975 (Anker-Nilssen *et al.* 1997).

Levels of organochlorines and mercury in eggs and adults collected from several colonies in Norway, Murman and

Diet of the black-legged kittiwake *Rissa tridactyla* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Hornøya	1980-94	Capelin (50-90%) Herring (0-90%) Euphausiids (0-40%)	Chicks/adults	1
-	Bleiksøy	1986-88	Glacial lantern fish Euphausiids	Chicks/adults	2
MC	Seven Islands	1935, 1947-49	Herring (20%) Capelin (20%) Cod (20%) Sandeel (10%) Euphausiids (10%) Molluscs (10%)	Adults	3
-	Seven Islands	1979-94	Capelin Sandeels Crustaceans Herring	Adults	1
NZ	Bezymyannaya Bay	1947	Polar cod (40%) Crustaceans (30%) Cod (10%)	Adults	3
-	Bezymyannaya Bay	1948-50	Polar cod, capelin, Polychaetes Polar cod	Adults	4
FJL	Rubini Rock	1991-93		Adults	5
SV	Hopen	1984	Capelin (90%)	Chicks	6
	Kongsfjorden	1982-87	Arctic cod, *Thysanoessa inermis*	Adults	7

1. Barrett & Krasnov 1996, 2. Barrett 1996a, 3. Belopolski 1957a, 4. Uspenski 1956, 5. Weslawski *et al.* 1994, 6. Barrett 1996b, 7. Mehlum & Gabrielsen 1993

Svalbard in the 1980s and 1990s were low and no cause for concern (Barrett, Skaare *et al.* 1985, Barrett *et al.* 1996, Savinova, Gabrielsen *et al.* 1995, Savinova, Polder *et al.* 1995, Henriksen *et al.* 1996).

In their review of threats to seabirds in Svalbard, Mehlum & Bakken (1994) mention none specifically concerning black-legged kittiwakes. In other areas, however, one area of conflict which is steadily increasing is disturbance by visitors (e.g. Gabrielsen 1987). There are, however, legislative measures to keep this at a minimum in the protected colonies in Norway and Russia by prohibiting boats from approaching within certain limits (1 km in the Kandalaksha State Nature Reserve) without permission. Landing on the islands is also often limited to those with permission from the reserve authorities. Aircraft are not allowed to break the sound barrier or fly below 2000 m (in Russia) near the colonies.

Special studies

The breeding biology of the black-legged kittiwake was studied in detail in Troms in 1973-1976 (Barrett 1978a, b, Barrett & Runde 1980, Runde & Barrett 1981). Black-legged kittiwakes have since become an integral part of a long-term study of the population trends and breeding biology, including chick diet, of seabird communities breeding on the islands of Røst (Lofoten), Hornøya (east Finnmark), Hopen (Svalbard) and Kharlov (Murman coast) (Shklyarevich 1977, Barrett 1983, 1996b, Barrett, Fieler *et al.* 1985, Furness & Barrett 1985, 1991, Barrett & Furness 1990, Krasnov 1995, Krasnov & Barrett 1995, Krasnov *et al.* 1995, Barrett & Krasnov 1996, Anker-Nilssen *et al.* 1996, Anker-Nilssen *et al.* 1997). Breeding investment and adult survival in relation to breeding effort are also being studied in detail on Hornøya (Barrett, Fieler *et al.* 1985, Jacobsen 1993, Tveraa 1994, Thomson 1995, Erikstad *et al.* 1995, Jacobsen *et al.* 1995). Several energetic studies (e.g. metabolic rates, thermoregulation) of the black-legged kittiwake have been made in Svalbard and on Kharlov Island and Hornøya (Golovkin 1963, Barrett 1978b, Brent *et al.* 1983, Bech *et al.* 1984, Gabrielsen *et al.* 1987, 1988, 1992, Klaassen *et al.* 1987, Gabrielsen & Mehlum 1989, Gabrielsen 1994). Organochlorine and trace element levels in black-legged kittiwakes and their eggs have also been studied in detail in various parts of the Barents Sea (Bourne & Bogan 1972, Fimreite *et al.* 1974, 1977, Fimreite & Bjerk 1979, Barrett, Skaare *et al.* 1985, 1996, Carlberg & Bøler 1985, Savinova 1991, Thompson *et al.* 1992, Henriksen 1995, Savinova, Gabrielsen *et al.* 1995, Savinova, Polder *et al.* 1995, Wenzel & Gabrielsen 1995, Henriksen *et al.* 1996).

In east Finnmark, black-legged kittiwakes have been the subject of three incidental, short-term studies of feeding flights and predation (Grastveit 1971, Götmark 1980, Burger & Gochfeld 1984). The effects of egg harvesting and disturbance by researchers are subjects of past and ongoing studies (Gabrielsen 1987, Barrett 1989, Sandvik & Barrett in press). Among the few studies of black-legged kittiwakes at sea, including distribution and feeding behaviour, are those of Brown (1984), Rikardsen *et al.* (1987), Strann & Vader (1987), Erikstad (1990, 1991) and Erikstad *et al.* (1988). Studies of black-legged kittiwake parasites include Belopolskaya (1951), Mehl & Traavik (1983), Engstrøm (1989), Galaktionov & Marasaev (1992), Galaktionov *et al.* (1993), Galkin *et al.* (1994), Galaktionov (1995), Krasnov *et al.* (1995). The movements and dispersal of black-legged kittiwakes ringed in the Barents Sea Region have been studied using recovery data by Dementjev (1934, 1948, 1955), Holgersen (1961), Yudin & Firsova (1988c), Barrett & Bakken (1997), Nikolaeva *et al.* (1997a).

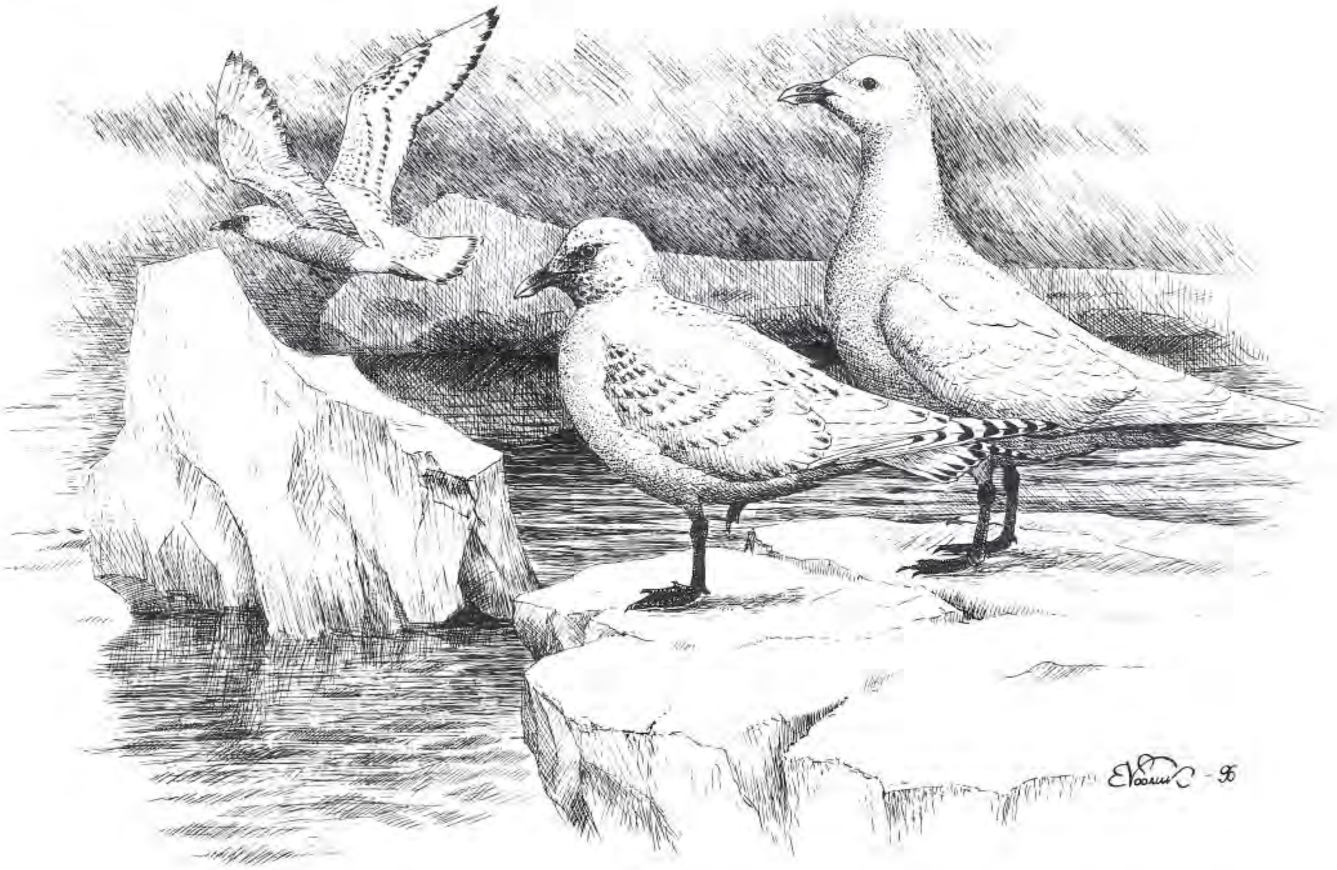
Recommendations

There is a general need for up-to-date counts and mapping of the colonies in Franz Josef Land, Novaya Zemlya and along the Kola Peninsula. As the majority of the Norwegian colonies have not been censused since the 1970s, repeat counts should also be made in Norway and Svalbard. The population monitoring studies in Røst, on Hjelmsøy, Hornøya and Kharlov should continue, but should also be expanded to cover parameters such as adult survival, breeding phenology, reproductive success and diet. Similar studies should be established in representative colonies elsewhere in the Barents Sea Region. More data concerning the geographical and seasonal variations in the diet of the black-legged kittiwake should also be collected, especially outside the breeding season. Such data are important for inclusion in the fisheries research multi-species models.

Robert T. Barrett & Grigori M. Tertitski

Ivory gull *Pagophila eburnea*

No: Ismåke Ru: Belaya chayka



Population size: >2000 pairs?
Percent of world population: ca. 15%
Population trend: Reasonably stable?

General description

The ivory gull is a medium-sized gull, about 10% larger than the black-legged kittiwake *Rissa tridactyla*, and breeds in the Arctic zone in Canada, Greenland, Svalbard and Russia (Blomqvist & Elander 1981, Cramp & Simmons 1983). No breeding colonies have been confirmed east of Severnaya Zemlya east in the Kara Sea (Volkov & de Korte 1996). Its feeding strategy and buoyant flight recall a *Sterna* tern, and it has an unusually short period of immaturity for a gull of this size (Haney & MacDonald 1995).

The world population is estimated to be ca. 14 000 pairs (Volkov & de Korte 1996), but the size of the populations in many regions is unknown. The species is monotypic. It is strongly associated with ice-covered arctic waters.

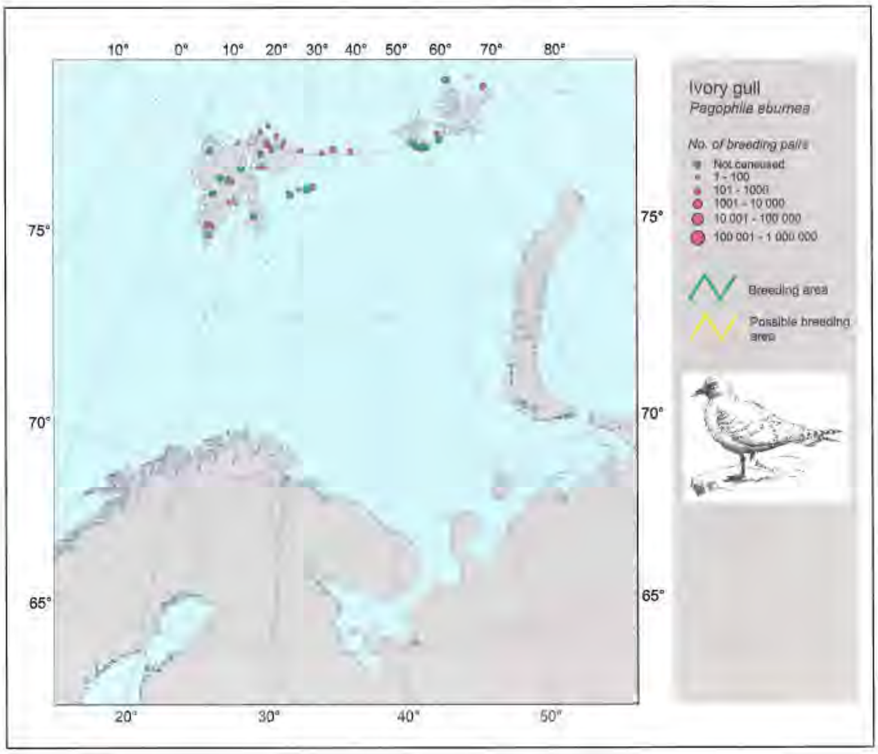
Population sizes and trends of the ivory gull *Pagophila eburnea* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	0						
MC	0						
WS	0						
ND	0						
NZ	?	1995	?	-	?	-	1
FJL	Several thousand	1930-95	(0)	1990-95	(-2)	1930-95	2
SV	ca. 200	1980-95	(0)	1986-95	(-2)	1887-1995	3
All	(>2000?)	-	-	-	-	-	

1. Antipitin 1938, 2.Uspenski & Tomkovich 1986, 3 SCRIB 1998

Breeding distribution and habitat preferences in the Barents Sea Region

Ivory gulls breed in the northern part of the Barents Sea, in Svalbard, Franz Josef Land and probably at the northern part of Novaya Zemlya. Many nest on steep cliffs, sometimes more than 20 km from the shore (SCRIB 1998), but in some areas, such as Victoria Island in Franz Josef Land, they breed on flat ground (Tomkovich 1986, Vuillenmier 1995). Ivory gulls breed in colonies, often mixed with black-legged kittiwakes and other seabirds (SCRIB 1998). Single nests have been found on the tundra (T. Winsnes, pers. comm.) and in 1924, Kristoffersen (1926) found a nest on a beached ice floe in Hornsund (Svalbard). Nests can be found from just above sea level to about 800 m a.s.l. (SCRIB 1998).



Movements

Most ivory gulls are probably pelagic in ice-covered waters in winter and may migrate far from the breeding area, although few data exist. One bird ringed in Franz Josef Land was recovered in Labrador six years later (Tuck 1971). An immature bird ringed on Victoria Island in 1960 was recovered on the Kanin Peninsula three years later, and a bird ringed on Graham Bell Island (Franz Josef Land) was recovered two years later in Anadyrski Bay in the Bering Strait (information from the Moscow Ringing Centre). Two birds ringed at Station Nord in Greenland were recovered in the Barents Sea; one in Franz Josef Land and the other south of Bjørnøya (Salomonsen 1979). Hjort (1976) described ivory gulls migrating southwestwards along the East Greenland Current in September 1975, and suggested that the species had a migration pattern similar to that of the Brünnich's guillemot *Uria lomvia*, little auk *Alle alle* and glaucous gull *Larus hyperboreus*. However, it is not known whether the ivory gulls observed came from the Barents Sea Region.

Many ivory gulls winter in ice-covered waters close to their breeding areas, often near where marine mammals are hunted and settlements (Antipin 1938). Many stay in the ice-covered parts of the Barents Sea (V. Bakken, pers. obs.). Based upon ringing recoveries, it is believed that some of the Barents Sea population winter in the Bering Sea (Tomkovich 1990). Ivory gulls have been observed north to 87°55'N (Uspenski 1969b) and south to the taiga zone (Yudin & Firsova 1988d).

In Franz Josef Land, the first spring observation of ivory gulls is reported to be early March, and the main part of the population arrives in early April (Gorbunov 1932). In the northern part of Novaya Zemlya, the ivory gull has been reported in the nesting areas in early April, but the birds stayed in the surrounding waters all year (Antipin 1938). In autumn, ivory gulls have been observed on the coasts of Novaya Zemlya until late November (Antipin 1938, But'ev 1959). Migrating ivory gulls have been observed almost annually at Wrangel Island in autumn (Stishov *et al.* 1991). In Svalbard, the first ivory gulls are observed around settlements in March, and most disappear to the breeding areas during May (G. Bangjord, pers. comm.).

Population status and historical trends

Volkov & de Korte (1996) estimated the total breeding population in the Russian Arctic to be 10 000 pairs. One breeding pair was registered on Cape Konstantin on Novaya Zemlya in 1936 (Antipin 1938). In 1995, J. de Korte (pers. comm.) probably observed breeding ivory gulls from a helicopter on the northern part of Novaja Zemlja. The ivory gull is universally reported to be common in the northern part of Novaya Zemlya.

In 1961, about 200 individuals nested on Victoria Island in Franz Josef Land (Govorukha 1970), in 1994 there were 135-205 pairs (Vuillenmier 1995), and in 1995 about 750 pairs (Forsberg 1995). Nine colonies of ivory gulls are known in Franz Josef Land (Gorbunov 1932, Uspenski 1972b, Tomkovich 1984). In 1981, 170-200 pairs were observed on the Kholmisty Peninsula, Graham Bell Island (Tomkovich 1984). About 300 pairs bred in six colonies on Cape Germania, Rudolf Island, in 1953 (Rutilevski 1957) where ca. 450 eggs were collected by the expedition and another 50 eggs were taken by glaucous gulls *Larus hyperboreus*. In 1897, Clark (1898) discovered a large ivory gull colony on Alexandra Land. The phrases he used were "immense number of ivory gulls" and "among thousands of these birds". The number of birds in the other colonies is not known, but calculations made by Uspenski & Tomkovich (1986) suggested that Franz Josef Land is the largest nesting area for ivory gulls in Russia, and the total number was several thousand pairs.

The size of the Svalbard population is not known, but based on counts in the colonies after 1980, it is estimated to be minimum 200 pairs (SCRIB 1998). Taking into consideration all counts since 1931, the breeding population in Svalbard is about 750 pairs, but many of the colonies have not been counted for many years.

The trend of the ivory gull population in Svalbard is uncertain. Many colonies disappeared as early as the 1950s or before (Dalgety 1932, Bateson & Plowright 1959, Løvenskiold 1964). Some new ones have been discovered, but in general it seems that the population has decreased. However, a major uncertainty is that many colonies are far from the coast and difficult to detect. Very few large colonies have been found in Svalbard. The largest one known was discovered on Kvitøya in 1931, where it was estimated that 400 pairs were nesting (Horn 1930, Ahlmann & Malmberg 1931). This area has been visited on many subsequent occasions without any observations of breeding ivory gulls. A large colony has also been reported from Storøya (Collett 1890), where the gulls nested on flat ground. The distance between Storøya, Kvitøya and Victoria Island in Franz Josef Land is relatively

Diet of the ivory gull *Pagophila eburnea* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
FJL	?	?	Polar cod	Adults	1
-	?	?	Garbage	Adults	1
SV	Ismåsefjellet	1924	Arctic char (50%)	Pullus	2
-	Billefjorden	1933	Thysanoessa (100%)	Adults	3
-	Ismåsefjellet	1958	Polar cod (100%)	Adults	3
-	Ismåsefjellet	1958	Fish and crustaceans	Chicks	4
-	Storfjorden	1968/89	Fish (37%) Gammaridae (25%) Cephalopods (12%)	Adults	5
-	East of Svalbard	1984	Polar cod (75%) Flesh (25%)	Adults	6
-	Stormbukta	1991	Chaetognatha and Gammarus sp.	Adults	7
-	Kovalskifjellet	1992	Carcasses	Adults	8
-	Unspecified	-	Fat, meat and garbage	Adults	9, 10, 11

1. Yudin & Firsova 1988d, 2. Binney 1925, 3. Hartley & Fisher 1936, 4. Bateson & Plowright 1959, 5. de Korte 1972, 6. Gjertz *et al.* 1985, 7. Camphuysen 1993, 8. V. Bakken, pers. obs., 9. Montague 1926, 10. le Roi 1911, 11. Løvenskiold 1964

short, and it is quite possible that the gulls alternate their breeding locality within this area from time to time. These islands have never been checked the same year, and it is quite possible that the number of ivory gulls in the area has been relatively stable in spite of the abandoned colonies. Bateson & Plowright (1959) suggested that the decrease in the population of polar bears *Ursus maritimus* could be a reason for the decline in ivory gulls. The polar bear population has since increased, but no data support a similar trend for the ivory gulls. In some colonies on flat ground, polar bears may be an important predator on eggs and chicks.

Feeding ecology

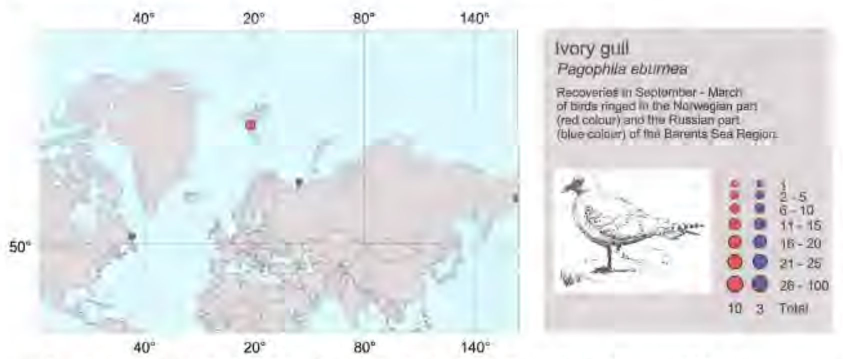
The ivory gull is a typical generalist, consuming many different kinds of food. At sea, it mainly feeds on the surface, among ice floes (V. Bakken, pers. obs.). The main food is polar cod *Boreogadus saida* and marine invertebrates (crustaceans and some molluscs) (Yudin & Firsova 1988d). On land, ivory gulls eat garbage and even cannibalise fledged ivory gull nestlings (Tomkovich 1986). Carcasses and other remains from seal hunting, excrements from seals, walruses *Odobenus rosmarus* and polar bears, and various garbage make up a considerable part of the food outside the breeding season (Longstaff 1924, But'ev 1959, Løvenskiold 1964, Uspenski 1972b, Belikov & Randla 1984, Tomkovich 1986). In spring, many ivory gulls feed on the sewage and garbage from the settlements in Svalbard, and in summer ivory gulls also feed on carcasses in seabird colonies (V. Bakken, pers. obs.).

In Svalbard, 50% of the content of chick stomachs collected by Binney (1925) consisted of arctic char *Salvelinus alpinus.* Bateson & Plowright (1959) found that adults had eaten polar cod *Boregadus saida* on Ismåsefjellet on Nordaustlandet, while their chicks were probably fed on crustaceans and fish. Of four ivory gulls investigated by de Korte (1972) in 1968-69 in Storfjorden, three contained fish (Gadidae), two gammaridae (*Gammarus sadachi, Gammarus wilkitzkii)* and one cephalopods (beaks, eye lenses). de Korte (1972) also observed

ivory gulls snapping flying insects. Gjertz *et al.* (1985) investigated four birds shot in ice-covered waters in July-August 1984. Three contained only polar cod, while the fourth had remains of mammalian bones and flesh. Mehlum & Gabrielsen (1993) analysed the stomach contents of 19 adult ivory gulls shot in spring and summer 1982-1990 and found mainly fish. Polar cod occurred in 56% of the birds examined. Other prey items were blenny *Lycodes* sp., cod *Gadus morhua* and saithe *Pollachius virens*, which occurred in 26% of the stomachs. Mammalian fat was also found in 21% of the birds. Camphuysen (1993) observed three ivory gulls feeding on Chaetognatha and *Gammarus* sp. In 1992, V. Bakken (pers. obs.) observed ivory gulls eating carcasses below a large seabird colony in Storfjorden.

Threats

Reduced food availability and disturbance in the nesting areas are major factors which reduce breeding success (Tomkovich 1986). The arctic fox *Alopex lagopus* and the polar bear are the main predators of eggs and chicks, but domestic dogs are also important near settlements. These predators can consume more than 70% of the clutches (Syroechkovski & Lappo 1994). Ivory gulls are also cannibals (Tomkovich 1984, 1986, Syroechkovski & Lappo 1994). Disturbance by tourists may be a problem, especially in Franz Josef Land.



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Special studies

Tomkovich (1986) studied the breeding biology of ivory gulls on Graham Bell Island in Franz Josef Land and this is the only study in the Russian part of the Barents Sea Region. Further east, at Severnaya Zemlya, Volkov & de Korte (1996) studied the distribution and numbers of ivory gulls.

In 1958, Bateson & Plowright (1959) studied the breeding biology of ivory gulls in Wahlenbergfjorden on Nordaustlandet (Svalbard). In 1993-1997, 168 ivory gulls have been colour ringed in Svalbard (Norwegian Polar Institute, unpubl. data). Similar ringing has also been done on Severnaya Zemlya and the Taymyr Peninsula. The main aims of this project are to study adult survival, site fidelity in the breeding colonies, spring staging areas and the general migration of ivory gulls in the Arctic.

Recommendations

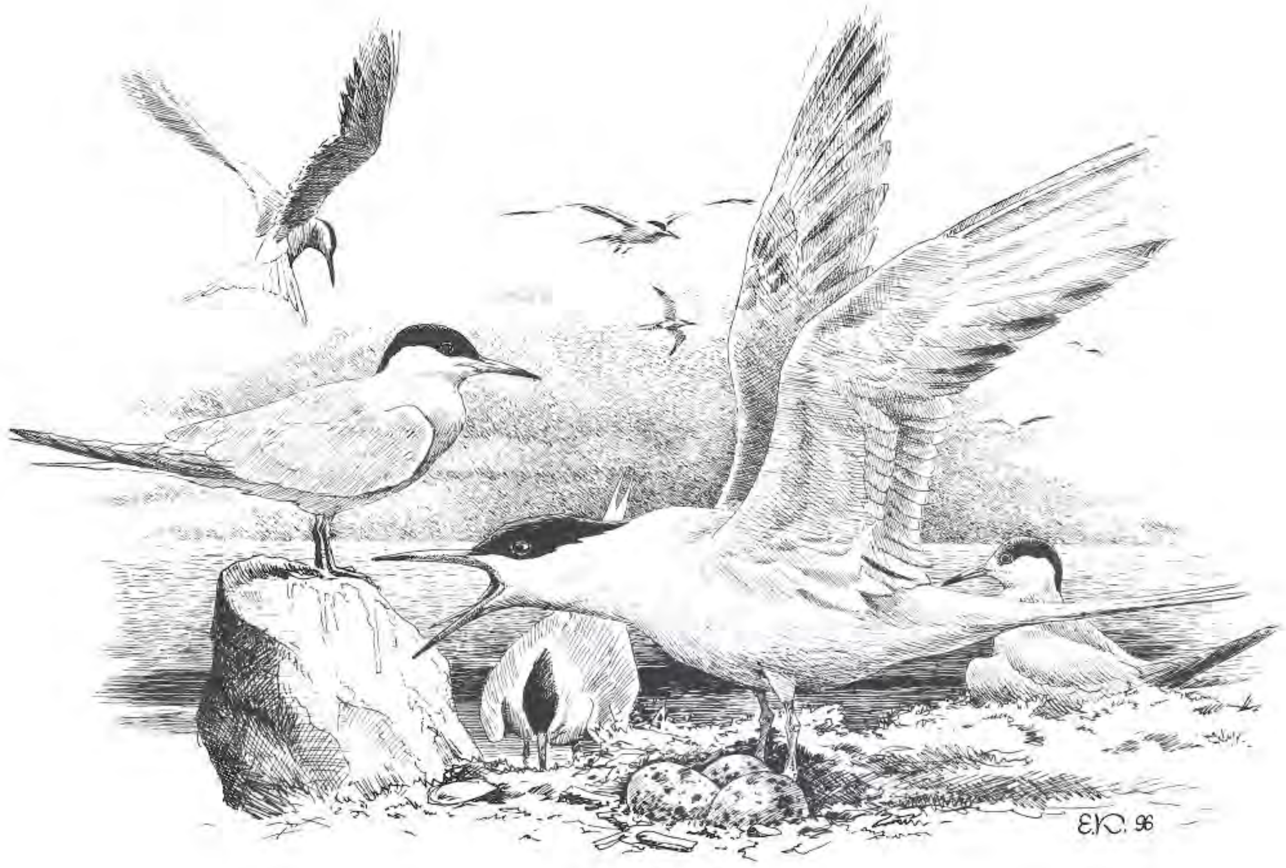
To be able to discover any changes in the numbers of ivory gulls in the Barents Sea Region, it is necessary to establish a monitoring system. Just monitoring the number of breeding pairs in the colonies is inadequate, the birds must also be colour ringed in order to document any alternation between different breeding colonies. The islands of Storøya, Kvitøya and Victoria Island form a feasible study area. Large colonies of ivory gulls have been found on flat ground on all these islands.

Camphuysen (1994) also recommended census studies and monitoring of breeding numbers throughout the range of the species and research to assess the main food items and the location of wintering areas.

Vidar Bakken & Grigori M. Tertitski

Common tern *Sterna hirundo*

No: Makrellterne Ru: Rechnaya krachka



Population size: 2000-3000 pairs
Percent of world population: <1%
Population trend: Reasonably stable

General description

In Europe, the common tern breeds in Britain, France, central Europe and eastwards through Russia towards the Pacific Ocean. It also breeds in large parts of North America (Cramp 1985). In Norway, it is a regular breeder along the coast north to Finnmark, but is unevenly distributed north-east of Tromsø.

Three sub-species are recognised, but the nominate, *S. h. hirundo*, is the only one found in the Barents Sea Region. *S. h. longipennis* is found in eastern Siberia and north-eastern China, while *S. h. tibetana* is found mainly from Kashmir through Tibet and eastwards to western Mongolia.

The common tern greatly resembles the arctic tern, but the latter can be distinguished by its more prominent bill and head, and adults have a shorter tail. Its cheeks are also partly grey, whereas the common tern has white cheeks. The flight feathers are transluscent and the outer primaries are very dark at the edges, giving an impression of an almost black edge.

Breeding distribution and habitat preferences in the Barents Sea Region

The common tern does not breed in Svalbard, or the Russian part of the Barents Sea Region. It breeds commonly in southern parts of north Norway, often in colonies mixed with arctic terns, but numbers decrease north of the Lofoten Islands. It breeds regularly along the entire coast of Troms and Finnmark, but in Finnmark the birds are scattered in small colonies or single pairs. It chooses to nest in sheltered places.

It does not breed inland as often as the arctic tern, but is often found nesting on small islets in fjords or in river mouths. Small colonies of up to 30-40 pairs have sometimes been found on lakes close to the sea, and very rarely on lakes in the mountains or on the upland plateau of Finnmarksvidda, an area totally dominated by the arctic tern.

Movements

The common tern arrives at its breeding grounds in north Norway in late May or the early weeks of June. The breeding season is very short since all the birds leave the region in August. Several recoveries of ringed birds show that common terns winter off the coast of west Africa, i. e. further north than arctic terns, most of which migrate all the way to the Antarctic Ocean.

Population status and historical trends

The size of the breeding population in north Norway is uncertain, but a likely estimate is between 2000 and 3000 pairs, fewer than 1000 being in Troms and Finnmark. There is very little information on the status of the species, but no signs of dramatic changes in breeding numbers have been noted during the last twenty years or so.

Feeding ecology

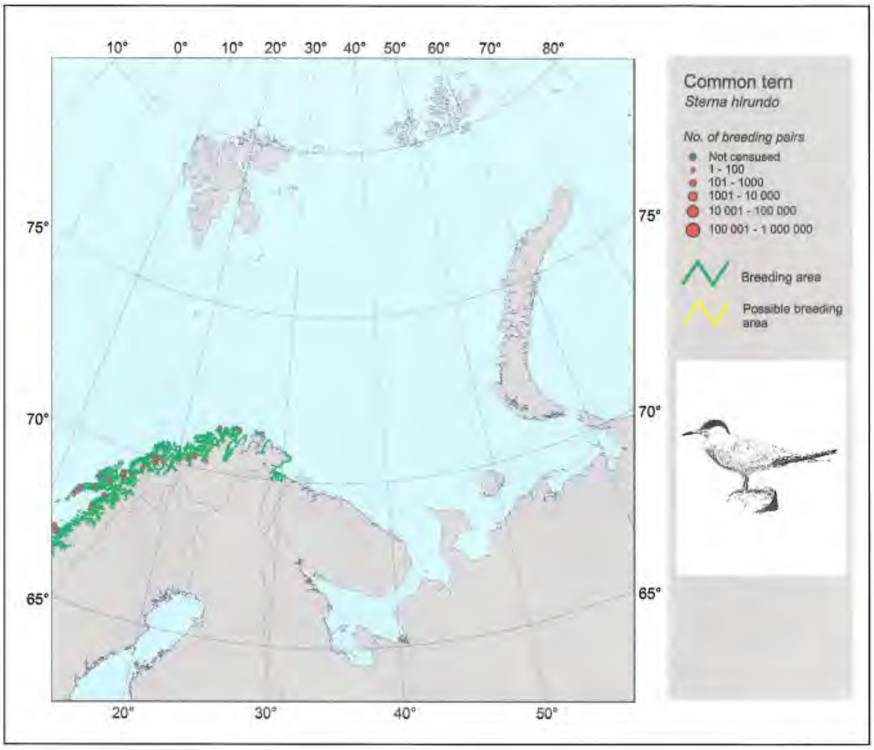
There is no information on the diet of the common tern in north Norway. Studies further south have shown that it takes many small fish, especially sprats *Sprattus sprattus*, small herrings *Clupea harengus*, sandeels *Ammodytes* spp. and sticklebacks *Pungitius pungitius* and *Gasterosteus aculeatus*. Apart from the sprat, which is mainly restricted to Nordland, all these species are common in coastal areas of north Norway. Hence, it probably depends on these in this region, too.

Threats

Like the arctic tern, the common tern is vulnerable to egg and chick predation by many predators, including gulls *Laridae*, skuas *Stercorariidae*, crows *Corvidae* and mustelids. Adults are taken by falcons, but have few other enemies.

Special studies

The common tern has not been studied in the Barents Sea Region.



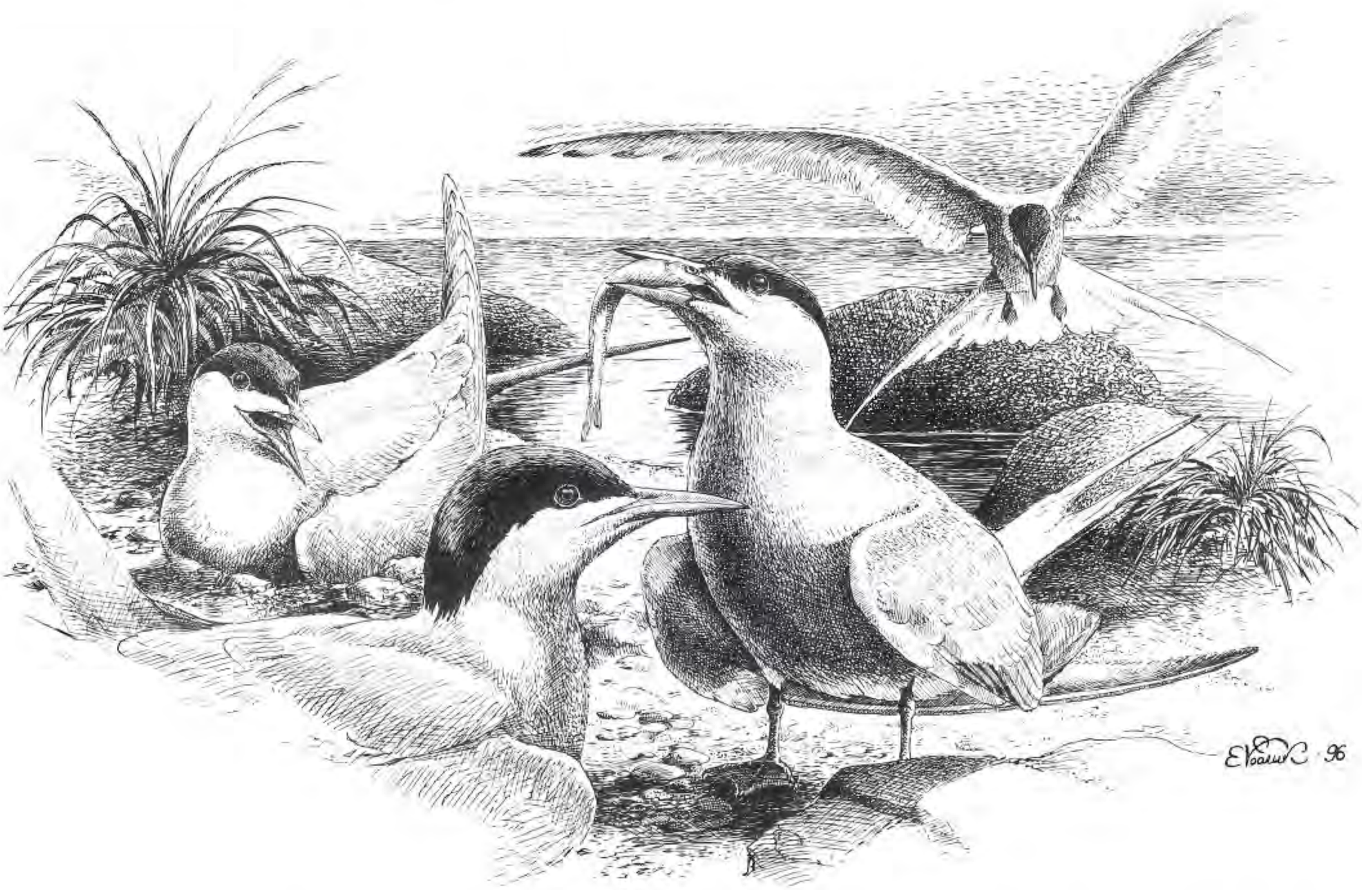
Recommendations

The species should be included in the monitoring programme for breeding seabirds and its distribution should be more thoroughly mapped. Suitable colonies for monitoring are found in Helgeland, Lofoten and Troms.

Karl-Birger Strann

Arctic tern *Sterna paradisaea*

No: Rødnebbterne Ru: Polyarnaya krachka



Population size: <130 000 pairs
Percent of world population: <20%
Population trend: Small decrease

General description

The arctic tern is a small tern with long narrow wings and elongated outer tail feathers. It strongly resembles the common tern *Sterna hirundo*, but differs from this species by having a uniform deep-red bill, shorter legs, longer tail feathers, greyer underparts as well as differences in wing shape and colouring.

The arctic tern has a circumpolar distribution and is the most northern of the terns. It is a common breeding species on islands and coastal mainland areas in both the northern Pacific and northern Atlantic south to about 50°N, as well as in the Arctic. In the eastern Atlantic, it breeds in the British Isles, the Baltic Sea, Iceland and Greenland, as well as along the coasts of Norway and northern Russia and on every archipelago in the Barents and White Seas. Even though the species has its stronghold in coastal areas, considerable numbers breed inland in several areas.

The total population of the arctic tern is large, but estimates are very approximate. When the estimates from European countries summarised by Cramp (1985) are combined, they give a rough estimate of 250 000 breeding pairs in Europe apart from the Russian areas. More recently, the population in the same area has been estimated at about 500 000 pairs (Klaassen & Lemmetyinen 1997). The Alaskan and Russian populations probably number several hundred thousand individuals and pairs respectively (Lensink 1984, Zubakin 1988). The Greenland population may also be of this magnitude (Evans 1984). Gochfeld & Burger (1996) estimated the total world population to be approximately 500 000 breeding pairs.

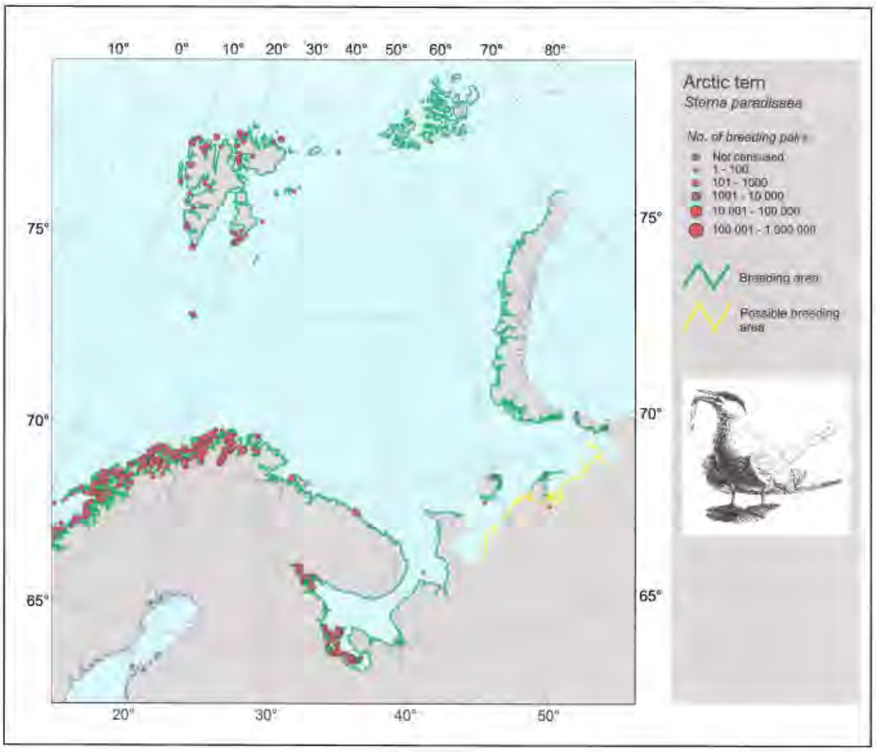
The species is monotypic with little geographical variation.

Population sizes and trends of the Arctic tern *Sterna paradisaea* within the Barents Sea Region. See text for details.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	20 000	1994	(0)	-	(-1)	1970–90	1, 2
MC	<10 000	1967, 1995	(0)	-	(-1)	1957–92	3
WS	12 500	1963	(0)	-	(0)	1960–90	4
ND	?						
NZ	?						
FJL	?						
SV	<10 000	1994	(0)	-	(0)	-	5
All	<130 000	-	(0)	-	(-1)	-	

1. Strann & Vader 1986, 2. Gjershaug *et al.* 1994, 3. Krasnov *et al.* 1995, 4. Bianki 1977, 5. Mehlum & Bakken 1994.

Breeding distribution and habitat preferences in the Barents Sea Region



The arctic tern breeds throughout the Barents Sea Region. In northern Norway, arctic terns breed along most of the coastline and, especially in Finnmark, more dispersed in the interior (see Gjershaug *et al.* 1994). The main part of the Norwegian population breeds along the coast. Colonies are found along most of the Murman coast, the coast of the White Sea and in the Nenetski district, as well as at some distance from the sea in the Nenetski district. Little is known about the breeding distribution on Novaya Zemlya. The breeding population in Franz Josef Land is sparse and small colonies are scattered on the islands in the archipelago. In Svalbard, colonies are confined to the coastal zone and the main part of the population breeds along the western coast.

Arctic terns may breed in single pairs, but most often in colonies varying in size from just a few up to several thousand pairs. The size of the colonies generally decreases towards the north and east; colonies of up to 17 500 pairs have been found in the Orkney Islands (Cramp 1985), up to 8000 pairs in the White Sea area (A. Cherenkov & V. Semashko, pers. comm.), up to 1500 pairs on the Aynov Islands in Varangerfjord (Kokhanov & Skokova 1967), up to 600 pairs on western Spitsbergen (Burton & Thurston 1959), up to 78 pairs in areas around the Kara Gate (Karpovich & Kokhanov 1967) and up to 15 pairs in Franz Josef Land (Parovshchikov 1963, Tomkovich 1984).

Most colonies are found on small islands and skerries where they are generally safe from terrestrial predators. Arctic terns may, however, also breed close to the waterline on mainland peninsulas and headlands with or without low vegetation. In the regions where inland breeding occurs, colonies are most often situated on islets and sand banks on rivers and lakes rich in fish and on marshy tundra. The nests are placed on bare rock or gravel, on shore meadows, grass tussocks in marshes, or other places with low vegetation.

Movements

Arctic terns leave their breeding grounds and start their southward migration soon after the chicks have fledged. The timing of breeding varies greatly, and in Svalbard chicks may not fledge before late August or September (Norderhaug 1964a). The migration from the Barents Sea Region starts in late July and continues in August and September. The main migration route follows the outer coastline of Russia and Norway towards west and south. Most of the birds from the White Sea fly directly south-west to the Gulf of Bothnia and the Gulf of Finland, whereas others probably follow the northern route along the coast of north Norway (Bianki 1977). The migration continues southwards off the western coasts of Europe and Africa towards the main wintering grounds in the pack ice in the Antarctic Ocean. Some birds probably winter in the waters off western and southern Africa (Cramp 1985, Vandewalle 1988, Runde 1997). Travelling this long distance twice a year (and in addition possibly undertaking extensive movements in the Antarctic Ocean during the austral summer; see Gudmundsson *et al.* 1992), means that the arctic tern has the longest migration of all birds.

The birds reach their breeding grounds between the middle of May and early June on the mainland of northern Norway and Russia as well as in Svalbard (Norderhaug 1964a, Haftorn 1971, Mineev 1982, Bianki *et al.* 1993), and in mid-June on Franz Josef Land (Gorbunov 1932, Parovshchikov 1963, Tomkovich 1984).

One- and two-year old non-breeders roam about along the migration routes, sometimes far off their normal routes. For instance, a two-year old bird from Kandalaksha Bay in the White Sea was shot in Greenland (Bianki 1965). Only a few of these sub-adults visit the breeding grounds during the summer, and when they breed for the first time they often settle in colonies other than the natal one. For instance, birds breeding in Kandalaksha Bay have been found to stem from colonies in Onezhski Bay, the Aynov Islands and the Gulf of Bothnia (Bianki 1965).

The nest-site fidelity of breeding terns depends to a great extent on their breeding success the previous breeding season. In the White Sea, the proportion of adults returning to their former nesting site has been found to be up to 80–85% in years following successful breeding, but only 40–75% after unsuccessful breeding seasons (Bianki 1965, Bianki & Khlyap 1970).

Population status and historical trends

The numbers and trends in arctic tern populations are difficult to assess because the terns frequently change nesting places. The proportion of the population attempting to breed also seems to vary from year to year, probably depending on food availability.

The total Norwegian population (excluding Svalbard) has recently been estimated at 20 000–60 000 pairs, with a mean estimate of 40 000 (Gjershaug *et al.* 1994, Spikkeland 1994). The arctic tern breeds along the coast south of the area

Diet of the arctic tern *Sterna paradisaea* in the breeding season within the Barents Sea Region. Prey species or species groups are listed in order of importance in the diet when this is given in the original paper.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
MC	Seven Islands	1941, 1946–48	Fish (60%)[a], insects (25%)[a], Crustacea (19%)[a]	Adults	1
–	Seven Islands	1941, 1946–48	Fish (83%)[a], insects (11%)[a],	Chicks	1
WS	Kandalaksha Bay	1956–60	Fish (58%)[a], insects (20%)[a], Crustacea (15%)[a], Polychaeta (5%)[a]	Adults	2
–	Kandalaksha Bay	1956–60	Fish (62%)[a], Polychaeta (20%)[a], Crustacea (8%)[a], insects (8%)[a]	Chicks	2
FJL	Hooker Island	1991–93	Amphipoda (75%)[b], fish (21%)[b], Polychaeta (4%)[b]	Adults	3
SV	Billefjorden (C Spitsbergen)	1933	*Thysanoessa inermis*, *Mysis oculata*, *Gammarus locusta*, fish	Adults	4
–	Kapp Linné (W Spitsbergen)	1957	Crustacea indet. (65%)[c], euphausiids (20%)[c], Polychaeta (setae) (15%)[c]	Adults	5
–	Edgeøya (E Svalbard)	1969	Gammaridae, *Thysanoessa inermis*	Adults	6
–	Ny-Ålesund (NW Spitsbergen)	1970	*Gammarus* spp., fish, Crustacea indet.	Chicks	7

1. Belopolski *et al.* 1977, 2. Bianki 1977, 3. Weslawski *et al.* 1994, 4. Hartley & Fisher 1936, 5. Burton & Thurston 1959, 6. de Korte 1972, 7. Lemmetyinen 1972a.

[a] Percentage by occurrence

[b] Percentage by wet weight

[c] Percentage by volume

treated here and also inland in northern Norway. The largest numbers are, however, found in coastal areas and along fjords in northern Norway (Strann 1991, Spikkeland 1994). Strann & Vader (1986) estimated that approximately 11 000 pairs bred along the coast in an area including most of the area assessed here except the western- and easternmost parts.

The coastal population in the area treated here may tentatively be set at 20 000 pairs. The basis for this estimate is, however, relatively weak. The population development in the area is uncertain, but the population in Troms may have increased somewhat since the 1930s (Strann & Vader 1986, Strann 1991). The breeding success in large parts of north Norway was low in 1982–1987, probably due to food shortage (Strann 1991). Gjershaug *et al.* (1994) suggested that there had been a decrease in the population in Norway as a whole of about 20–50% in the period 1970–1990.

The population on the Murman coast probably numbers about 10 000 pairs in normal breeding seasons, but varies considerably from year to year. For instance, from 100 to 3300 pairs bred annually in Seven Islands in 1936–1992 (Krasnov *et al.* 1995). During the 1970s and 1980s, the number of terns declined on the Murman coast, presumably due to declining fish stocks (T.D. Gerasimova and T.D. Paneva, pers. comm.). The population in this area has not yet recovered.

In Kandalaksha Bay, there are now about 1000–1200 pairs of breeding arctic terns (Kandalaksha State Nature Reserve, unpubl. data), only 20% of the numbers in the 1950s (Bianki 1977). In Onezhski Bay, the number of terns was estimated to be 9000 pairs in 1960 (Bianki 1963), 10 000 pairs in 1983 (V. Bianki, unpubl. data) and 10 000 pairs in the 1990s (A. Cherenkov and V. Semashko, pers. comm.). The total population in Onezhski Bay thus seems to have been stable in this period. The distribution of the breeding birds has, however, changed considerably; the number of pairs having increased in the southern areas, but decreased in the northern areas.

Most of the arctic tern population in the south-eastern Barents Sea breeds from the Kola Peninsula to Khaypudyrskaya Bay. The terns breed on the tundra from the coast to about 100 km inland. A minimum of 7500 pairs nested on the coastal tundra from the White Sea to Khaypudyrskaya Bay in 1976 (V. Bianki, unpubl. data; see also Zubakin 1988). The total arctic tern population in the south-eastern part of the Barents Sea (Murman coast, White Sea and Nenetski district) is estimated to be maximum 80 000–100 000 pairs. No population estimates are available from Franz Josef Land or Novaya Zemlya, but the populations in these areas are relatively small (see Kalyakin 1993).

The Svalbard population has been estimated to be less than 10 000 pairs (Mehlum & Bakken 1994). There is little information concerning the development of the population, but it has probably not changed much during the last decades.

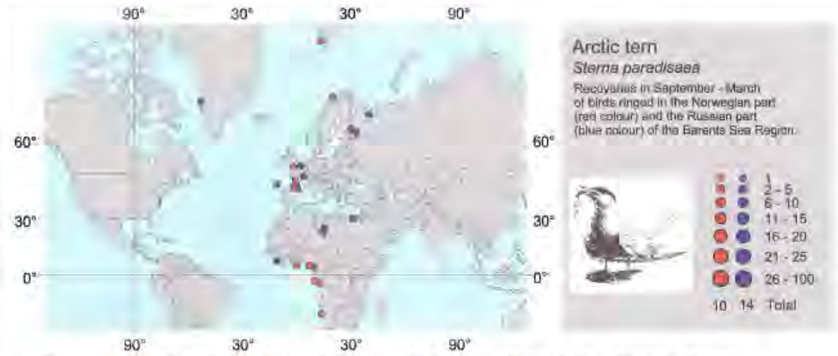
Feeding ecology

The main food of arctic terns is small fish, crustaceans, polychaetes and insects caught near the water surface. Most of the prey is taken in relatively shallow water along the shores. Fish are of great importance in several southern areas, and the breeding success depends to a large extent on the availability of one or a few key species of fish. In the Shetlands (UK), a depletion in the stock of sandeels *Ammodytes marinus* led to an extensive breeding failure in arctic terns in the 1980s (Avery & Green 1989, Monaghan *et al.* 1989, Avery *et al.* 1993). Very low breeding success, probably due to food shortage, was also observed in north Norway in 1982–1987 (Strann 1991). Reduction in the availability of sandeels was probably important also here (Spikkeland 1994).

The three-spined stickleback *Gasterosteus aculeatus* used to be the main food of arctic terns in Kandalaksha Bay. The sticklebacks disappeared almost completely in the 1960s and the terns have since had difficulty obtaining enough alternative prey (polychaetes, gammarids and insects) to rear their chicks successfully (V. Bianki, unpubl. data). On the Solovetskie Islands in the White Sea, three-spined sticklebacks are still the principal food for arctic tern chicks (V. Semashko, pers. comm.). On the East Murman coast, the arctic terns feed mainly on sandeels and herring *Clupea harengus* and, to a lesser extent, crustaceans and insects (Belopolski *et al.* 1977).

Generally, birds breeding in the most northern areas, such as Svalbard and Franz Josef Land, seem less dependent on fish and more on crustacean prey. Crustaceans (crabs and shrimps) have, however, also been found to be important prey in more southerly areas of Europe (e.g. the Wadden Sea; Frick & Becker 1995).

Little information is available on the diet of arctic terns outside the breeding period.



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Threats

In the southern part of the Barents Sea Region, arctic terns often seem to depend on a high availability of one or a few key species of fish, such as sandeel and three-spined stickleback, for successful breeding. Depletion of the stocks of these species due to over-fishing or other reasons is therefore one of the main threats to arctic terns in these areas. If little food is available, arctic terns may abandon their eggs or young, or not breed at all (Kartashev 1949b, Strann 1991, Spikkeland 1994).

The increasing petroleum activity in the Barents Sea Region may pose a threat to arctic terns, although they are considerably less vulnerable to oil spills than, for instance, auks and eiders (Anker-Nilssen, Bakken *et al.* 1988, Fjeld & Bakken 1993, Isaksen *et al.* 1998).

There are several important predators of arctic tern eggs and chicks that may locally reduce the breeding success considerably. Colonies of moderate size (up to a hundred nesting pairs) may be robbed by red foxes *Vulpes vulpes*, arctic foxes *Alopex lagopus* or dogs from human settlements. Gulls, skuas, corvids and ruddy turnstones *Arenaria interpres* are also important nest predators in some areas. Merlins *Falco columbarius* and white-tailed eagles *Haliaeetus albicilla* may take recently fledged juveniles (Løvenskiold 1964, Kokhanov & Skokova 1967, Bianki 1977, Strann 1991). The expansion of feral and introduced North American mink *Mustela vison* into areas where it has previously not occurred in Norway and parts of Russia may be one of the most serious threats to the species (see Folkestad 1982, Craik 1997). The slight predation on adults by peregrine falcon *Falco peregrinus* and gyr falcon *Falco rusticolus* represents no threat to the populations.

Special studies

Detailed studies of the ecology of the arctic tern have been carried out on the Murman coast (Belopolski 1957a, Anzigitova *et al.* 1980) and in Kandalaksha Bay (Bianki 1977). In addition to the counts of breeding pairs on the islands of the Kandalaksha State Nature Reserve, the distribution and numbers of terns have been studied in Onezhski Bay during the last decade (A. Cherenkov & V. Semashko, pers. comm.).

There have not been any long-term studies of arctic terns in Svalbard or north Norway. The breeding biology in Svalbard was studied by several authors in the 1950s and 1960s, mostly for just a single breeding season (Burton & Thurston 1959, Norderhaug 1964a, Gullestad & Norderhaug 1967, Bengtson 1971b, Lemmetyinen 1972a, b). More recently, research has been carried out on the energetics of arctic terns in Svalbard (Klaassen *et al.* 1989a, b, c, Klaassen & Bech 1992). There has been no systematic monitoring of the numbers of breeding arctic terns in Svalbard, but a few colonies in northern Norway are monitored (see Lorentsen 1997).

Recommendations

The number of breeding arctic terns in a colony may vary greatly from year to year. To be able to track changes in the breeding population, all colonies within a large area should be monitored. This may be very time consuming, costly and hard to accomplish. Instead of monitoring the number of breeding pairs each year it may therefore be more realistic to undertake larger censuses of all colonies within a large area every fourth or fifth year. These censuses should be supplemented with the monitoring of the breeding success (especially in relation to food availability) in a few reference colonies annually.

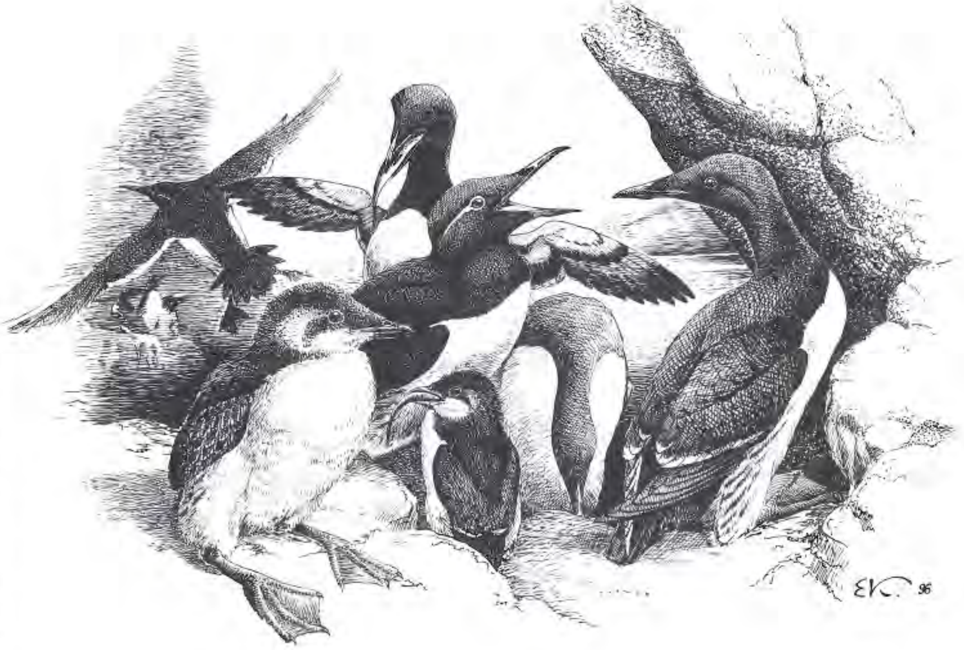
The monitoring of arctic terns in Kandalaksha Bay should continue and the Solovetskie Islands should also be included in the study area. Long-term studies of the breeding ecology should also be carried out in other parts of the Barents Sea Region.

It is noteworthy that no detailed studies of the feeding ecology of arctic terns have been undertaken in north Norway, especially as a reduction in a single fish stock is thought to be the cause of the large-scale breeding failure in parts of this area in the 1980s. Such studies should be carried out. As arctic terns in several areas seem to rely on one or a few species of fish for successful breeding, avoiding over-fishing of these stocks is of major importance in the management of arctic tern populations.

Vitali V. Bianki & Kjell Isaksen

Common guillemot *Uria aalge*

No: Lomvi Ru: Tonkoklyuvaya kayra



Population size: 130 000-150 000 pairs
Percent of world population: 3-4%
Population trend: Large increase

General description

The common guillemot is the largest of the extant auk species. It has a circumpolar boreo-low arctic distribution, and breeds in dense colonies between 40°N and 75°N. In the north-west Atlantic, common guillemots breed in the Bay of Fundy, Newfoundland, Gulf of St. Lawrence, Labrador and Greenland. The largest concentration is found on Iceland, and large colonies also exist on the Faeroes and Jan Mayen. Elsewhere in Europe, the species breeds in small numbers in Portugal, Spain, France, Ireland, Helgoland and the Baltic, and in much larger numbers in Britain, Shetland, Norway, the Kola Peninsula, Bjørnøya and Novaya Zemlya. In the Pacific, there are colonies in California, Washington, Oregon, British Columbia and Alaska, the Pribilof, Aleutian, Kurile and Komadorskie Islands, Kamchatka and the Seas of Okhotsk and Japan (Golovkin 1984, Nettleship & Evans 1985, Lloyd *et al.* 1991).

Six races of *Uria aalge* have been described within the North Atlantic (*aalge, albionis, hyperborea, ibericus, intermedia* and *spiloptera*) (Salomonsen 1933), but they are poorly differentiated. Those most recognised today are the south and west European *albionis*, the north-western and nominate *aalge* and the northern *hyperborea*. There is a bridled morph of common guillemots and, in Europe, the frequency of this morph increases from near 0% at the extreme south of its range to >50% in the Barents Sea.

The world population is estimated to be 8-11 million birds with 3-5 million breeding in the North Atlantic (Lloyd *et al.* 1991). Of these, about 130 000-150 000 pairs now breed in the Barents Sea Region, about 100 000 of them on Bjørnøya. Populations in many parts of the North Atlantic declined in the 1800s due to human persecution, but started to recover as soon as harvesting and disturbance were reduced. Recent declines have been recorded in the Faeroes, north Norway (west of Nordkapp) and probably Iceland, but the rest of the European population has increased within most of its range although some local declines have been documented (Nettleship & Evans 1985, Lloyd *et al.* 1991).

Population sizes and trends of the common guillemot *Uria aalge* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	10-15 000	1974-96	-2	1986-87	-2/-1	1960-87	1-11
			variable	1987-96			7-11
MC	20-30 000	1960-76	-2	1986-87	+2	1965-85	1, 12
			+1	1987-96			1
WS	0						
ND	0						
NZ	ca. 750	?	-	-	-	-	12
FJL	0						13
SV	100 000	1995	-2	1986-87	-	-	14
			+2	1987-96	-	-	14
All	130 000-150 000	-	-	-	-	-	

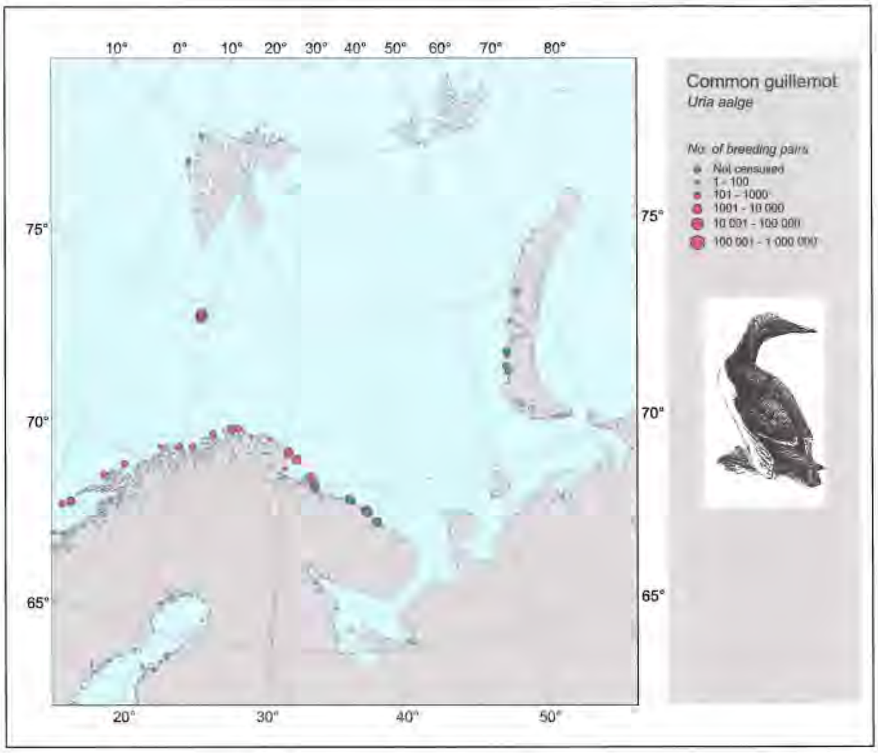
1. Krasnov & Barrett 1995, 2. Bakken 1989, 3. Brun 1979, 4. Rikardsen *et al.* 1987, 5. Bustnes *et al.* 1993, 6. Strann & Vader 1986, 7. Lorentsen 1995, 8. Iversen & Iversen 1989, 9. R.T. Barrett, unpubl., 10. Tromsø Museum, unpubl., 11. NINA, unpubl., 12. Golovkin 1984, 13. Gavrilo *et al.* 1993, 14. V. Bakken, unpubl.

Breeding distribution and habitat preferences in the Barents Sea Region

The common guillemot breeds in about 20 colonies along the coast of north Norway (ca. 20 000 individuals = 90% of the Norwegian population), 10 colonies on the Murman coast (20 000-30 000 pairs) and 7-9 colonies on Novaya Zemlya (ca. 1000 individuals). The largest single concentration of common guillemots in the Barents Sea is found on Bjørnøya where approximately 100 000 pairs bred in 1995 among 120 000 pairs of Brünnich's guillemots (V. Bakken, unpubl. data). About 200 individuals bred on Spitsbergen on three sites only, but no birds were recorded on two of these during recent surveys (Mehlum & Bakken 1994, V.

Bakken, unpubl. data). No common guillemots have been recorded in Franz Josef Land (Gavrilo *et al.* 1993).

Common guillemots breed in dense colonies on steep cliffs, tops of stacks and occasionally on flat, low-lying islands. They generally lay their eggs directly on open, broad ledges, but sometimes hidden among large boulders or in deep cracks. In many colonies in the Barents Sea Region, they breed intermingled with Brünnich's guillemots *Uria lomvia*, although the latter nest on narrower, more extreme ledges. Many of the colonies also contain northern fulmars *Fulmarus glacialis*, black-legged kittiwakes *Rissa tridactyla*, razorbills *Alca torda* and occasionally Atlantic puffins *Fratercula arctica*.



Movements

North Norwegian and Murman common guillemots leave their breeding sites in late July - early August and disperse rapidly away from the colony. Many winter in the southern Barents Sea and off the coasts of north Norway and Murman (Holgersen 1951, 1961, Kaftanovski 1951, Strann & Vader 1987, Bianki *et al.* 1993, Isaksen & Bakken 1995b, Nikolaeva *et al.* 1996, 1997b, A.N. Golovkin, unpubl. data). Some birds from Murman and Novaya Zemlya move into the central part of the White Sea in autumn (Bianki *et al.* 1993) whereas others, along with birds from north Norway, have been recovered as far south as the Skagerrak (Brown 1985, Anker-Nilssen, Jones *et al.* 1988).

Large numbers of guillemots have been observed in February in the central Barents Sea where there are varying degrees of concordance between their distribution and that of their prey species and/or the physical properties of the sea (Erikstad *et al.* 1990, Skarsfjord 1995, Fauchald & Erikstad 1995, Fauchald *et al.* 1996). In some years, thousands of common guillemots spend much of the winter (Oct.-Jan.) near the Murman coast (Kaftanovski 1951, Bianki *et al.* 1993, A.N. Golovkin, unpubl. data). In March, huge flocks often gather off the coast of Finnmark and sometimes also the Kola Peninsula when capelin *Mallotus villosus* approach land to spawn (Barrett 1979b, Erikstad & Vader 1989, Isaksen & Bakken 1995b). They then disperse and return to their colonies which they start to occupy in late March - early May.

Recoveries of foreign-ringed birds in late winter show that many first-winter and sub-adult guillemots from Britain and Iceland move up the coast of Norway where they mix with the Norwegian and Russian populations (Brown 1985, Strann *et al.* 1991). Two birds ringed as chicks on Shetland have even bred on Hornøya (R.T. Barrett, unpubl.). There is also recent evidence of considerable inter-colony movements of both breeding and immature guillemots among colonies in Finnmark and Murmansk (Nikolaeva *et al.* 1996).

Population status and historical trends

Since the first comprehensive counts were made in north Norway in the early 1960s (Brun 1963, 1969a), the population of common guillemots has declined dramatically on all colonies west of Nordkapp. Most alarming is the collapse of the colony on Hjelmsøy from what was Norway's largest colony of approximately 220 000 individuals in 1964 to less than 5000 individuals today. Some of the colonies can today be considered as being seriously threatened with extinction with the possibly too few pairs remaining for the colony to be viable. For example, numbers on Sør-Fugløy have dropped from 10 000 pairs in 1940 (Soot-Ryen 1941a), 4000 pairs in 1961, 100 pairs in 1966 to 10 pairs in 1974 (Brun 1969a, Norderhaug *et al.* 1977). Rikardsen *et al.* (1987) estimated the Sør-Fugløy population to number less than 100 pairs, and only one bird was seen during a visit in 1995 (K.O. Jacobsen, pers. comm.). Numbers on Nord-Fugløy have also dropped from 10 000-15 000 pairs in the 1960s (Lütken 1965, Brun 1969a) to a few hundred pairs in the late 1980s (Anker-Nilssen & Barrett 1991).

Norwegian colonies east of Nordkapp have either fluctuated around stability or increased during the same period, at least until 1986. The largest colony on the Murman coast is on Kuvshin Island, in the Seven Islands archipelago. In 1938, its population was estimated to be about 2000 pairs, but by 1976 it had increased to more than 7000 pairs (Shklyarevich 1977). Although Kuvshin is probably the largest Russian colony of common guillemots in the Barents Sea Region, annual counts have been made on Kharlov, a neighbouring island, since 1938. After a sudden decline from more than 2000 pairs in about 1950 to less than 1000 pairs in 1956, numbers on Kharlov fluctuated greatly until a steady increase began about 1965. In 1986-1987, there were huge declines on all colonies in the region, including Bjørnøya (Vader *et al.* 1990, Isaksen & Bakken 1995b, Mehlum & Bakken 1994, Krasnov & Barrett 1995), but numbers in east Finnmark and on the Murman coast have been recovering rapidly since then (14% p.a. on Kharlov, 5.4% p.a. on Hornøya in 1987-1994 (Krasnov & Barrett 1995)).

The largest concentration of breeding common guillemots in the Barents Sea is on Bjørnøya. Historical estimates of numbers of guillemots (common and

Diet of the common guillemot *Uria aalge* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Vedøya	1970s	Sandeel Saithe	Chicks	1
-	Hjelmsøy	1983	Capelin (99%)	Chicks	2
		1984	Saithe (70%)	Chicks	3
-	Syltefjord	1985	Capelin (40%) Sandeel (40%) Herring (10%)	Chicks	3, 4
-	Hornøya	1980-95	Capelin (20-90%) Sandeel (10-50%) Herring (0-50%)	Chicks	1, 3
MC	Seven Islands	1935 1947-49	Sandeel (5-20%) Capelin (10-40%) Herring (10-40%) Cod (10-50%)	Adults	5
-	Seven Islands	1980-95	Sandeel (10-90%) Capelin (10-80%) Herring (0-20%)	Chicks	3, 4
NZ	Bezym. Bay	1948-50	Polar cod Sandeel Capelin Cod	Adults	6
SV	Bjørnøya	1988-95	Capelin (60-100%) Squid (0-30%)	Chicks	3

1. Tschanz & Barth 1978, 2. Vader *et al.* 1990, 3. Barrett, Bakken *et al.* 1997, 4. Uspenski 1956, 5. Belopolski 1957b, 6. Barrett & Krasnov 1996

Brünnich's) breeding on Bjørnøya have been very imprecise with descriptions such as "vast", "enormous" or "fantastic" numbers which should be counted in "millions" (Jourdain 1922, Lütken 1969). Even recent counts, again of both species, have ranged between 310 000 individuals (in 1970, Williams 1971a) and "at least 2 000 000" (in 1980, van Franeker & Luttik 1981). In 1986, the Norwegian Polar Institute carried out a comprehensive survey and estimated the population to be 245 000 pairs (Mehlum & Bakken 1994). In 1987, the number of breeding birds had crashed to 36 000 pairs. However, by 1989, they had nearly tripled to 90 000 pairs, indicating that many birds failed to breed in 1987. The population has remained fairly stable around 100 000 pairs since 1990 (Lorentsen 1995, V. Bakken, unpubl. data).

Very few common guillemots breed on Novaya Zemlya and the population in 1950 was estimated to be less than 1000 birds. The biggest concentration (300-400 birds) was on the south shore of Bezymyannaya Bay (Uspenski 1956). In 1994, numbers on the same stretch of coastline were estimated to be 280 birds (Strøm *et al.* 1994) and their distribution was very similar to that described in the 1930s and 1950s by Krasovski (1937) and Uspenski (1956). This suggests that there has been little overall change in the numbers breeding in the easternmost part of the Barents Sea. It is probable, however, that common guillemots suffered to some extent during the years of intensive harvesting of eggs and adults (mostly of Brünnich's guillemots) in the 1930s and 1940s (Krasnov & Barrett 1995).

Feeding ecology

Common guillemots are predominantly piscivores, basing their diet on small (max. ca. 200 mm long) schooling fish which they catch underwater. Maximum diving depths recorded on Hornøya in 1980-1991 were around 50 m (Barrett & Furness 1990, Barrett, Aasheim *et al.* 1997).

Nearly all our knowledge concerning their choice of food is based on direct observations and collections of fish being brought to chicks, and on stomach samples of birds caught in the colony. As a result, almost nothing is known about their diet outside the breeding season (Barrett, Bakken *et al.* 1997). However, from the general concordance between the distributions of guillemots and capelin in early spring (Barrett 1979b, Strann *et al.* 1991, Skarsfjord 1995, Fauchald & Erikstad 1995), we can infer that capelin are an important constituent of their diet in north Norway immediately prior to the breeding season. This was the case in April 1986 when the stomachs of birds collected in east Finnmark contained only capelin (Erikstad & Vader 1989).

Few data are available concerning the diet of common guillemots during the breeding season west of Nordkapp, despite the relatively large numbers breeding there. Incidental samples of chick food collected on Hjelmsøy were dominated by capelin in 1983 and saithe *Pollachius virens* in 1984. The stomach contents of birds shot off Bleiksøya in 1987 consisted mainly of squid beaks (R.T. Barrett, unpubl. data), but possible fish remains, including otoliths, may have dissolved before dissection. There is little quantitative information on the diet of common guillemots on Røst, but the general impression from many occasional observations made between 1980 and 1996 is that they feed their chicks mainly on gadids such as saithe, haddock *Melanogrammus aeglefinus* and whiting *Merlangius merlangus*. Sandeels *Ammodytes* spp. and young herring *Clupea harengus* are also sometimes taken (T. Anker-Nilssen, pers. comm.). In east Finnmark, capelin, sandeels and herring were the commonest items recorded being brought to chicks in the 1980-1995 breeding seasons, although the proportions of each species varied considerably from year to year (Barrett & Krasnov 1996). Samples of capelin and herring collected on Hornøya were within the 100-140 mm size class (Barrett & Furness 1990, Barrett & Krasnov 1996). The capelin caught during Erikstad & Vader's (1989) survey in April 1986 were 130-160 mm long. On Bjørnøya, chicks were fed 90-100% capelin in five of six seasons. In the sixth season, they received 30% squid *Gonatus fabricii* and 70% capelin (Barrett, Bakken *et al.* 1997)

The food spectrum along the Kola Peninsula was similar to that in east Finnmark (sandeels, capelin, herring and cod *Gadus morhua*) in the 1930s and 1940s and in 1980-1995 (Belopolski 1957a, Barrett & Krasnov 1996). As in east Finnmark, the proportions of fish changed considerably both during the breeding season and from year to year. Small differences were also noted between males and females (Belopolski 1957a). Further east, on Novaya Zemlya, polar cod *Boreogadus saida*, sandeels, capelin and cod were all found in a very limited sample collected in 1948-50 (Uspenski 1956).

Threats

Direct threats

Due to their habit of spending most of their time on the sea, guillemots are very sensitive to oil pollution. In the Barents Sea, they are extra sensitive in that they often occur in huge flocks (e.g. above shoals of spawning capelin), and even very small oil spills can cause huge mortalities. Such was the case in March 1979 (Barrett 1979b). An incident was also recorded in spring 1966 when oiled birds were found beached at a rate of 1-2 per km along the Kola coast near Dal'nie Zelentsi (A.N. Golovkin, unpubl. data). As yet, no major oil spills have occurred in the Barents Sea, but an increasing interest in offshore oil exploration and production in the region, including the high-Arctic, ice-covered waters, is an impending threat to the common guillemot population (Anker-Nilssen, Bakken *et al.* 1988, Fjeld & Bakken 1993).

Pollution in the form of organochlorines and mercury is not considered a threat. Levels measured in eggs from several colonies in 1983 and 1993 were very low (Barrett, Skaare *et al.* 1985, 1996).

Common guillemots (and other seabirds) have been exploited for their eggs, feathers and meat for a long time in Norway and Russia (Uspenski 1956, Bratrein 1982, Krasnov & Barrett 1995). In the 1930s, the annual harvest on Novaya Zemlya was 200 000-350 000 eggs and 10 000-15 000 adult guillemots (mostly Brünnich's, but also some common) (Uspenski 1956). There was also an intense harvest on Novaya Zemlya and along the Kola coast during the Second World War (1941-45). The result of these harvests was a reduction in breeding success and ultimately a decline in breeding numbers (Krasnov & Barrett 1995). After unsuccessful attempts to regulate the harvest to sustainable levels (Kafatanovski 1951, Kartashev 1951), the colonies were legally protected in 1947 (Novaya Zemlya) and 1960 (Kharlov) enabling the populations to start their recovery. However, up to 400 eggs were collected illegally every spring from other colonies along the Murman coast in the 1960s (A.N. Golovkin, unpubl. data) until they too were protected through an expansion of the Kandalaksha State Nature Reserve.

Egging was also prolific on Norwegian colonies, including Bjørnøya where 50 000-60 000 eggs were harvested annually in the 1950s (Rossnes 1981). Up to 1970, when the trade ended, the harvest was reduced by about 50%. Egging on the Norwegian coast may have contributed to the declines west of Nordkapp in the 1960s-1980s (Tromsø Museum, unpubl. data). However, egging is now forbidden although poaching still occurs on Hjelmsøy and is a serious threat to the possible recovery of the local population.

Seabird hunting outside the breeding season was also very popular in Norway, and in the 1970s the annual bag included 30 000-40 000 auks (mostly common guillemots) (Barrett & Vader 1984). The hunting of common guillemots was banned in 1979, and the auk bag dropped to about 7000 birds. In some localities, such as Røst, common guillemots were also illegally harvested during the breeding season (ca. 500-700 birds a year, Brun 1979). Although this harvest has now all but ceased, it almost certainly contributed to the decline of the local population.

Disturbance by visitors to colonies is considered to be a minor threat. However, there are legislative measures to keep this at a minimum in the protected colonies in Norway and Russia by prohibiting boats to approach within certain limits (1 km in the Kandalaksha State Nature Reserve) without permission. Landing on the islands is also often limited to those with permission from the reserve authorities. Aircraft are not allowed to break the sound barrier or fly below 2000 m (in Russia) near the colonies.

Drowning in fishing nets has been, and still is, one of the most serious threats to the population of Norwegian common guillemots (Brun 1979, Myrberget 1980, Barrett & Vader 1984). The fishing activities involved are the winter cod fishery, the spring cod fishery and the salmon *Salmo salar* fishery. Their effects were documented by Strann *et al.* (1991). In one extreme case, up to 200 000 common guillemots drowned in a brief incident in Troms in April 1985, and tens of thousands are estimated to have drowned in north Norwegian salmon nets every year in the 1970s and 1980s. The banning of salmon drift-nets in 1989 has done much to alleviate this problem, but salmon pound nets set near colonies still catch common guillemots and may pose a threat to some populations (Bustnes *et al.* 1993). The periodic drowning of common guillemots in cod and salmon fishing gear is still probably the most serious threat to guillemots in the Barents Sea Region, including the many foreign birds which winter in the region (Strann *et al.* 1991). Although gill-netting is not a tradition in Russia, a recent need to exploit new fish resources may result in an increase in this activity and hence pose a threat to local guillemot populations.

Indirect threats

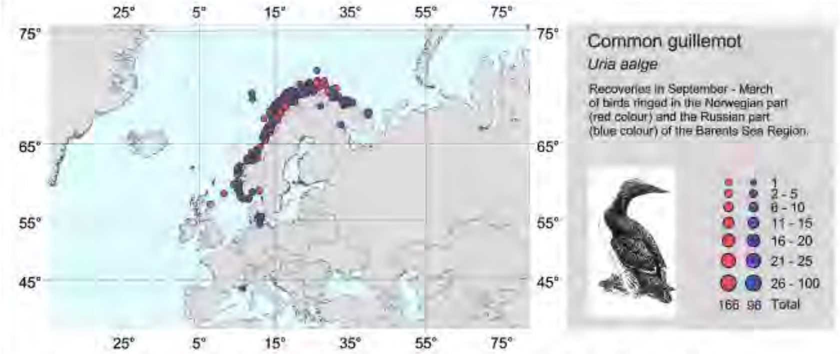
The collapse of the Norwegian spring-spawning herring stocks in the late 1960s probably contributed to the recent declines in local guillemot populations west of Nordkapp as a result of a reduction in chick survival and, hence, insufficient recruitment to the breeding population (Tschanz & Barth 1978, Barrett & Vader 1984, Bakken 1989).

Although only partly due to fishing pressures, the collapse of the Barents Sea capelin stock in the mid-1980s had the most serious effects documented to date, and resulted in an 85% reduction in the numbers of common guillemots breeding on, for instance, Hjelmsøy, Syltefjord, Hornøya, Kharlov and Bjørnøya between 1986 and 1987 (Vader *et al.* 1990, Isaksen & Bakken 1995b, Krasnov & Barrett 1995). However, the capelin stocks recovered rapidly and the common guillemot populations now monitored annually on Hornøya and Kharlov are recovering rapidly (Krasnov & Barrett 1995). This recovery continues despite a second collapse in the capelin stock in 1993 and 1996, probably due to the current availability of alternative food (herring). Further reductions in pelagic fish stocks (herring and/or capelin) can thus have serious consequences for the Barents Sea population of common guillemots.

Special studies

Common guillemots are one of the three main species included in the Norwegian seabird monitoring programme and annual counts are made in Røst, on Hjelmsøy, Hornøya and Bjørnøya (Vader *et al.* 1990, Lorentsen 1995, Isaksen & Bakken 1995b, Krasnov & Barrett 1995, Anker-Nilssen *et al.* 1996). They are also counted annually on Kharlov Island (Shklyarevich 1977, Krasnov & Barrett 1995).

Common guillemots are included in a systematic study of the seabird community in relation to fish stocks on Hornøya (including chick growth, food, adult survival and recruitment mechanisms) which started in 1980 (Barrett 1983, Furness & Barrett 1985, Barrett & Furness 1990, Erikstad *et al.* 1994, Krasnov & Barrett 1995, Barrett & Krasnov 1996). Adult survival and nest site fidelity are also being monitored on Bjørnøya (V. Bakken, pers. comm.). A specific study of



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

the ecological relationships between common and Brünnich's guillemots was carried out in 1990-1991 (Aasheim 1993, Aasheim *et al.* in manus., Barrett, Aasheim *et al.* 1997), and their genetic interrelationships have been studied in Norwegian colonies by several authors (Tschanz & Wehrlin 1969, Moum 1989, 1993, Moum *et al.* 1991, Moum & Johansen 1992, Friesen *et al.* 1993, Friesen, Baker *et al.* 1996, Friesen, Montevecchi *et al.* 1996). Morphological studies include those of the frequency of the bridled morph in north Norway and on Bjørnøya (Watson 1954, Regnell 1957, Brun 1970a, 1971c, Birkhead 1984 and refs. therein) and systematics (Kozlova 1957, Pethon 1967). Russian studies of guillemot morphology include those of the skeletal and muscular systems (Krasovski 1936, 1940, Kaftanovski 1951, Kartashev 1955a, 1957, 1960a, Yudin 1965) and central neural system and immunology (Averkina *et al.* 1965, Avilova & Korneeva 1973, Barsova 1984). Problems concerned with the by-catch of guillemots in fishing gear have been described by Strann *et al.* (1991), Bustnes *et al.* (1993) and Follestad & Runde (1995). Attempts to alleviate these problems have been pioneered by Hansen (1996).

Guillemot behaviour has been studied in detail on Bjørnøya (Williams 1971b, 1975) and Vedøy, Røst (Tschanz 1959, 1964, 1968, Oberholzer & Tschanz 1968, 1969, Wehrlin & Tschanz 1969, Tschanz *et al.* 1969, 1989, Oberholzer 1975, Tschanz & Hirsbrunner-Scharf 1975 and Wehrlin 1977), as were the problems in estimating and monitoring the breeding population (Tschanz 1978, 1983, Bakken 1989, Anker-Nilssen *et al.* 1996).

Body temperatures and energetics have been subjects of detailed studies on Hornøya (Barrett 1984, Gabrielsen 1994, 1996), as have the organochlorine and heavy metal levels in the eggs and feathers of common guillemots in north Norway and on Bjørnøya (Bourne & Bogan 1972, Fimreite *et al.* 1974, 1977, Fimreite & Bjerk 1979, Barrett, Skaare *et al.* 1985, 1996, Thompson *et al.* 1992, Wenzel & Gabrielsen 1995).

Studies of common guillemot distribution and feeding behaviour at sea include Brown (1984), Rikardsen *et al.* (1987), Strann & Vader (1987), Erikstad (1991) and Erikstad & Vader (1989), and a special study of the correlation between the pelagic distribution of guillemots, their prey (capelin) and oceanographical features started in the Barents Sea in 1986 (Erikstad *et al.* 1990, Fauchald 1994, Skarsfjord 1995, Fauchald & Erikstad 1995, Fauchald *et al.* 1996). A similar study has also been carried out off Bjørnøya (Mehlum, Nordlund *et al.* 1998). Movements of Norwegian guillemots and recoveries of foreign-ringed birds in Norway have been summarised by Holgersen (1951, 1961) and Nikolaeva *et al.* (1996, 1997b).

Most Russian studies on the biology of common guillemots have been comparative, including those of breeding, food choice and behaviour (Kaftanovski 1938, 1941, 1951, Rolnik 1948, Belopolski 1957a, b, c, Karpovich *et al.* 1980, Biancki *et al.* 1993). The exploitation and protection of guillemot colonies have been described by Kartashev (1949a, 1951) and Krasnov & Barrett (1995), and several authors (Dementjev 1947, Kartashev 1955b, Bianki 1967, Bianki & Gerasimova 1960, Nikolaeva *et al.* 1996, 1997b) have analysed the migration and movements of ringed birds. The ecto- and endoparasites of guillemots have been studied in great detail (Belopolskaya 1951, Belogrudov & Smetanina 1965, Flint & Kostyrko 1967, Karpovich 1970, Podlipaev & Golovkin 1977, Galaktionov 1995, Krasnov *et al.* 1995). Attempts to evaluate the competition between guillemots and commercial fisheries started as early as 1938 (Kaftanovski 1951) and have continued since (Belopolski 1957a,b, Golovkin 1963, Krasnov *et al.* 1995, Barrett & Krasnov 1996, Anker-Nilssen *et al.* 1997). The role of guillemot excrement as a source of nutrients for marine biota and their influence on the development of plankton communities were studied in the 1960s and 1970s (Golovkin & Pozdnyakova 1964, Golovkin & Zelickman 1965, Golovkin 1967, Galkina 1974, Golovkin & Garkavaya 1975, Golovkin *et al.* 1975).

Recommendations

There is a general need for up-to-date counts and mapping of common guillemots on Novaya Zemlya and on the Kola Peninsula. Some repeat counts should also be made in the Norwegian and Svalbard colonies. The population monitoring studies on Bjørnøya, Røst, Hjelmsøy, Hornøya and Kharlov should continue (using internationally recognised counting methods). They should also be extended to Novaya Zemlya and expanded to include parameters such as adult survival and reproductive success. More data concerning the diet of common guillemots should be collected, especially outside the breeding season. Such data are important for a fuller understanding of interactions between seabirds and fisheries and for inclusion in multi-species management models.

An up-to-data analysis of ring recoveries should be made to help target the future ringing effort. There is also a great need to continue Hansen's (1996) pioneer effort to design fishing gear which has a low by-catch of seabirds.

Robert T. Barrett &
Alexander N. Golovkin

Brünnich's guillemot *Uria lomvia*

No: Polarlomvi Ru: Tolstoklyuvaya kayra

Population size: 1 750 000 pairs
Percent of world population: ca. 20%
Population trend: Reasonably stable?

General description

The Brünnich's guillemot is one of the most numerous and high-Arctic seabirds in the northern hemisphere. Its distribution is circumpolar, in arctic and sub-arctic seas between 46°N and 82°N (Nettleship & Evans 1985). In the North Atlantic, it breeds from northern Baffin Bay south to the Gulf of St. Lawrence and south-east Newfoundland, and from Iceland, Jan Mayen, Svalbard, northern Norway and the Taymyr Peninsula through eastern Siberia to Cape Parry in the Amundsen Gulf and south in the North Pacific to the Aleutian Islands and northern Japan (Nettleship & Evans 1985). In the southern parts of its breeding range, its distribution overlaps that of the common guillemot *Uria aalge*.

Estimates of the world population vary considerably. Tuck (1961) evaluated the total number at 42 million. Nettleship and Evans (1985) estimated the number at 6.8 million pairs with a possible variation of 4.9-7.5 million for the Atlantic population alone. The population in the eastern Atlantic is approximately three times larger than the breeding population in the western Atlantic.

A single morph *lomvia* is recognised in the North Atlantic range (Bédard 1985). The *arra* morph in the Pacific is connected to the Atlantic by the two morphs, *eleonorae* (breeding in Taymyr and on the New Siberian Islands) and *heckeri* (breeding on Wrangel Island, Herald Island and Chukotskiy Peninsula)(del Hoyo *et al.* 1996).

Breeding distribution and habitat preferences in the Barents Sea Region

Population sizes given as breeding pairs and cited as SCRIB (1998) are estimating by multiplying the number of breeding individuals censused in the colonies by a conversion factor of 0.6 (Bakken & Mehlum 1988).

Population sizes and trends of the Brünnich's guillemot *Uria lomvia* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	1000-2000	1964-92	+2	1985-95	+2	1964-92	1, 2
MC	ca. 3000	1960-95	-2	1986-95	-2	1960-95	1
WS	0						3
ND	0						3
NZ	ca. 850 000	1936-93	(0)	1986-95	-2	1936-94	3
FJL	ca. 25 000	1984-92	(0)	1986-92	(0)	1984-92	3
SV	ca. 850 000	1973-95	(0)	1986-95	(0)	1973-95	3, 4
All	ca. 1 750 000	1936-95	(0)	1985-96	(0)	1936-95	3

1. Krasnov & Barrett 1995, 2. Barrett 1994, 3. SCRIB 1998, 4. Mehlum & Bakken 1994

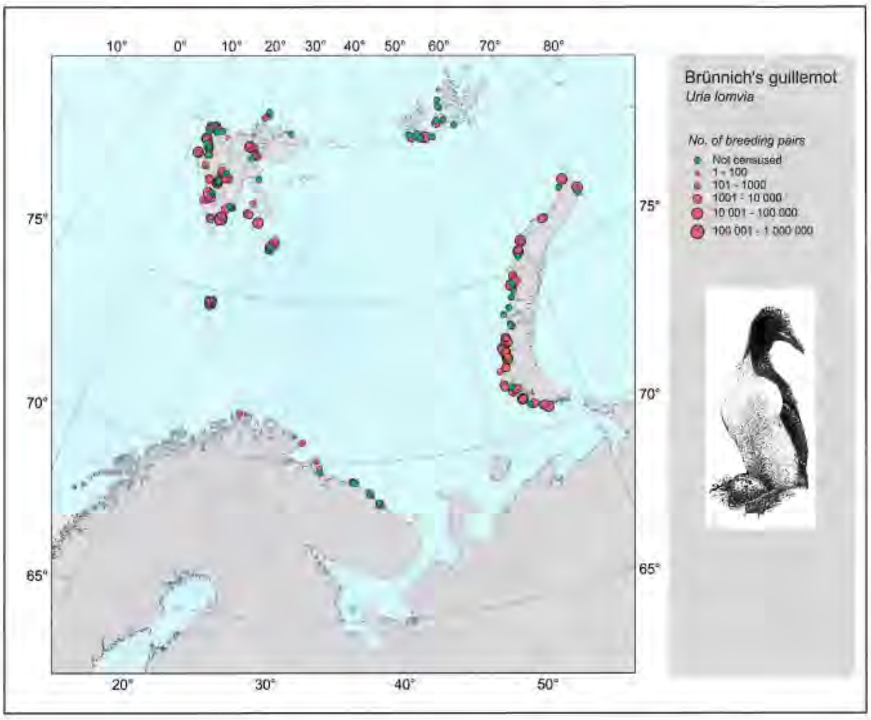
The Brünnich's guillemot breeds in about 250 colonies in the Barents Sea Region, which range from a few to about 270 000 pairs (SCRIB 1998). The latest counts indicate that the mean number of birds in each colony is about 8400 pairs (SCRIB 1998).

About 1000-2000 pairs breed in six colonies on the Norwegian coast (Hornøya, Reinøya, Syltefjord, Gjesværstappan, Hjelmsøy and Røst) (Barrett 1994). Twenty-eight colonies have been recorded on the Murman coast and the total population is about 3000 breeding pairs (SCRIB 1998). Here, as along the Norwegian coast, Brünnich's guillemots breed sympatrically with guillemots. The largest colonies in Murman are on the eastern part of the coast (Gerasimova 1962, Paneva & Krasnov 1994).

Although most of the Brünnich's guillemot colonies are in Svalbard (56%), the largest numbers of birds are probably found on Novaya Zemlya where 55 colonies have been recorded (SCRIB 1998), and a few more probably remain to be discovered. More than 95% of the Novaya Zemlya population breeds in colonies of more than 10 000 individuals (Gavrilo *et al.* 1993). Twenty colonies are known in Franz Josef Land, but only six have been censused (SCRIB 1998). The majority of the Franz Josef Land population breeds in the southern part of the archipelago. The northernmost breeding location in the world is found in Franz Josef Land, at 81°19'N, 55°30'E, and breeding is successful only when ice conditions are favourable (Gavrilo *et al.* 1993).

In Svalbard, 142 colonies containing breeding Brünnich's guillemots have been recorded, and the total population is estimated at about 850 000 pairs (SCRIB 1998). Nearly half the population breeds in the western part of the Storfjorden area. Other important colonies are on Hopen and Bjørnøya, with about 102 000 and 115 000 pairs, respectively (SCRIB 1998). On Bjørnøya, Brünnich's guillemots breed sympatrically with a large population of guillemots (Bakken & Mehlum 1988).

Brünnich's guillemots in the Barents Sea Region breed mainly on narrow ledges on vertical cliffs. In some colonies, the distance between the foot of the cliff and the sea is several hundred metres, but usually the colonies are situated on the seashore (SCRIB 1998).



Movements

Generally, the Brünnich's guillemot leaves the colony when the chick fledges, which in the Barents Sea Region occurs mainly in the second half of July and early August. Krasnov (1995) suggested that birds from Novaya Zemlya migrate to the central part of the Barents Sea. The same migration pattern is probably typical for birds breeding in Franz Josef Land, but there are no ringing recoveries to document this.

In winter, Brünnich's guillemots breeding in the Barents Sea are generally found south-west of their breeding colonies. Some migrate to waters around Iceland, Greenland and Newfoundland (Kampp 1988, Norwegian Polar Institute, unpubl. data), but many stay in the Barents Sea throughout the year (Isaksen 1995a). Antipin (1938) observed Brünnich's guillemots near the north-east coast of Novaya Zemlya all year around in 1936-37. He suggested the existence of a clockwise migration route of seabirds, including Brünnich's guillemot, in the Barents Sea. This hypothesis was based on the arrival and departure dates in spring at Franz Josef Land and Novaya Zemlya.

Of 646 birds ringed on Hornøya and at Syltefjord on the Norwegian coast, one has been recovered in Newfoundland (ringed as a chick), one in Greenland (ringed as an adult) and one on Kharlov Island (ringed as a breeding adult), where it continued to breed (Nikolaeva *et al.* 1996).

There are 14 long-distance recoveries in autumn, winter and spring of birds ringed as adults in Seven Islands. Six were reported from the coast of Greenland and eight from the Murman and Norwegian coasts (Nikolaeva *et al.* 1996). Of birds ringed as fledglings, there are 10 recoveries from the west coast of Greenland and two from the Murman and Norwegian coasts (Nikolaeva *et al.* 1996).

Of more than 45 000 Brünnich's guillemots ringed on Novaya Zemlya (Bezymyannaya Bay and Gribovaya Bay) in 1933-1956, only 22 had been recovered by the end of the 1950s (Bianki & Gerasimova 1960). Six of these were recovered in Greenland (four ringed as adults, two as immatures), eight on the Murman and Norwegian coasts (Bianki & Gerasimova 1960) and seven were recovered or controlled in the breeding colonies on Novaya Zemlya. The last one was recovered on a lake close to the White Sea in winter (Kozlova 1955, Nikolaeva *et al.* 1996). In 1994-1996, 7041 Brünnich's guillemots were ringed (3357 adults and 3684 chicks) in Arkhangel'skaya Bay, Vil'kitski Bay, Gribovaya Bay and Bezymyannaya Bay (Strøm *et al.* 1994, 1995, 1997), but to date none of these birds have been recovered outside the ringing area.

Of more than 10 000 Brünnich's guillemots ringed in Svalbard, a total of 186 have been recovered (data from the Norwegian Ringing Centre) in Greenland (90%), Canada (5%) and Iceland (5%); 95% were reported as having been shot. No birds ringed in Svalbard have been recovered on the European mainland. One hundred and forty two (76%) of the birds recovered were ringed as chicks. Of nine birds recovered in Iceland, six (66%) were adults, and only about 20% of those recovered in Greenland and Canada were adults. The proportion of adults recovered in Iceland is significantly higher than those recovered in Greenland and Canada ($\chi^2 = 12.7$, $P < 0.001$), showing that immature birds probably migrate longer distances in winter.

Population status and historical trends

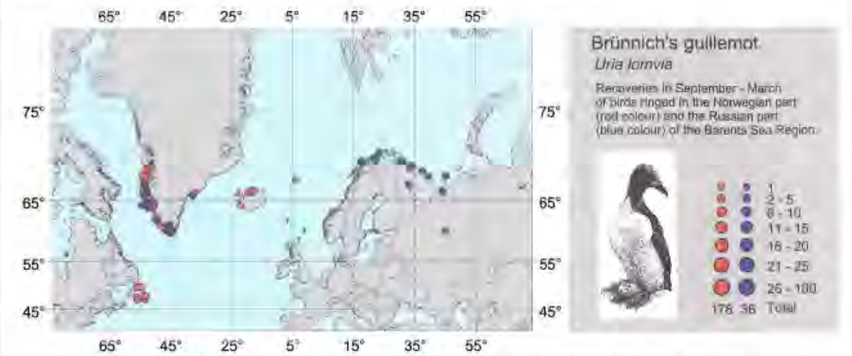
The population on Hornøya in Finnmark was first counted in 1964, and has been monitored sporadically since then (Krasnov & Barrett 1995). It numbered about 100 individuals in 1964 and increased to around 450 in 1983. In 1987, there were only about 300 individuals, but the population increased again to almost 500 in 1992 (Krasnov & Barrett 1995) and to at least 600 in 1996 (R. Barrett, pers. comm.).

On Kharlov Island (Murman coast), the numbers of Brünnich's guillemots increased from 1958 until the mid-1970s (Krasnov & Barrett 1995). Two major drops have occurred since then, a 42% drop in 1978-1980 and a 40% drop in 1986-1987. There has been no clear population trend since 1987 (Krasnov & Barrett 1995).

On Novaya Zemlya, Portenko (1931) estimated the total number of Brünnich's guillemots at 4 million individuals in 1929. In the 1950s, Uspenski (1956) estimated the population to be almost 2 million individuals, and that this figure was more than 100 times higher than all the other seabirds on the islands. Observations made at some colonies indicate that Brünnich's guillemot numbers today are lower than in the 1950s, but a total estimate is difficult due to lack of detailed data (Pokrovskaya & Tertitsky 1993). The population is probably approximately the same size as that in Svalbard (about 1 300 000 individuals) (Mehlum & Bakken 1994).

The largest colony on Novaya Zemlya is situated in Bezymyannaya Bay on the west coast of the southern island. Kaftanovski (1951) believed it to be the largest colony of seabirds in the Northern Hemisphere and Krasovski (1937) estimated that a total of 1 600 000 individuals was breeding there in the 1930s. There are now far fewer birds. A large decline occurred in the 1940s due to intensive harvesting of eggs and birds, and in 1948 the population was estimated at 200 000 individuals (Uspenski 1956). A count in 1992 recorded only 81 000 individuals (Krasnov 1995, Krasnov & Barrett 1995). However, another census in 1994 put the number at 141 000 individuals (Strøm *et al.* 1994). The large difference in the two recent estimates is considered to be due to different counting methods (Krasnov & Barrett 1995). Another large colony on Novaya Zemlya used to be situated on Cape Lil'e with approximately 200 000 breeding individuals in the 1920s (Gorbunov 1929). This colony no longer exists (Kalyakin 1993).

Twenty Brünnich's guillemot colonies are known in Franz Josef Land, four of which were discovered in the 1990s (Gorbunov 1932, Frantzen *et al.* 1993, Gavrilo *et al.* 1993, Muzhchinkin 1995). The largest colonies are concentrated in the southern part of the archipelago, with 7000 individuals on Rubini Rock (Hooker Island) (Belikov & Randla 1984), 6000 pairs at Cape Flora on Northbrook Island (Gavrilo *et al.* 1993) and 10 000 pairs at Cape Grant on George Land (Frantzen *et al.* 1993). There are also two large colonies on Bell Island with 8000 and 4000 individuals, respectively (Frantzen *et al.* 1993). The world's northernmost colony of breeding Brünnich's guillemots is located at Cape Bystrov on Jackson Island. In 1992, this colony totalled 130 individuals (Gavrilo *et al.* 1993). Uspenski (1959a) estimated the total population in Franz Josef Land to be 200 000 individuals. This number has later been criticised as an overestimate, and a maximum of 50 000 individuals seems more realistic (Gavrilo *et al.* 1993). There are too few studies to document any general historical trends for the Franz Josef Land population. However, some fragmentary data may indicate that the population has decreased. In 1931, about 20 000 Brünnich's guillemots were estimated to be breeding at Rubini Rock (Demme 1934). Fifty years later, in 1981, only 7000 birds were recorded in this colony (Belikov & Randla 1984). Furthermore, Uspenski (1959a) estimated that 100 000 Brünnich's guillemots were nesting on Cape Flora in 1959, but Gavrilo *et al.* (1993) recorded only 6000 individuals there in 1992.



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Mehlum & Bakken (1994) compared counts made in 1981, 1985 and 1989 in colonies in Svalbard and demonstrated that the trends differed from area to area. In the Kongsfjorden-Krossfjorden area, numbers decreased by 31% between 1981 and 1985, whereas on north-west Spitsbergen they increased by 21% in the same period. In Hornsund, they increased by almost 600% between 1985 and 1989! Overall, a 17% increase (145 000 to 171 000 individuals) was recorded in Svalbard between 1981 and 1989.

Feeding ecology

The diet of adult Brünnich's guillemots consists mainly of fish and crustaceans (Bradstreet & Brown 1985). In the Barents Sea, important prey items are polar cod *Boreogadus saida*, cod *Gadus morhua*, capelin *Mallotus villosus*, sandeels *Ammodytes* sp., redfish *Sebastes marinus* and *S. mentella*, saithe *Pollachius virens*, herring *Clupea harengus*, sculpins Cottidae, blennies *Lumpenus* sp., eelpouts Zoarcidae, the squid *Gonatus fabricii* and crustaceans. The diet differs considerably within the Barents Sea Region (Barrett, Bakken *et al.* 1997). There is quite a lot of information about the diet of Brünnich's guillemot in the Barents Sea Region.

In the ice-covered waters of the northern Barents Sea, adult Brünnich's guillemots feed mainly on polar cod and crustaceans such as Mysidacea, Euphausicea and Amphipoda, especially *Gammarus wilkitzkii* and *Parathemisto libellula* (Lønne & Gabrielsen 1992, Mehlum & Gabrielsen 1993).

In the open sea, their diet is different and more diverse (Hartley & Fisher 1936, Kaftanovski 1951, Belopolski 1957b, Lydersen *et al.* 1985, 1989, Erikstad & Vader 1989, Erikstad 1990). Important prey are capelin, cod, redfish, saithe and crustaceans. In the eastern part of the Barents Sea, crustaceans are the most important food in spring (Demme 1934, Kaftanovski 1951). The autumn and winter diet is varied and determined by local concentrations of food items (Barrett 1979b, Golovkin 1989, Barrett, Bakken *et al.* 1997). During the pre-laying season, Erikstad & Vader (1989) found that Brünnich's guillemots off Finnmark fed exclusively on capelin and in mixed flocks Brünnich's guillemots took larger fish than common guillemots. The chick diet differs from that of adults, both in ice-covered waters and the open sea.

On the Murman coast, herring *Clupea harengus* was the main prey delivered to the chicks, whereas their diet on Novaya Zemlya was dominated by polar cod *Boreogadus saida* and young cod (Belopolski 1957b). Sandeels, capelin and sometimes herring are important components of the chicks' diet in the southern part of the Barents Sea (Kaftanovski 1951, Belopolski 1957b, Barrett, Bakken *et al.* 1997).

On Bjørnøya, chicks are fed a large proportion of fish, including capelin, polar cod, sculpins Cottidae, shannies *Lumpenus* sp. and eelpouts Zoarcidae, as well as the squid *Gonatus fabricii* (Barrett, Bakken *et al.* 1997). On Spitsbergen, crustaceans have also been observed as chick food (Barrett, Bakken *et al.* 1997), but constituted less than 2% of the total number of feeds registered.

Herrings and sandeels have never been found as food for Brünnich's guillemot chicks in the northern part of the Barents Sea. Similarly, polar cod are never seen being fed to chicks in the southern part of the Barents Sea (Barrett, Bakken *et al.* 1997). The main reason for this is the separation of Atlantic and Arctic water masses in the Barents Sea. The different prey have different preferences in relation to water masses and are geographically separated. There is a tendency for birds sampled at sea around Spitsbergen and Franz Josef Land to contain more crustaceans than those sampled close to Novaya Zemlya, Bjørnøya and in the southern part of the Barents Sea (Barrett, Bakken *et al.* 1997).

The daily food consumption depends on the latitude and changes from 60 g on the eastern Murman coast to 100 g on Novaya Zemlya for adults and from 20 g to 30-35 g for chicks (Belopolski 1957b). Golovkin (1990) estimated the daily need of adults to be 250-300 g. The mean assimilation efficiency of ten Brünnich's guillemots fed on capelin in Svalbard was 74.4% (Brekke & Gabrielsen 1994). Mehlum & Gabrielsen (1995) have estimated the total daily consumption of all the Barents Sea Brünnich's guillemots to be 1256.9 tonnes, which is 63% of the food biomass consumed by seabirds in the Barents Sea.

Threats

Intensive egg harvesting and hunting of adult birds used to be important threats to the population (Krasnov & Barrett 1995), but are now much reduced. The influence is now only local, primarily associated with the polar stations in Russia. Today, the harvest of eggs does not exceed 300-400 per year in any Russian colony (Pokrovskaya & Tertitsky 1993). In future, egg collecting will be further reduced due to the closure of a number of polar stations. Egg collecting is prohibited along the Norwegian coast and in Svalbard.

Fisheries may represent a threat, but few of the prey species of the Brünnich's guillemot are of commercial interest. Although the feeding strategy of the species is quite flexible and adaptive (Bradstreet

Diet of the Brünnich's guillemot *Uria lomvia* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Hjelmsøy	1983	33% capelin, 24% squid, 22% sandeel	Chicks	1
-	Hornøya	1983, 1989-1991, 1993	Sandeel, capelin, herring	Chicks	2
-	Tromsø	1985 (April)	Mostly capelin	Adults	1
-	East Finnmark	1986 (April)	Capelin	Adults	3
MC	Kharlov	1938	86% sandeel, 8% herring, 3% gadoid, 3% other	Chicks	4
-	Kharlov	1935, 1940s	Herring 30, sandeel 18, gadoid 16, capelin 14, crustaceans 5	Adults	5
-	Kharlov	1960	Capelin 5, gadoid 5, *Sebastes 1*	Adults	6
-	Kharlov	1994	80% sandeel, 14% capelin, 5% herring	Chicks	2
-	Kharlov	1992	Capelin 3, herring 2, gadoids 2, sandeel 1	Adults	2
NZ	Bezmyannaya Bay	1934	Mainly cod	Chicks	7
-	Bezmyannaya Bay	1942, 1947	Mainly cod and polar cod	Adults	8
-	Bezmyannaya Bay	1948-1950	Cod, polar cod, sandeels	Adults	9
-	Bezmyannaya Bay	1992	Gadoids 4, sculpins 2, cod 1, capelin 1, sandeel 1, *Liparis 1*, crustaceans 1	Adults	10
-	Bezmyannaya Bay	1994	Polar cod 7, capelin 4, sandeel 2, blennies 2	Chicks	11
-	Bezmyannaya Bay	1995	Polar cod 5, Two-horn sculpin 3, capelin 1, spotted snake blenny 1, sandeels 1	Chicks	12
-	Arkangel'skaya Bay	1996	Polar cod 50, haddock 1, two-horn sculpin 1, eel blenny 1, fish unid. 16	Chicks	13
FJL	Rubini Rock	1931	Crustaceans 8, unid. fish 7, polychaetes 2	Adults	14
-	Rubini Rock	1991-1993	93% (by mass) polar cod, 6 spp. of crustaceans, mainly *Parathemisto libellula*	Adults	15
-	Rubini Rock	1992	Polar cod 12, crustaceans 4, polychaetes 1 and unid. fish 1	Adults	10
SV	Isfjorden	1896	Polar cod	Chicks	16
-	Midterhuken	1910	Mainly polar cod	Adults	17
-	Billefjorden	1933	All contained *Thysanoessa inermis*	Adults	18
-	Edgeøya	1967-1969	Only gammarids	Adults	19
-	Kovalskifjellet	1989	84% polar cod, 10% Lumpenide, 2% Cottidae, 4% unid. fish	Chicks	20
-	Storfjorden	1992	Polar cod, *Parathemisto libellula, Thysanoessa inermis, Gonatus fabricii, Nereis* sp.	Adults	21
-	Kovalskifjellet	1992	99% polar cod, 1% crustaceans	Chicks	22
-	Bjørnøya	1899	Crustacea, polychaetes and fish	Adults	23
-	Bjørnøya	1908	Crustaceans	Adults	24
-	Bjørnøya	1948	Small gadoids	Chicks	25
-	Bjørnøya	1988-1991, 1993, 1995	Capelin, squid, sculpins, polar cod, blennies, eelpouts	Chicks	2
-	Bjørnøya	1993	Frequency of occurrence: 83.3% *Thysanoessa inermis*, 8.3% *T. rashi*, 8.3% Amphipoda indet., 8.3% *Hyas* sp., 8.3% *Nereis* sp., 50.0% Pisces indet., 58.3% polar cod	Adults	26

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Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
-	Open water/ice-covered waters	1986-1986	*Pandalus borealis*, amphipods and polar cod	Adults	27
-	Open water/ice-covered waters	1986	48% fish, mostly polar cod. 33% amphipods, most *G. wilkitskii*.	Adults	27
-	Open water/ice-covered waters	1982-1987	*Parathemisto libellula*, polar cod	Adults	28, 29
-	Open water/ice-covered waters	1984-1985	Benthic amphipods, polar cod, unid. fish	Adults	20

1. Vader *et al.* 1990, 2. Barrett, Bakken et al. 1997. 3. Erikstad & Vader 1989. 4 Kaftanovski 1938, 5. Belopolski 1971, 6. Krasnov *et al.* 1995, 7. Krasovski 1937, 8. Belopolski 1957b, 9. Uspenski 1956, 10. Krasnov 1995, 11. Strøm *et al.* 1994, 12. Strøm *et al.* 1995, 13. Strøm *et al.* 1997, 14. Demme 1934, 15. Weslavski *et al.* 1994, 16. Trevor-Battye 1897, 17. Munsterhjelm 1911, 18. Hartley & Fisher 1936, 19. de Korte 1972, 20. Mehlum & Gabrielsen 1993, 21. Mehlum, Hunt *et al.* 1998. 22. Mehlum *et al.* 1996. 23. Swenander 1900, 24. le Roi 1911, 25. Duffey & Sergeant 1950. 26. Mehlum, Nordlund *et al.*1998. 27. Lønne & Gabrielsen 1992, 28. Mehlum & Gjertz 1984, 29. Gjertz *et al.* 1985,

& Brown 1985), over-fishing of certain species can escalate the imbalance of the Barents Sea ecosystem as a whole and therefore negatively affect the population of Brünnich's guillemots. Due to their ability to utilise alternative food sources, Brünnich's guillemots did not decrease in number as much as common guillemots after the collapse of the Barents Sea capelin stock in 1986-87 (Vader *et al.* 1989).

Pollution from oil and gas exploitation exerts a serious threat to Brünnich's guillemots, one of the seabirds most sensitive to oil spills (Anker-Nilssen, Bakken *et al.* 1988). In 1979, 10 000-20 000 oiled Brünnich's guillemots beached in Vardø, Finnmark (Barrett 1979b), an incident which possibly contributed to a population decrease on Kharlov Island on the Kola Peninsula (Krasnov & Barrett 1995). The gas condensate deposit which is being developed at Shtockman is probably situated in the migration and wintering area for Brünnich's guillemots breeding on Novaya Zemlya and Franz Josef Land. The southern part of the Barents Sea has been opened for test drilling, but so far no oil deposits have been found. If the sea transit passage along the Siberian coast (the Northern Sea Route) is opened for commercial shipping, the risk of oil spills in the Barents Sea will increase.

Incidental mortality in fishing gear is also important. The number of salmon pound nets was reduced in 1984 and the drift-net fishery for salmon was banned in 1989. Probably some thousands of Brünnich's guillemots were killed annually by the salmon fishery along the Norwegian coast (Strann *et al.* 1991). Today, the toll is probably lower. In the early 1970s, 230 000-820 000 Brünnich's guillemots were killed annually in salmon drift nets off west Greenland (Tull *et al.* 1972). Falk & Durinck (1991) reported that 1150 guillemots were killed in 1988, but this fishery is now much reduced. The salmon fishery took place in August-October, and it is not likely that many birds from the Barents Sea were caught. Svalbard birds probably arrive in Greenland waters later in the autumn.

The cod fishery in spring may be an important mortality factor for Brünnich's guillemots along the north Norwegian coast. Capelin migrates to the coast of north Norway where they spawn in spring, and are followed by many predators, such as cod and diving seabirds (Strann *et al.* 1991). The high density of gill nets used in this fishery represents a great hazard for the birds and the bird toll is a serious nuisance to the fishermen (Strann *et al.* 1991). In 1985, probably at least 200 000 guillemots were killed in cod nets off the county of Troms, but only a small proportion of these were Brünnich's guillemots (Strann *et al.* 1991). Such incidents do not happen every year and are also dependent on where the capelin spawns. If spawning occurs off Finnmark, there is a greater risk of more Brünnich's guillemots being killed.

Intensive hunting in Greenland and Newfoundland affects the Barents Sea population, but recovery data from birds ringed in Svalbard indicate that most of the birds shot are immatures and the negative effect on the population is probably not very significant. The total number of Brünnich's guillemots shot annually in Greenland and Newfoundland is about 283 000-386 000 (Falk & Durinck 1992) and 600 000-900 000 (Elliot 1991) individuals, respectively. Most of these birds are from colonies in Canada, Greenland and probably Iceland.

Special studies

On the Norwegian coast, Vader *et al.* (1990) studied the size of common guillemot and Brünnich's guillemot populations in relation to the capelin stock. A number of studies have been carried out on Hornøya including population size, migration, survival, chick food, diving depths, environmental contaminants and population genetics (Furness & Barrett 1985, Barrett & Furness 1990, Thompson *et al.* 1992, Aasheim 1993, Birt-Friesen *et al.* 1992, Friesen *et al.* 1993, Erikstad *et al.* 1994, Moum *et al.* 1994, Barrett *et al.* 1996, Friesen, Montevecchi *et al.* 1996, Barrett, Aasheim *et al.* 1997, Barrett, Bakken *et al.* 1997).

The most comprehensive investigations of Brünnich's guillemot ecology in Russia were made in the eastern part of the Barents Sea in 1930-1950. One of the first studies was done by Krasovski (1937) on Novaya Zemlya. At the end of the 1930s and the beginning of the 1940s, Kaftanovski (1951) studied the breeding ecology of Brünnich's guillemot in the Seven Islands Nature Reserve off the Kola Peninsula. In the late 1940s, Uspenski (1956) did similar work on the west coast of Novaya Zemlya. All these studies included breeding ecology, feeding ecology and intra- and interspecific relations. Special morphological studies were carried out by Kartashev (1955a, 1957) on the east Murman coast in the early 1950s.

Fragmentary data on Brünnich's guillemot ecology in Franz Josef Land and Novaya Zemlya have been published by Gorbunov (1925, 1929, 1932) and Gavrilo *et al.* (1993).

Several special studies have been done in Svalbard by the Norwegian Polar Institute. Studies of population size, migration, survival, pair and site fidelity and chick food were carried out on Bjørnøya in 1988-1997 (Bakken & Mehlum 1988, Barrett, Bakken *et al.* 1997, Norwegian Polar Institute, unpubl. data). The distribution of Brünnich's guillemots at sea and in ice-covered waters has been studied by Bakken (1990), Mehlum (1990), Isaksen (1995a), Mehlum & Isaksen (1995), Hunt *et al.* (1996) and Mehlum (1997b). Corresponding data from the north-western Barents Sea have been compared with the distribution of prey and oceanographic features (Mehlum *et al.* 1996, Mehlum 1997b, Mehlum, Hunt *et al.* 1998, Mehlum, Nordlund *et al.* 1998, Mehlum *et al.* 1999). Gabrielsen *et al.* (1988) have studied the basal metabolic rate (BMR) of Brünnich's guillemots in Svalbard, and the field metabolic rate (FMR) and food consumption of adults during the chick-rearing period on Hornøya, Finnmark (Gabrielsen 1996). Based on these metabolic data, the chemical composition of the food (energy, fat, protein and water) (Gabrielsen & Ryg 1994), the assimilation efficiency (Brekke *et al.* 1994) and the food consumption of Brünnich's guillemots in the Barents Sea have been estimated (Mehlum & Gabrielsen 1995).

Erikstad & Vader (1989) studied the selection of capelin by Brünnich's guillemots during the pre-laying season. Erikstad *et al.* (1990) correlated their pelagic distribution with the occurrence of prey, and Fauchald & Erikstad (1995) examined the predictability of the spatial distribution of guillemots. In addition, many surveys of seabirds at sea have been carried out, most of which have contributed to better knowledge of the distribution throughout the year (Byrkjedal 1976, Brown 1984, Anker-Nilssen, Bakken *et al.* 1988, Mehlum 1989, Joiris 1992, 1996, Isaksen 1995a, Klekowski & Weslawski 1995, Joiris *et al.* 1996).

Recommendations

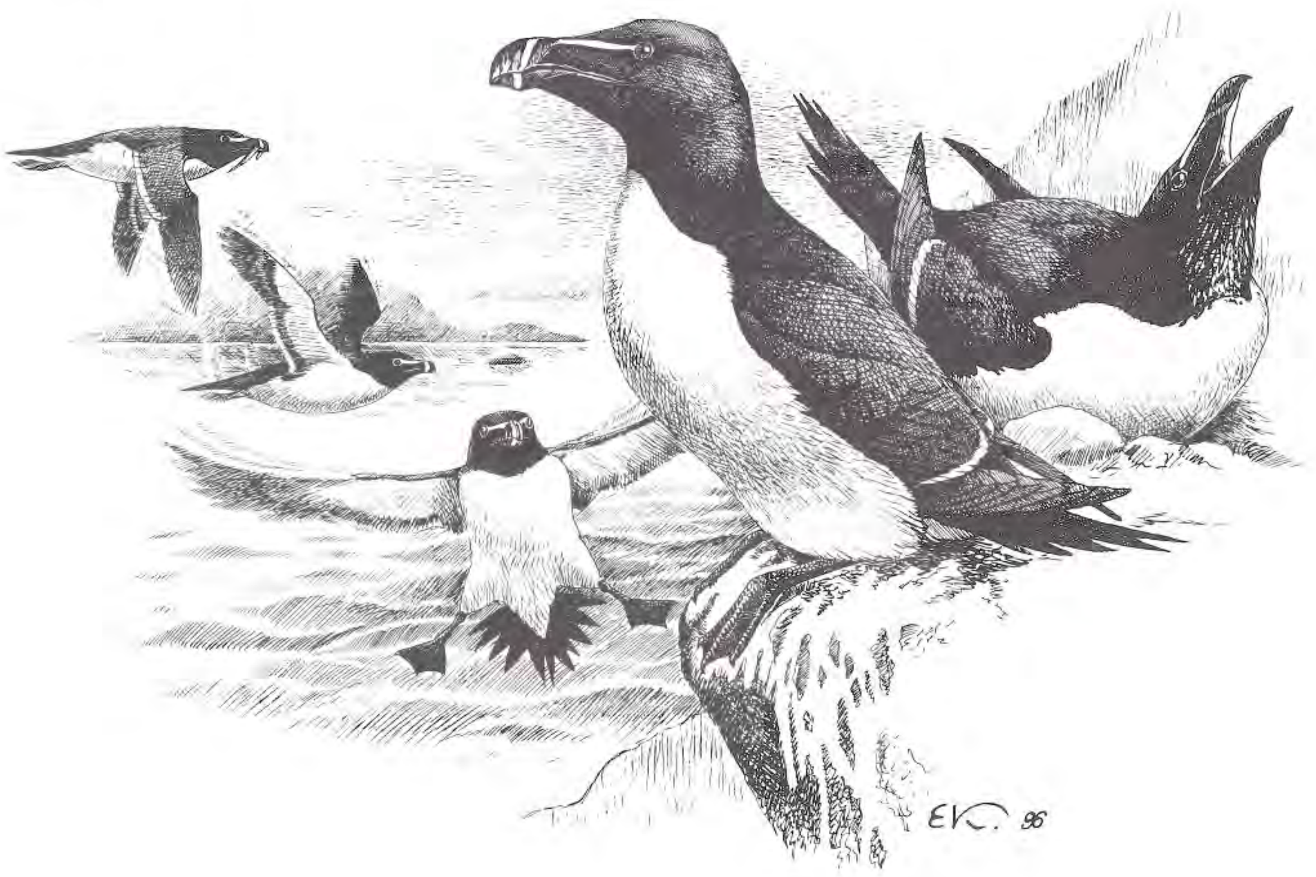
A representative and robust monitoring programme should be designed covering all the breeding areas of the Brünnich's guillemot within the Barents Sea Region. It should not only register the number of birds present in the colonies, but also monitor adult survival, breeding success and chick food. An aim should be to use the Brünnich's guillemot as an indicator of changes in the marine ecosystem.

The migration routes and wintering sites used by different age groups should be further investigated to evaluate the effect on the Barents Sea population of the intensive hunting in Greenland and Newfoundland. To study the migration in more detail than can be explored by conventional ringing, satellite tracking should be considered as a supplementary method.

Vidar Bakken & Irina V. Pokrovskaya

Razorbill *Alca torda*

No: Alke Ru: Gagarka



Population size: 25 000-35 000 pairs
Percent of world population: 4-7%
Population trend: Small increase?

General description

The razorbill breeds on temperate, boreal and low-arctic coasts of the North Atlantic. Its habit of nesting in rock crevices or behind stones makes it extremely difficult to census the population accurately. The centre of its population is Iceland where up to half a million pairs may breed (Lloyd *et al.* 1991). About 200 000 pairs breed in Britain (mainly in Scotland) and Ireland, and Norway is the third most important region for the world population (Lloyd *et al.* 1991). The Norwegian population has not been censused recently and the most recent figure is that of Brun (1979) who estimated the population to be about 30 000 pairs, about 80% of which bred north of the Arctic Circle.

Razorbills were severely persecuted up to the early 1900s, the populations being reduced on both sides of the Atlantic. In some regions, numbers have continued to drop, for instance in the Gulf of St. Lawrence and Britain (Nettleship & Evans 1985). Some British colonies have now stabilised or are recovering.

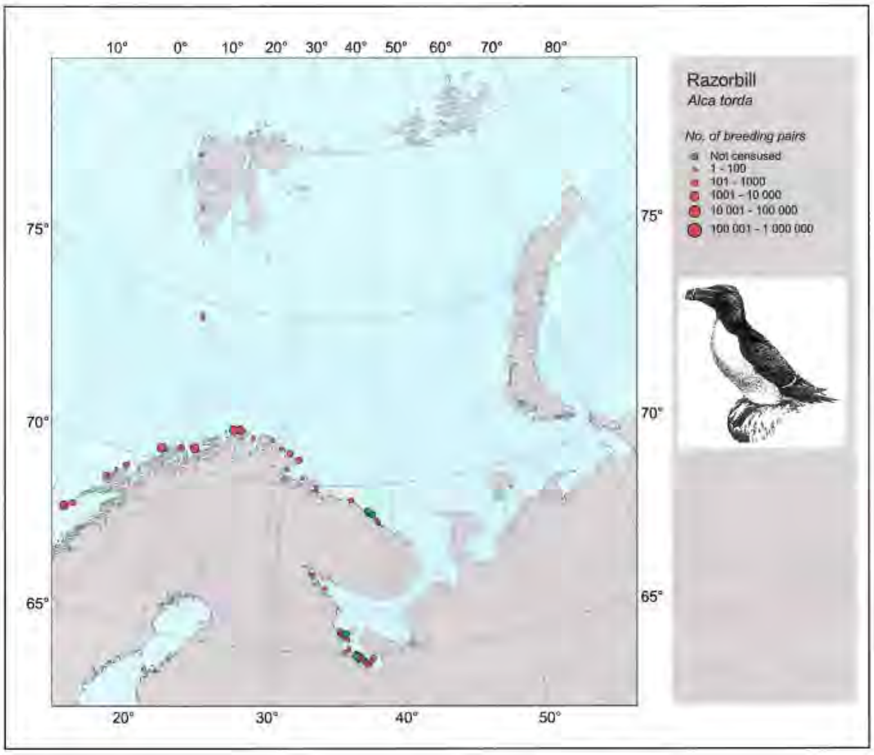
Population sizes and trends of the razorbill *Alca torda* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	25-30 000	1966-94	-	-	-1/+1	1960-90	1-8
MC	100-1000	1990	-	-	0	1960-90	9
WS	ca. 3000	1990-93	-	-	+1	1960-90	10
ND	0						
NZ	<10	1995	-	-	-	-	11
FJL	0	1993	-	-	-	-	12
SV	100	1994	-	-	-	-	13
All	25 000-35 000	-	-	-	-	-	

1. Brun 1979, 2. Barrett & Vader 1984, 3. Tromsø Museum, unpubl. data, 4. Anon. 1995b, 5. Bustnes *et al.* 1993, 6. Stougie *et al.* 1989, 7. Iversen & Iversen 1989, 8. R.T. Barrett, unpubl. data, 9. J.V. Krasnov, pers. comm., 10. A.E. Cherenkov & V.Yu. Semashko, unpubl. data, 11. Strøm *et al.* 1995, 12. Gavrilo *et al.* 1993, 13. Mehlum & Bakken 1994

Breeding distribution and habitat preferences in the Barents Sea Region

The razorbill breeds in about 20 colonies in north Norway, the largest being on Hjelmsøy, Gjesvær, Loppa, in Røst and on Sør-Fugløy (each of 1000-5000 pairs). How many breed in the region today is unknown, but the population is in the order of tens of thousands of pairs. Off the Murman coast, several hundred pairs breed on the archipelagos of the Aynov Islands, the Gavrilovskie Islands and the Seven Islands (J.V. Krasnov, pers.



comm.). Nearly 3000 pairs breed in the White Sea, including about 2750 pairs in more than 60 colonies in Onezhski Bay (V. Bianki, unpubl. data, V. Cherenkov & A. Semashko, unpubl. data). Most of these colonies are small (24 of 1-10 pairs, 21 of 11-50 pairs) and only eight are larger than 100 pairs. More than half of the White Sea population breeds in these eight colonies (V. Cherenkov & A. Semashko, unpubl. data). Other White Sea colonies are in Kandalaksha Bay and on the Samba-ludy Islands (Bianki 1958, 1963, 1967, Breslina 1987). Breeding has yet to be proved on Novaya Zemlya, but several birds seen in the seabird colony in Gribovaya Bay in 1995 were possibly breeding (Strøm *et al.* 1995). None are known to breed in Franz Josef Land (Gavrilo *et al.* 1993). Fewer than 100 pairs breed on Bjørnøya and about 10 pairs breed on Spitsbergen (Brun 1970c, Mehlum & Bakken 1994).

Razorbills nest in association with other seabirds (black-legged kittiwakes *Rissa tridactyla*, Atlantic puffins *Fratercula arctica*, common guillemots *Uria aalge*) in all the colonies. They lay their eggs in rock crevices, behind stones, among boulders or in entrances to puffin burrows. In the White Sea colonies, they also lay eggs among logs lying on the ground.

Movements

The Barents Sea and White Sea razorbills disperse from their colonies in July and August. While many spend the winter in north Norwegian fjords (Norderhaug *et al.* 1977, R.T. Barrett, pers. obs.), ring recoveries and measurements of wintering birds show that the majority move south and spend the winter in south and west Norway, the Skagerrak, Kattegat, North Sea and Irish Sea (Holgersen 1951, Kozlova 1957, Bianki 1967, Anker-Nilssen, Jones *et al.* 1988, Jones 1990).

Population status and historical trends

Norderhaug *et al.* (1977) and Brun (1979) suggested that the Norwegian population of razorbills had declined in the 1960s and 1970s, but apart from apparent collapses of the Nord-Fugløy population (from 10 000 pairs in 1967 to no more than 1500 pairs in 1989) and the Syltefjord population (from 1200 pairs in 1966 to less than 500 pairs in 1985 and 1989) (Brun 1969b, Stougie *et al.* 1989, Tromsø Museum, unpubl. data), there is little evidence to support the idea that this decline has continued in Troms and Finnmark. On the contrary, numbers seem to have increased, in some colonies dramatically, over the last 2-3 decades, for instance Loppa (750 pairs in 1969, 2000-4000 in 1993), Sør-Fugløy (15 pairs in 1974, 1000-5000 pairs in 1994) and Hornøya and Reinøya (120 pairs in 1967, about 300 pairs in 1988) (Brun 1969b, 1979, Strann & Vader 1986, Iversen & Iversen 1989, Bustnes *et al.* 1993, Anon. 1995b, R.T. Barrett, unpubl. data). At Røst, numbers seem to have decreased over the last 15 years (T. Anker-Nilssen, unpubl. data).

The population along the Murman coast was estimated to be about 300 pairs in the 1960s (Gerasimova 1962). Later counts suggest that numbers have decreased since the end of the 1950s (Kokhanov & Skokova 1967, Krasnov *et al.* 1995). Numbers in Onezhski Bay in the White Sea have increased from about 1700 pairs in the 1960s (Bianki 1963, 1967) to the present estimate of 2750 or more pairs.

Feeding ecology

There are very few published data documenting the diet of north Norwegian razorbills, but observations of adults feeding chicks in east Finnmark and Murman corroborate Norderhaug *et al.*'s (1977) note that sandeels *Ammodytes* spp., capelin *Mallotus villosus*, herring *Clupea harengus* and some gadoids make up most of their diet (Belopolski 1957a, 1971a, Furness & Barrett 1985, Barrett & Furness 1990, R.T. Barrett, unpubl. data). In the White Sea, they feed mainly on sandeels, but also some capelin, cod *Gadus morhua*, crustaceans and polychaetes (Bianki 1967). Stomachs of a sample of adults shot near Tromsø in winter in the late 1980s contained almost exclusively crustaceans (R.T. Barrett, unpubl. data).

Threats

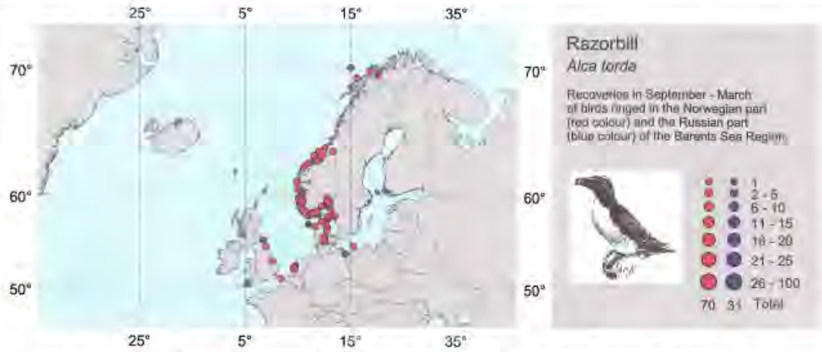
Like all auks, razorbills are very sensitive to oil pollution. Hence, the present increase in oil exploration and production in the region and the consequent chances of an acute oil spill are a constant threat. Pollution in the form of organochlorines and heavy metals is not considered to be a threat to razorbills in the region (Thompson *et al.* 1992, Barrett *et al.* 1996).

The hunting of auks has had long traditions in Norway and was the most frequent cause of death documented by Norwegian ring recoveries (Follestad & Runde 1995). Such pressure undoubtedly had negative effects on the population (Holgersen 1951, Brun 1979), but is now considered negligible after hunting was banned in 1979.

Drowning in fishing gear is a problem faced by razorbills in the Barents Sea Region, and although numbers involved are low compared to, for instance, guillemots, the extent of this threat is unknown

(Strann *et al.* 1991, Bustnes *et al.* 1993). More ringed razorbills are reported drowned in fishing gear in north Norway than in the south of the country (Follestad & Runde 1995).

There is evidence to suggest that the population along the Murman coast was negatively influenced by decreases in stocks of prey fish in the 1960s and 1970s and that food availability is still limiting the population (Krasnov *et al.* 1995). Predation by large gulls may also be a threat to razorbills breeding on the Aynov Islands (Kohanov & Skokova 1967, I.P. Tatarinkova, pers. comm.).



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Special studies

Few studies of the razorbill have been made in the region. Brun (1969b, 1970c) was the first to systematically document their distribution. The behaviour and breeding ecology of the population in Røst (Vedøy) have been studied in some detail (Ingold & Tschanz 1970, Ingold 1973, 1974, 1976, Tschanz *et al.* 1989), and Bianki (1967) and Barrett (1984, 1985b) have studied razorbills in the White Sea and East Finnmark, respectively. There is only one comprehensive analysis of ring recoveries (Holgersen 1951). Razorbills were among the species chosen for periodic surveys of organochlorine and mercury contents in seabird eggs in the region (Barrett *et al.* 1996 and refs. therein). They have also been included in general parasitological surveys of seabirds in Murman (Belopolskaya 1951, Galkin *et al.* 1994, Galaktionov 1995, Krasnov *et al.* 1995). An analysis of razorbill biometrics has also been made (Barrett, Anker-Nilssen *et al.* 1997).

Recommendations

The present distribution and numbers of razorbills breeding in the region should be documented in detail. An up-to-date analysis of ring recoveries should also be made, and attempts should be made to monitor numbers, breeding success and diet in colonies that are representative for the region.

Robert T. Barrett, Vladimir Yu. Semashko & Alexander E. Cherenkov

Black guillemot *Cepphus grylle*

No: Teist Ru: Chistik

Population size: 60 000-80 000 pairs
Percent of world population: ca. 20%
Population trend: Reasonably stable?

General description

The black guillemot has a nearly circumpolar distribution from the Canadian Arctic via Greenland and Iceland to the British Isles and the Scandinavian coastline (including the Bay of Bothnia) to the Russian Arctic where it breeds along the whole coastline. In Maine in the USA, it breeds as far south as 42°N, while in Russia it breeds on Franz Josef Land at 82°N (Cramp 1985). Breeding populations are more difficult to assess than for other auks. The world population is estimated to be about 350 000 pairs (Lloyd *et al.* 1991).

The black guillemot is a medium-sized auk with a tubby appearance. As indicated by the name, its body is entirely black, but the wing coverts have a broad white oval patch. The plumage is paler in winter. Five sub-species with complex differences occur in the western Palaearctic (Cramp 1985). In the Barents Sea Region, the nominate form *grylle* breeds along the Norwegian and Murman coasts, whereas the sub-species *mandti* breeds in Svalbard, Franz Josef Land, Novaya Zemlya and on Vaygach Island.

Breeding distribution and habitat preferences in the Barents Sea Region

The black guillemot is common in the Barents Sea Region. It breeds in Svalbard, along the whole Norwegian coast, along the Murman coast, in Kandalaksha Bay and Onezhski Bay in the White Sea (Tatarinkova & Golovkin 1990), in Franz Josef Land and on Novaya Zemlya and Vaygach Island. It breeds solitarily or in colonies of up to 2000 pairs.

The black guillemot most often breeds on islands in shallow coastal areas. The nest is usually placed in crevices or screes not far from the sea, but some birds nest in depressions in peat bogs or under logs (e.g. Bianki 1977). Sometimes, the nest may be found two to three km from

Population sizes and trends of the black guillemot *Cepphus grylle* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	30 000	1985	-	-	-1	1960-90	1
MC	6000	1990	-	-	-	-	
WS	2500	-	1	1985-95	-	-	2
ND	?	-	-	-	-	-	
NZ	6000-7000	1990	-	-	-	-	3
FJL	3000-4000	1994	-	-	-	-	4
SV	20 000	1989	-	-	-	-	5
All	60 000-80 000	-	-	-	-	-	

1. Norwegian Seabird Registry 1998, 2. V. Cherenkov & A. Semashko, unpubl. data, 3. I. Pokrovskaya, unpubl. data, 4. Gavrilo *et al.* 1993, 5. Mehlum & Bakken 1994

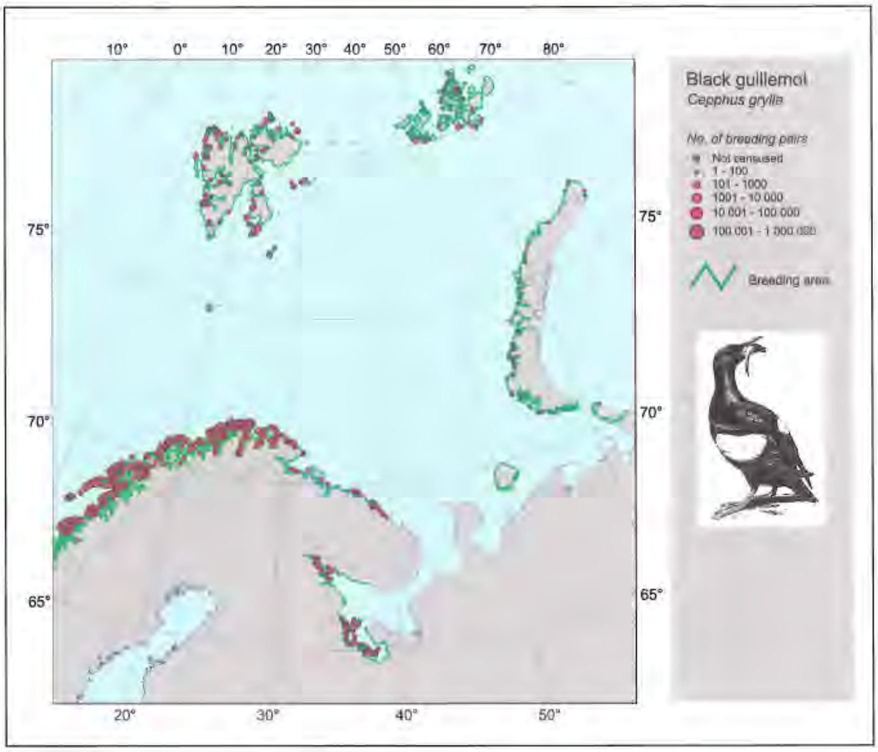
the coast (e.g. on Spitsbergen) (Birulya 1910).

Movements

The migration patterns for arctic populations of this species are not known in detail as few rings have been recovered. Some general patterns are, however, evident. Black guillemots move less than other auks and are seldom observed outside the breeding range or in offshore waters (Cramp 1985). In the southern parts of the Barents Sea, they probably spend the winter near their breeding localities or only move locally. Norwegian birds ringed as adults (from the whole country) were recovered in winter 3 km to 700 km (mean 268 km) from their breeding site. Recoveries of 15 birds ringed in northern Norway showed that eight stayed close to their breeding site in winter, and the rest moved southwards as far as 1310 km (Myrberget 1973b).

In the northern part of their breeding range, many black guillemots move southwards in September-October, but some also winter near the breeding areas when the sea is ice free (e.g. around western Spitsbergen) (Cramp 1985). Gorbunov (1929) noted that black guillemots from Novaya Zemlya migrate south. In 1936 and 1937, however, individuals were observed all the year round at the very north of the archipelago, demonstrating that, even at this latitude, they may stay all winter provided the ice conditions are favourable (Antipin 1938). Black guillemots in the White Sea, winter in polynias at the head of Kandalaksha Bay or in the White Sea basin (Bianki 1977).

Some individuals may be observed very far north. For instance participants at the *Fram* Expedition (1893-1896) noted black guillemots 330 km north of Franz Josef Land. They have also been observed as far north as 88°-89°N (Kozlova 1957).



Population status and historical trends

Along the Norwegian coast north of the Arctic Circle, there are at present approximately 750 black guillemot colonies totalling about 30 000 pairs (Norwegian Seabird Register, NINA, unpubl. data). The sizes of these colonies range from a few to about 2000 pairs. The population has decreased during recent decades, probably mostly due to predation by North American mink *Mustela vision* (e.g. Folkestad 1982). Myrberget (1981) reported a significant decrease in the breeding populations of black guillemot on two islands in Troms from the 1960s to 1980, probably related to drowning in fishing nets outside the colonies. In Svalbard, the breeding population in the early 1990s was estimated to be about 20 000 pairs (Mehlum & Bakken 1994).

On the Murman coast, Gerasimova (1962) counted 2140 pairs early in the 1960s. At the end of the same decade, V.N. Karpovich (pers. comm. cited in Tatarinkova & Golovkin 1990) estimated the total number of breeding pairs at 2500. Kaftanovski (1951) estimated that 250 pairs bred in the Seven Islands Nature Reserve and did not observe any significant changes in the numbers between 1937 and 1940.

There are 49 known colonies of black guillemots in Franz Josef Land, 13 (27%) of which have been censused. The largest are on Cape Grant (George Land) with 500 pairs, Stolichka Island with 250 pairs, Cape Dillon (McClintock Island) with 200 pairs and the southern part of Bell Island with 550 pairs. Uspenski (1959a) estimated the breeding population in Franz Josef Land to be 30 000 individuals, but this has since been revised to 3000-4000 pairs (Gavrilo *et al.* 1993).

Novaya Zemlya has 55 known colonies of black guillemots, but only five (9%) have been censused. These totalled about 200 pairs. There are probably many undiscovered colonies on Novaya Zemlya, especially on the east coast. Uspenski (1956) noted a large number of colonies, but gave the exact locations of only some of them. Approximately 6000-7000 pairs of black guillemots breed on Novaya Zemlya (I. V. Pokrovskaya pers. obs.).

There is only one colony of unknown size in the Nenetski district. The Murman coast has 55 known colonies, 35 (65%) having been censused. These totalled 2305 pairs plus 3261 individuals which suggest a total population of around 6000 pairs. In the White Sea, there are a large number of colonies most of which are rather small; 248 colonies have been registered and 242 (98%) of these have been censused. The total breeding population is estimated to be nearly 2500 pairs. In Onezhski Bay in the White Sea, a slight increase in the number of black guillemots has been observed on the Solovetski Islands between 1985 and 1996. The numbers on the islands in the southern part of the bay have remained stable (V. Semashko & A. Cherenkov, pers. comm.).

The total population of black guillemots in the whole Barents Sea Region is estimated to be 60 000-80 000 pairs.

Feeding ecology

Black guillemots are opportunistic in their food choice and switch rapidly between prey types as their availability changes (Cramp 1985). In the southern parts of their range, they eat mostly demersal fish, whereas in the arctic regions they take many crustaceans. Their food is mainly caught within 4 km off the coast

Diet of the black guillemot *Cepphus grylle* in the breeding season within the Barents Sea Region.

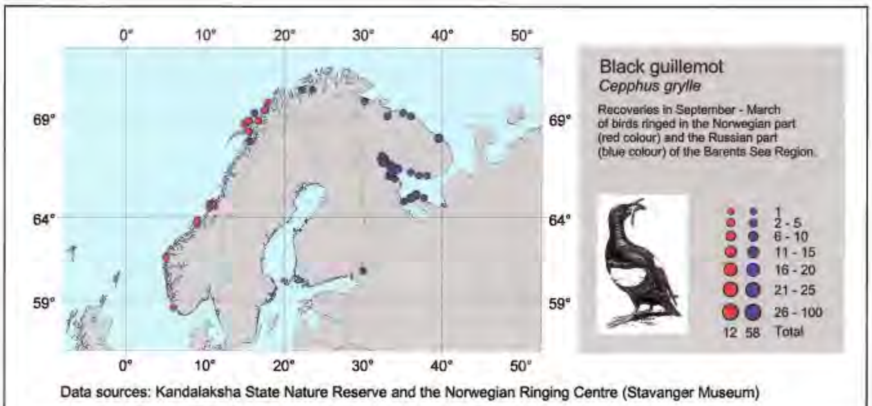
Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Hernyken, Røst	1990-96	Butterfish *Pholis gunnellus* (46%), sculpins Cottidae (33%), rocklings and similar looking species (12%)	Chicks	1
MC	Seven Islands	1937-40	Sand eels *Ammodytes tobianus* + *Clupea harengus* (45%), Gadus spp. (42%)	Chicks	2
	Kharlov Island	ca. 1940	Fish (73%), crustaceans (21%), molluscs (3%)	Chicks	3
WS	Kandalaksha Bay	?	Gobidae (52%), Lumpenidae (34%), cod (7%)		
NZ	Novaya Zemlya	ca. 1940	Crustaceans (42%), fish (42%), Polychaetes (8%)	Adults	3
SV	Spitsbergen	1930s	Crustaceans (61%), fish (19%), molluscs (19%)	Adults	4
-	First-year ice	1985	Fish (100%)	Adults	5
-	Multi-year ice	1985	Fish (92%), *Gammarus wilkitzkii* (33%), *Mysis oculata* (8%)	Adults	5
-	Marginal ice zone	1982-90	Polar cod *Boreogadus saida* (71%), Pisces indet. (29%), other fish (14%)	Adults	6
	Coastal areas	1982-90	Nereis (54%), Decapods (33%), Gammarids (31%)	Adults	6

1. Barrett & Anker-Nilssen 1997, 2. Kaftanovski 1951, 3. Belopolski 1957a, 4. Hartley & Fisher 1936, 5. Lønne & Gabrielsen 1992, 6. Mehlum & Gabrielsen 1993

at depths shallower than 20 m (Bergman 1971).

Few detailed studies of their food choice have been made in the Barents Sea Region. Hartley & Fisher (1936) and Belopolski (1957b) confirmed the stronger dependency on crustaceans for arctic colonies (mean 50% of the diet in Svalbard and Novaya Zemlya). Lønne & Gabrielsen (1992) reported that black guillemots feeding in first-year ice near Svalbard mainly consumed fish, whereas 92% of the stomachs of birds feeding in multi-year ice contained fish, 33% the amphipod *Gammarus wilkitzkii*, and 8% the mysidacea *Mysis oculata*. Mehlum & Gabrielsen (1993) found mostly fish (mainly polar cod *Boreogadus saida*) in birds collected in the marginal ice zone near Svalbard, whereas those collected in coastal areas showed a more diverse diet dominated by Nereis, Decapods, Gammarids, Amphipoda and fish. Barrett & Anker-Nilssen (1997) seldom observed crustaceans in the chick diet in Røst, in Lofoten, during a long-term study. Here, butterfish *Pholis gunnellus* and sculpins Cottidae dominated the diet, although significant inter- and intra-year variations were observed. Bianki (1977) also reported a preference for fish in the diet offered to chicks, gobies Gobidae and Lumpenidae being most important.

Gorbunov (1932) found remains of polar cod *Boreogadus saida* in all the stomachs he examined (n = 14) in Franz Josef Land.



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

Threats

There is no egg harvesting or strong hunting pressure on black guillemots in the Barents Sea Region. The main threat factors are drowning in fishing nets (Norwegian Ringing Centre, unpubl. data), predation by North American mink (e.g. Folkestad 1982) and oil pollution (e.g. Folkestad 1994). Black guillemots have proved to be very vulnerable to oil spills due to their preference for coastal habitats (Hallet & Miller 1980). Of 136 black guillemots ringed in Norway up to 1969, 43% were reported shot, 25% died in fishing gear and the rest died of unknown causes (Myrberget 1973b).

Special studies

The breeding site habitat and microclimate have been studied by Tschanz *et al.* (1989) and the content of environmental pollutants (polychlorinated biphenyls) has been mapped in black guillemots from Svalbard (Daelemans *et al.* 1992). Thermoregulation and energy expenditure during chick rearing were studied by Gabrielsen *et al.* (1988) and Mehlum *et al.* (1993), respectively. Diet studies have been carried out around Svalbard (Lønne & Gabrielsen 1992, Mehlum & Gabrielsen 1993) and on Hekkingen (Troms) and in Røst (Barrett & Anker-Nilssen 1997). Chick growth and the timing of breeding have been studied on Hekkingen and Røst (Barrett & Anker-Nilssen 1997). Bianki (1977) studied several aspects of the breeding biology of the black guillemot in the White Sea. Population counts are made infrequently in the whole region. The species is not monitored on a regular basis.

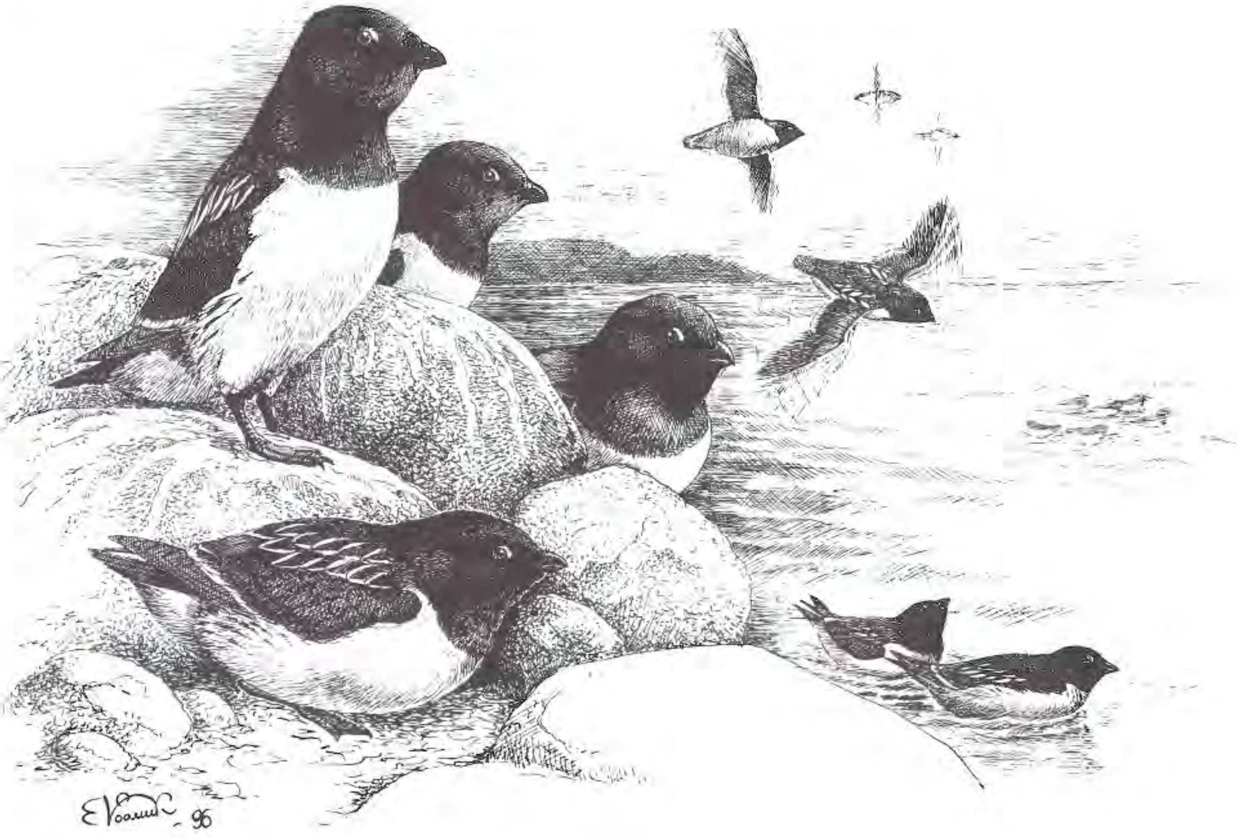
Recommendations

There is a clear need for more detailed mapping of colonies throughout the region. This is especially important considering the potential increase in oil exploration in the Barents and Norwegian Seas. Moreover, because the black guillemot is the only inshore fish-eating alcidae in the North Atlantic, monitoring of population trends, adult mortality and recruitment rates should start in selected colonies.

Svein-Håkon Lorentsen &
Irina V. Pokrovskaya

Little auk *Alle alle*

No: Alkekonge Ru: Lyurik



Population size: >1.3 million pairs
Percent of world population: 10%
Population trend: Reasonably stable

General description

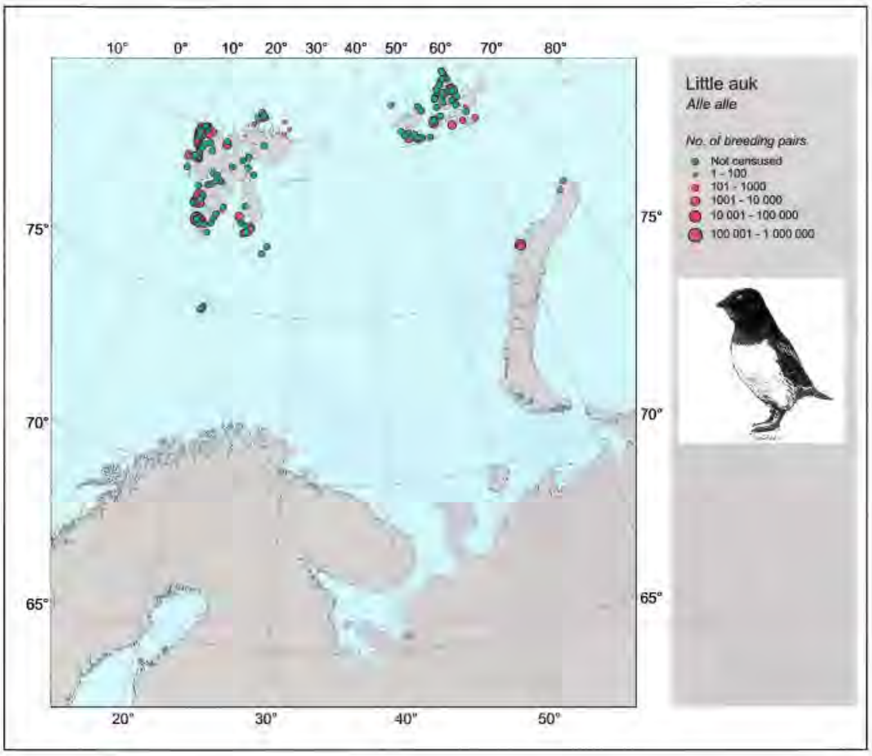
The little auk is one of the smallest species in the family Alcidae; only two species in the genus *Aethia*, inhabiting the northern Pacific, are smaller. It is a high-Arctic species breeding on eastern Baffin Island (Canada), Greenland, Iceland, Jan Mayen, Svalbard (including Bjørnøya), Franz Josef Land, Novaya Zemlya and Severnaya Zemlya. One observation indicative of breeding has also been reported from Finnmark, north Norway (Lorentsen 1982). Repeated observations on islands in the Bering Strait and the northern Bering Sea suggest that the little auk may breed in small numbers here as well (Day *et al.* 1988). It is a rare vagrant in the area between Severnaya Zemlya and the Bering Strait (Rutilevski 1967, Stishov *et al.* 1991, Rogacheva *et al.* 1995). Kartaschew (1960b) stated that the species may breed on the northern coast of the Taymyr Peninsula (Mys Chelyuskin) and on Bennett Island (Novosibirskie Islands), but this is doubtful. The very small Icelandic population has declined and the little auk may no longer breed there (Petersen 1994).

Only very rough estimates of the world population of little auks are available. The species is the most numerous alcid in the Atlantic (including the Barents Sea) (Nettleship & Evans 1985) and is probably one of the most numerous seabird species in the world. Thule in north-west Greenland is the most important breeding area with very crude estimates of the breeding population ranging from 7 to 20 million pairs (see Nettleship & Evans 1985, Boertmann & Mosbech 1998). The Scoresby Sound area in central East Greenland is also an important area with at least a few million breeding pairs, possibly exceeding 10 million pairs (Kampp *et al.* 1987). When Nettleship & Evans' (1985) mean estimate of 12 million pairs is combined with the updated

Population sizes and trends of the little auk *Alle alle* within the Barents Sea Region

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	0						
MC	0						
WS	0						
ND	0						
NZ	30-50 000	1967–92	(0)	–	(0)	–	1, 2, 3
FJL	250 000	1950	(0)	–	(0)	–	4
SV	>1 000 000	1994	(0)	–	(0)	–	5, 6, 7
All	>1 300 000	–	(0)	–	(0)	–	

1. Uspenski 1959a, 2. Pokrovskaya & Tertitski 1993, 3. Strøm *et al.* 1997, 4. Golovkin 1984, 5. Norderhaug 1980, 6. Mehlum & Bakken 1994, 7. Isaksen 1995b



information from East Greenland (Kampp *et al.* 1987), a very rough mean estimate of the world population may be 15 million pairs.

Two sub-species of the little auk are recognised; the nominate *A. a. alle* and *A. a. polaris*. The latter is significantly larger than the nominate in all standard biometrical measures, but considerable overlap occurs (Stempniewicz *et al.* 1996). *Alle a. polaris* inhabits Franz Josef Land whereas the nominate sub-species inhabits the rest of the breeding areas from Canada in the west to Novaya Zemlya in the east. It is not clear to which sub-species the birds breeding on Severnaya Zemlya belong (Stempniewicz *et al.* 1996). Those occurring in the Bering Sea seem to belong to the nominate sub-species (Day *et al.* 1988).

Breeding distribution and habitat preference in the Barents Sea Region

The little auk breeds in all the high-Arctic archipelagos in the Barents Sea Region, but not on the mainland of Norway or Russia. On Novaya Zemlya, breeding colonies are known only within relatively small areas in the north-west of the northern island from Arkhangel'skaya Bay to the Oranskie Islands (Golovkin 1972). The colonies in Franz Josef Land are distributed over most of the archipelago, but none are known on the easternmost islands (Gavrilo *et al.* 1993). The majority of the population in Svalbard breeds in colonies in the south-western and north-western parts of Spitsbergen, especially in Hornsund, Bellsund and the area around Magdalenefjorden (Norderhaug *et al.* 1977).

Little auks breed in both unvegetated screes and rock crevices. The large colonies in Hornsund (south-west Svalbard) are typical of the scree type. Here, the slopes of the high mountains along the coast are covered by screes, often from 50 to 300 m above sea level. Large portions of these screes are inhabited by breeding little auks laying their eggs in open spaces underneath stones, often as deep as 1 m below the surface of the scree. The breeding density in these screes seems to vary with the size of the stones in the scree, but other factors are probably also important. The lowest density (about 0.5 pair/m^2) has been found in study plots with small stones, whereas study plots with larger stones had a considerably higher density (about 1.5 pairs/m^2) (Isaksen & Bakken 1995d). In between the breeding areas in the screes are vegetated areas and areas with stones that are too small to form a suitable breeding habitat. Little auks may also breed underneath stones in flat areas.

Breeding in rock crevices probably occurs in most parts of both Svalbard and Franz Josef Land. The breeding density in this habitat is probably generally low and variable; nests are often scattered over large areas high in the mountains and it is consequently very difficult to make censuses of the breeding population in these areas. Breeding sites that are free of snow early in spring are probably favoured by the little auks, and this may lead to rock crevices being the preferred breeding habitat in some regions, for instance in Franz Josef Land (see Stempniewicz *et al.* 1996).

Although most colonies are situated close to the sea, little auks may also breed far inland. For instance, in Svalbard one colony has been found on Newtontoppen, 1500 m a.s.l. and about 30 km from the nearest coast (Longstaff 1924).

Movements

Both little auk chicks and adults leave the breeding colonies in August (mostly in mid-August on Spitsbergen and late August or early September in Franz Josef Land). There is some evidence that the females leave the colonies before the chicks are fledged, and that the males accompany the chicks during their first period at sea (Roby *et al.* 1981, Bradstreet 1982, Stempniewicz 1995). As the young are able to fly when they leave the colonies, there is probably no marked swimming migration from the breeding colonies, as in guillemots *Uria* spp.

Recoveries of little auks ringed in breeding colonies on western Spitsbergen indicate that the waters off south-western Greenland are important wintering areas for this population (Norderhaug 1967, Isaksen & Bakken 1996). Details of the migration between Spitsbergen and south-western Greenland are not known. The general affinity that little auks may show for ice-filled waters (Brown 1984), and the fact that high densities were found only in the western, ice-filled waters of the Greenland Sea during a cruise in late August (Mehlum & Bilet 1993), indicate that the birds move quickly from the breeding colonies on Spitsbergen to the ice-filled areas of the western Greenland Sea. They probably start moulting when they reach these areas and are then flightless for several weeks. The recoveries from Greenland (17 up to 1995; Isaksen & Bakken 1996) are from the period November–February (except one questionable summer recovery), probably indicating the time-span of their stay in this area. They probably follow the edge of the drift ice towards the south-west and reach the waters off south-western Greenland in October–November (Salomonsen 1981). They then spread northwards at least up to the Egedesminde district in western Greenland (68°N). Some birds probably also stay in the drift-ice belt off eastern Greenland during the winter. The little

Diet of the little auk *Alle alle* in the breeding season within the Barents Sea Region. Prey species or species groups are listed in order of importance (by wet weight) in the diet when this is given in the original paper.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NZ	Arkhangel'skaya Bay	1967	*Calanus* spp. (92/100%)[b], Euphausiids (83/90%)[b], Hyperiids (85/81%)[b], *Mysis oculata* (9/5%)[b], Decapod larvae (42/43%)[b], Fish (43/24%)[b]	Chicks[a]	1
FJL	Hooker Island	1991	*Calanus* spp. (91%), *Apherusa glacialis* (5%), *Themisto libellula* (2%)	Adults & Chicks[a]	2
–	Hooker Island	1991–1993	*Calanus* spp. (72%), *Thysanoessa inermis* (11%), *Gammarus wilkitzkii* (7%), *Apherusa glacialis* (6%)	Adults & Chicks[a]	3
SV	Isfjorden (C Spitsbergen)	1911	*Mysis* spp., *Themisto* spp., *Crangon borealis*	Adults Adults	4 5
–	Isfjorden (C Spitsbergen)	1933	*Thysanoessa inermis*, *Themisto libellula*		
–	Wijdefjorden (N Spitsbergen)	1954	*Mysis* spp., *Calanus* spp.	Chicks[a]	6
–	Hornsund (SW Spitsbergen)	1962–1965	*Calanus finmarchicus*, *Themisto* spp., *Mysis* spp., Decapod larvae	Chicks[a]	7
–	Multi-year ice E & N Svalbard	1986	*Apherusa glacialis* (30%)[c], Amphipoda ind. (30%)[c], Crustacea ind. (20%)[c], *Calanus* sp. (12%)[c]	Adults	8
	Kongsfjorden (NW Spitsbergen)	1985	*Themisto* spp., *Gammarids*	Adults	9
–	Isfjorden (C Spitsbergen)	1990	*Calanus* spp. (71%), *Themisto* spp. (19%), *Thysanoessa* sp. (6%), Decapod larvae (4%)	Chicks[a]	9
–	Hornsund (SW Spitsbergen)	1987	*Calanus* spp. (86%), Decapod larvae (10%), *Themisto* spp. (3%)	Chicks[a]	9

1. Golovkin *et al.* 1972, 2. Weslawski & Skakuj 1992, 3. Weslawski *et al.* 1994, 4. Mathey-Dupraz 1913, 5. Hartley & Fisher 1936, 6. Løvenskiold 1964, 7. Norderhaug 1980, 8. Lønne & Gabrielsen 1992, 9. Mehlum & Gabrielsen 1993

[a] Based on food brought to pullus in the parents' throat pouch

[b] Frequency of occurrence in males and females, respectively

[c] Percentages are of total dry weight of prey

auks probably start journeying back to their breeding colonies on Spitsbergen in February–March (Salomonsen 1981, Isaksen & Bakken 1996). There are two recoveries of Svalbard little auks away from Svalbard and south-western Greenland. These are from north and north-east Iceland (Isaksen & Bakken 1996). One bird recovered in March may have been on its way back to Spitsbergen from south-west Greenland, whereas a bird recovered in January may have wintered in the area. Arrival at the breeding colonies in Svalbard starts around April (Løvenskiold 1964).

No little auks have been ringed in the Russian part of the breeding range. Little is therefore known about the migrations and wintering areas of these populations. Little auks have been observed returning to their breeding colonies in Franz Josef Land in large numbers already in early March, and it has therefore been suggested that they winter relatively close to the archipelago, maybe in part in polynyas (Collett & Nansen 1900, Gorbunov 1932, Demme 1934). Little auks are known to winter in polynyas off northern Novaya Zemlya, and the numbers of wintering birds here seem to vary significantly from year to year depending on ice conditions (Antipin 1938, Butev 1959). The birds wintering in this area may come from both Novaya Zemlya and Franz Josef Land, as well as from Severnaya Zemlya. Little auks are regularly observed along the Barents Sea coast of the Kola Peninsula and in the mouth of the White Sea during spring and autumn migrations, as well as in winter. They are, however, not numerous there (Bianki *et al.* 1993).

The lack of recoveries from areas other than Greenland and Iceland does not mean that birds from the Spitsbergen population only winter in these regions. As little auks are only hunted in Greenland, and the conflict with fisheries is small (see Threats), the chance of getting recoveries from other areas is small. It is known that little auks winter in relatively low numbers around Svalbard and in the Barents Sea (Løvenskiold 1964, Anker-Nilssen, Bakken *et al.* 1988, Isaksen 1995a). Those wintering in the Barents Sea may include birds breeding in Russian territories, including Severnaya Zemlya.

Large numbers of little auks pass northern Norway on a southern migration in September–November (Strann & Vader 1987, 1988). They occur in variable numbers all along the Norwegian coast during the non-breeding season, but particularly high concentrations have been found in coastal waters off central Norway (Follestad *et al.* 1986, Follestad 1990, Strann *et al.* 1993). The Skagerrak, off southern Norway, is a very important wintering area (Lorentsen *et al.* 1993, Skov *et al.* 1995). Skov *et al.* (1995) estimated the numbers of little auks in the Skagerrak and the North Sea to be 180 000 in October–November and 850 000 in December–February. The origin of these birds is not known. The majority of the birds examined have been assigned to the sub-species *Alle a. alle*, but there may also be some from the larger sub-species *A. a. polaris* among them (Vaurie 1965, Jones *et al.* 1985, Camphuysen 1986, 1996, Anker-Nilssen, Jones *et al.* 1988, Heubeck & Suddaby 1991). Birds wintering in the Skagerrak and the North Sea may also breed in eastern Greenland, since the wintering range of those birds is not known. In some winters, large numbers are observed along the coasts of Sweden, Great Britain, the Netherlands, and occasionally even further south (e.g. Andersen *et al.* 1996, Camphuysen & Leopold 1996). Single birds have been found far inland. These southern movements are in some cases associated with high mortality ('wrecks'). Persistent, relatively strong winds blowing the little auks in one direction and possibly influencing the availability of prey, may explain both the southern movement and the occasional high mortality. This may, however, not always be the case and birds may also be weakened by food shortage before they are displaced (Sergeant 1952, Bateson 1961, Wheeler 1990, Camphuysen & Leopold 1996).

Population status and historical trends

Relatively little is known about the present status of the little auk populations in the Barents Sea. The concealed nesting places make the little auks notoriously difficult to census. Also, irregular and unpredictable attendance patterns at the colonies make direct counts of birds visible in the breeding screes or on nesting cliffs of little value. A rough method of combining representative breeding densities (obtained by mark-resight studies of breeding birds in study plots) with the inhabited area in breeding screes has been used in some of the large colonies on western Spitsbergen (Isaksen 1995b, Isaksen & Bakken 1995d). No attempt has been made to monitor populations of little auks in any part of the Barents Sea Region, and only large-scale, dramatic changes will be detected.

The population breeding on Novaya Zemlya is relatively small, probably 30 000–50 000 pairs, and the estimate for Franz Josef Land is 250 000 pairs. A very rough estimate of more than 1 million pairs has been made for the population in Svalbard. The recent work in colonies on western Spitsbergen so far gives figures in accordance with this estimate (Isaksen 1995b). The population on Bjørnøya has been reported to be in the lower part of the range of 10 000–100 000 pairs (van Franeker & Luttik 1981, Nettleship & Birkhead 1985).

Data on population changes in the Barents Sea Region are lacking. It is known that the small populations in Iceland and southern Greenland have declined during the last century and some colonies have disappeared. Climatic changes, resulting in warmer waters around these southernmost little auk colonies, have been thought to be the reason for this (Salomonsen 1950, Evans 1984, Petersen 1994).

Little auks mainly feed on small pelagic crustaceans (see next section). This is also the staple food of the bowhead whale *Balaena mysticetus* which was very numerous in the northern parts of the Barents Sea when the early explorers came there in the 16th and 17th centuries. Intense whaling in the 17th, 18th and 19th centuries almost made the bowhead whale extinct in the Barents Sea (Burns *et al.* 1993). There has been speculation as to whether this major decline may have increased the availability of pelagic crustaceans and, in turn, resulted in an increase in the little auk population, paralleling changes in the numbers of baleen whales and some species of penguins which have taken place in the Antarctic (Kampp *et al.* 1987). Little auks were, however, undoubtedly also very numerous when the early explorers and whalers came to the Barents Sea (see Løvenskiold 1964).

Feeding ecology

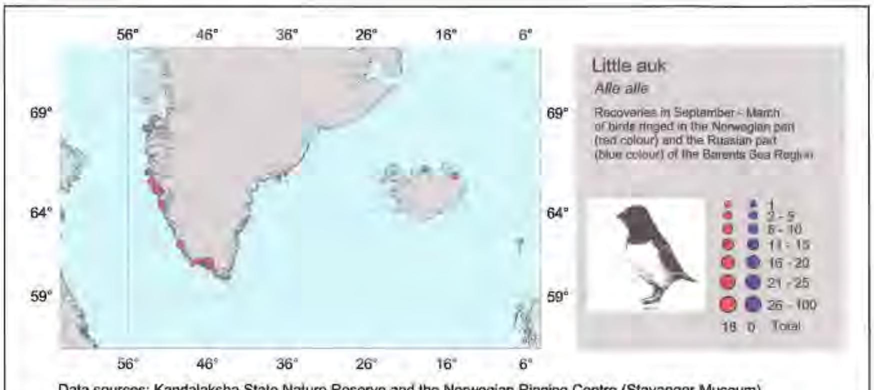
The main food of the little auk in the breeding season is small crustaceans. Copepods *Calanus* spp. are specially important and may dominate the diet almost completely, as has been found on Novaya Zemlya, Franz Josef Land and western Spitsbergen (Golovkin *et al.* 1972, Norderhaug 1980, Weslawski & Skakuj 1992, Mehlum & Gabrielsen 1993, Weslawski *et al.* 1994). Generally, *Calanus glacialis* has been found to dominate in areas with cold, arctic water (Franz Josef Land), whereas the smaller *C. finmarchicus* dominates in most studies from areas influenced by warmer, Atlantic water (Novaya Zemlya and western Spitsbergen). Other important prey species are pelagic amphipods *Themisto* spp., euphausiids *Thysanoessa* spp., mysidaceans *Mysis* spp. and decapod larvae. Sympagic (sea-ice associated) amphipods, especially *Apherusa glacialis* and *Gammarus wilkitzkii*, have been found to be important prey in the breeding season in areas where multi-year ice prevails, such as northern and eastern Svalbard and Franz Josef Land (Lønne & Gabrielsen 1992, Weslawski *et al.* 1994).

In autumn, polar cod *Boreogadus saida* and the amphipod *Themisto libellula* were the most important prey species of little auks in Hornsund (south-west Spitsbergen), but young specimens of the benthic striped snailfish *Liparis liparis*, also seemed to be an important prey (Lydersen *et al.* 1985, 1989). The estimated mean length of polar cod taken was 3.4 cm (young-of-the-year polar cod); 1–3 cm smaller than what was found in other alcids and black-legged kittiwakes from the same area at the same time (Lydersen *et al.* 1985). This is the only study from the Barents Sea Region where fish have been found to constitute an important part of the diet of little auks, but similar results have been reported from western Baffin Bay in autumn (Bradstreet 1982). Copepods, sympagic gammarid amphipods and *Themisto* spp. were the only species groups found in late summer in pelagic, ice-covered areas east of Svalbard (Mehlum & Gabrielsen 1993).

In spring, copepods, amphipods (other than *Themisto*) and euphausiids were found to be the main prey species in Hornsund, whereas copepods, chaetognaths and fish dominated in the marginal ice zone south-east of Svalbard (Mehlum & Gabrielsen 1993). Similarly, copepods and chaetognaths were found in all little auks collected in first-year ice in Storfjorden, south-eastern Svalbard (Lønne & Gabrielsen 1992). The diet of little auks sampled in polynyas near Rubini Rock, Franz Josef Land, consisted mainly of amphipods (other than *Themisto*) and small fish (Demme 1934).

There is little published information on the diet of little auks in winter. Fish, especially gobies (Gobiidae) and clupeids (Clupeidae; most probably sprat *Sprattus sprattus*) were found to be important food in the Skagerrak in December/January (Blake 1983; see also Skov *et al.* 1989 and Camphuysen 1996). High concentrations of larval herring *Clupea harengus* were found in areas with large numbers of little auks off central Norway in late March (Follestad 1990).

The above summary of the available information on the diet of little auks in the Barents Sea Region reveals that there are marked differences both between areas and between seasons (see also Bradstreet 1982). However, many of these studies have relatively small sample sizes, making the representativeness of the results questionable. Some of the geographical differences are explained by oceanographic differences between areas in the Barents Sea (cold, arctic water in the north and east, and warmer, Atlantic water in the south and west), influencing which prey species are present and their relative abundance. Sea ice, especially multi-year ice, hosts a specific sympagic fauna which seems to be readily utilised by little auks where and when it is available. From western Baffin Bay, Bradstreet (1982) reported that little auks seemed to switch their diet from mainly copepods in May to mainly amphipods (*Themisto* and *Apherusa*) in late summer, and suggested that this reflected development of the zooplankton community and seasonal availability in surface waters. A similar shift in diet from spring to autumn may



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

also take place in Svalbard (Mehlum & Gabrielsen 1993).

The little auk seems to be an opportunistic feeder, being able to utilise a wide range of zooplankton and also small fish. Few studies have, however, been able to shed light on food preferences by comparing the birds' diet with the availability of different food items in the area studied. Bradstreet (1982) found that, with respect to biomass, amphipods were highly overrepresented in the diet of first-year little auks in late summer in Baffin Bay compared to the total biomass of zooplankton in the water column. He suggested that amphipods are the preferred food of little auks when they are at or above some threshold of availability in surface waters, since they give a significantly higher energetic return per individual prey than the small copepods. Little auks were also found to select the largest copepod species and the largest life stage of each species compared with what was available (Bradstreet 1982). Other considerations in prey choice may be valid for adults bringing food to chicks (see below).

Breeding little auks are thought to be able to forage over long ranges; a range of up to 100–150 km has been suggested as realistic and feasible from an energy consumption viewpoint (Brown 1976). High densities of little auks have been observed far from the breeding colonies in several areas (Collett & Nansen 1900, Rüppell 1969, Brown 1976, Roby *et al.* 1981, Mehlum 1989, Camphuysen 1993, Isaksen 1995a). At least some of these were, however, probably non-breeding birds that do not have to undertake regular flights between the colony and feeding areas. The high field metabolic rate of adult little auks feeding chicks on south-western Spitsbergen also indicates that large foraging ranges are involved (Gabrielsen *et al.* 1991, Konarzewski *et al.* 1993). It has been suggested that little auks breeding in Franz Josef Land feed mainly in sounds and ice-filled waters relatively close to the breeding colonies and thus have shorter foraging ranges than Svalbard birds (Weslawski & Skakuj 1992, Stempniewicz *et al.* 1996).

The parents bring food to their chicks in their throat pouch. They were found to feed their chicks on average 8.5 and 5.2 times per day in two studies in colonies on south-western Spitsbergen (Norderhaug 1980, Stempniewicz & Jezierski 1987). The number of feeds probably varies with the extent of the foraging range. When foraging trips are long, adults are likely to select prey for their chick that maximises the energy per gram, or energy per volume as the size of the throat poach may be the limiting factor. This may have important implications for the selection of prey species and may result in differences between the diet of chicks and adults. From the summary in the table of diets from western Spitsbergen, it may be suggested that chicks are fed mainly copepods, whereas the adult diet contains more amphipods. Bradstreet (1982) found that copepods in late summer contained more energy per gram dry weight than amphipods and polar cod.

Threats

Large numbers of little auks have been killed in several oil-spill incidents, especially in the southern wintering areas (Anker-Nilssen & Røstad 1982, Røv 1982). They are also thought to be among the seabird species generally most vulnerable to oil pollution (Anker-Nilssen, Bakken *et al.* 1988, Fjeld & Bakken 1993, Lorentsen *et al.* 1993, Strann *et al.* 1993, Williams *et al.* 1994, Isaksen *et al.* 1998). Oil pollution close to the breeding colonies, in feeding areas in the breeding season, or in important wintering areas where high aggregations occur, is probably the most important threat to the Barents Sea populations of the little auk. The levels of chlorinated hydrocarbons and heavy metals found in little auks indicate that this form of pollution is not a serious threat at present (see Savinova, Gabrielsen *et al.* 1995).

Little auks wintering off south-western Greenland are hunted for food by local Greenlanders (Salomonsen 1967, Evans 1984). Otherwise, there is no hunting of little auks in the Barents Sea Region. Although it leads to increased mortality, the present hunting is no threat at the population level. Little auks rely mainly on crustacean prey which are not fished by man. They are therefore probably little affected by over-harvesting of fish resources. Possible exceptions are the autumn and winter seasons when small fish seem to be important, at least in the southern wintering areas. A considerable by-catch of little auks in salmon drift nets in western Greenland has been reported earlier (Christensen & Lear 1977), but these birds were probably from Greenlandic colonies. This fishery has since experienced much reduced quotas and the by-catch in these waters is probably negligible at present (Falk & Durinck 1991, K. Falk, pers. comm.). Significant by-catches have not been reported from other areas, and fisheries do not seem to represent a threat to little auks.

It has been suggested that climatic change is the reason for the decline in little auk populations in southern Greenland and Iceland. If recent scenarios for global warming are fulfilled, which predict the greatest changes in arctic regions, the consequences may be serious for the little auk, as for probably most other arctic seabirds.

The glaucous gull *Larus hyperboreus* and arctic fox *Alopex lagopus* are the main predators on little auks, taking both adults and young, and to a minor extent also eggs. The polar bear *Ursus maritimus* has been reported to be a predator in colonies in Franz Josef Land (Stempniewicz 1993). The predation pressure probably differs significantly from colony to colony. In one colony in Hornsund, Svalbard, it was estimated that glaucous gulls killed roughly 3% of the adults and 7% of the young during the breeding season (Stempniewicz 1995). Very little is known about the demography of little auk populations, but natural predation probably does not constitute any threat to the populations.

Special studies

Studies of feeding ecology with emphasis on trophic relations in the marine ecosystem, including hydrochemistry, planktonic productivity and feeding strategy were carried out on Novaya Zemlya several decades ago (Golovkin 1972, Golovkin *et al.* 1972).

In Franz Josef Land, feeding ecology (Weslawski & Skakuj 1992, Weslawski *et al.* 1994), predation (Stempniewicz 1993) and sub-species morphology (Stempniewicz *et al.* 1996) were studied during expeditions in the summers of 1991–1993, mainly on Hooker Island.

Magnar Norderhaug and companions were the first to carry out intensive studies on little auks in the Barents Sea Region. The work focused on large-scale ringing (11 000 individuals in four years) and various aspects of breeding biology in colonies on western Spitsbergen, mainly in the period 1962–1965 (Bang *et al.* 1963, Norderhaug 1964b, 1967, 1970b, 1980).

Several people have studied various aspects of the biology of little auks near the Polish Research Station in Hornsund, south-west Spitsbergen: breeding biology and colony attendance (Stempniewicz 1981, 1986, Stempniewicz & Jezierski 1987, Dunin-Kwinta & Olbromska 1992), predation (Stempniewicz 1983b, 1995), fertilization around breeding colonies (Stempniewicz 1990, 1992, Godzik 1991), and physiology and chick growth (Stempniewicz 1980, 1982, Konarzewski & Taylor 1989, Taylor & Konarzewski 1989, Gabrielsen *et al.* 1991, Konarzewski *et al.* 1993).

Work on colony attendance, breeding density and colony surveys has taken place recently on western Spitsbergen (Isaksen 1995b, Isaksen & Bakken 1995d). In 1996, a study of demography using individual colour marking started in Bjørndalen, close to Longyearbyen on western Spitsbergen (K. Isaksen, unpubl.).

Recommendations

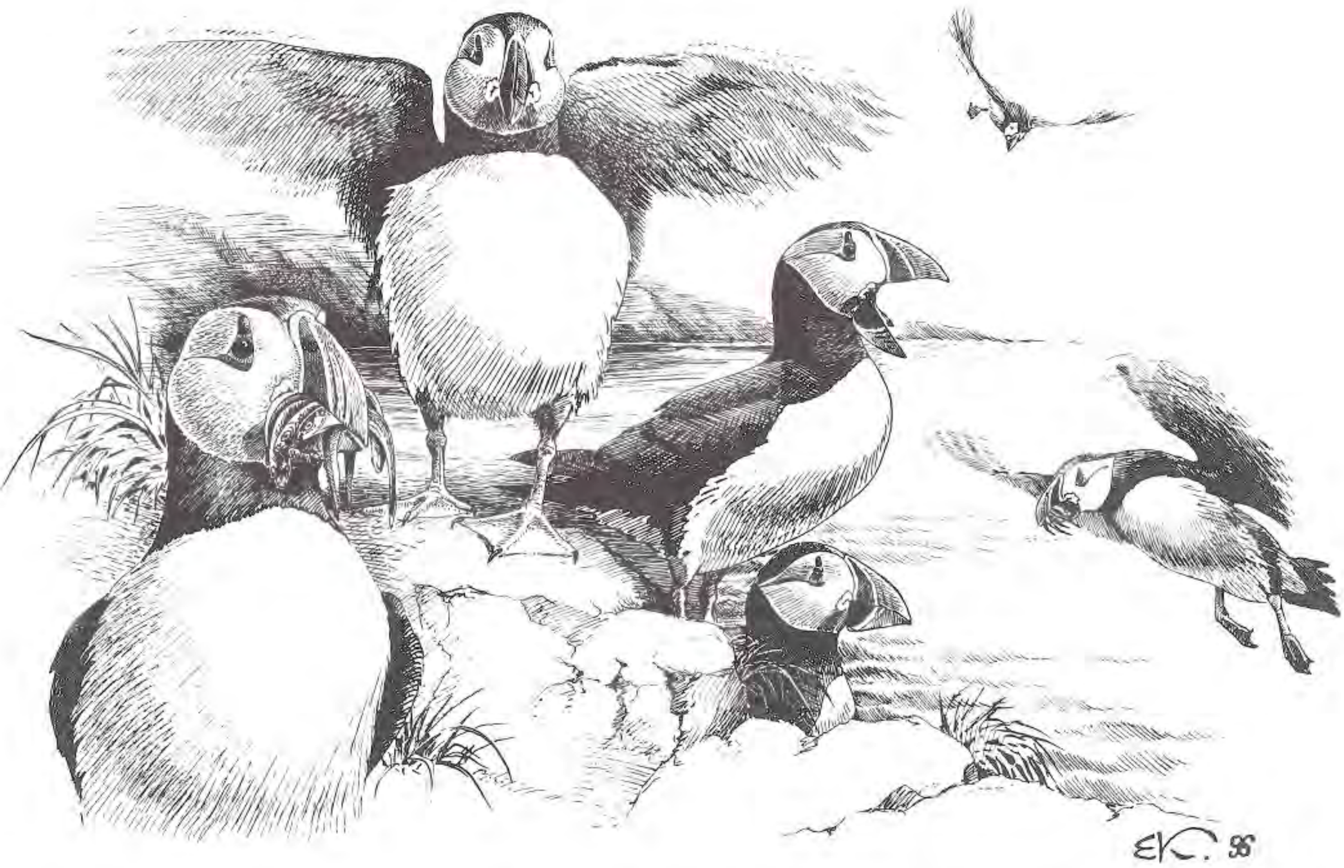
Several aspects of the biology of the little auk are insufficiently known. This especially pertains to demography, migration and the attendance of different age groups in colonies during breeding. To be able to assess the effects on the populations of losses due to oil spills, for example, we need more information on key demographic parameters such as age at first breeding, survival rates and reproductive success. Practically no information exists on at least the first two of these parameters. Only long-term, intensive studies in breeding colonies can provide this information. Such studies should preferably be made both in Svalbard and Franz Josef Land.

Most little auk colonies have never been censused. The methods have differed greatly in the few censuses that have been performed, producing estimates that are difficult to compare. There is at present no census technique that is known to produce reliable estimates of the number of breeding pairs in colonies. The method used in Svalbard (Isaksen 1995b, Isaksen & Bakken 1995d) seems promising, but provides only very rough estimates and needs refining. As no monitoring of little auk populations in the Barents Sea Region has been carried out, it will not be possible to detect changes in numbers in what is one of the most numerous seabird species in the area. Emphasis should be placed on refining census techniques to allow reliable censuses and monitoring to be undertaken. At least the larger colonies in each sub-region should be censused and representative plots established for long-term monitoring.

Kjell Isaksen & Maria V. Gavrilo

Atlantic puffin *Fratercula arctica*

No: Lunde Ru: Tupik



Population size: ca. 2 000 000 pairs
Percent of world population: ca. 30%
Population trend: Reasonably stable

General description

The Atlantic puffin is a boreo-panarctic auk that breeds on both sides of the North Atlantic. The world population can be estimated at 7 (5-9) million pairs (Nettleship & Evans 1985, Anker-Nilssen 1991b). Iceland has at least 3 million pairs (43%) and Norway around 2 million pairs (29%), most of the remainder breeding in the British Isles (10%), the Faeroe Islands (7%) and eastern Canada (5%). Small numbers are found in Maine (re-introduced), Greenland, Brittany, Jan Mayen, the Kola Peninsula, Novaya Zemlya, Bjørnøya and Spitsbergen. Less than 1% of the population breeds within the high-Arctic marine zone (Nettleship & Evans 1985).

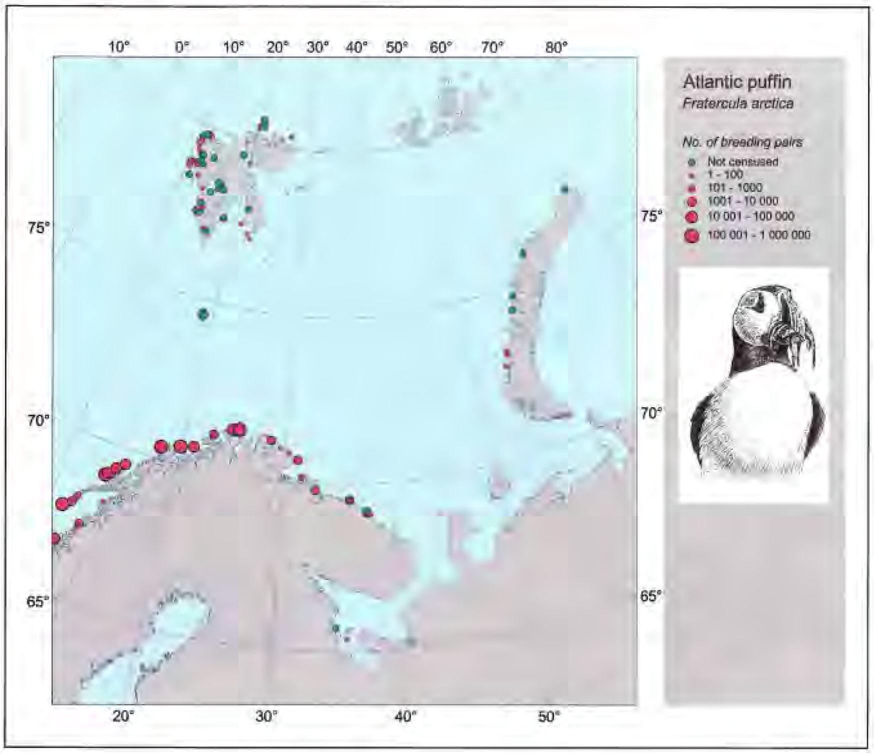
In Europe, the vast majority of puffins breed along the Atlantic Ocean and the Norwegian Sea. With few exceptions, the populations found along the North Sea and Barents Sea coasts are comparatively small. The breeding range extends from Brittany in France to Sjuøyane in Svalbard and east to the Oranskie Islands on the northern tip of Novaya Zemlya. The population in the north-west Atlantic is only about 380 000 pairs, distributed from the Gulf of Maine in the USA to the Thule district in Greenland (Nettleship & Evans 1985, Chardine 1999); most breed in Newfoundland (73%) and Labrador (23%).

The burrow-nesting Atlantic puffin is a plump, medium-sized auk. The colourful horny plates of the large bill, combined with the white face and its characteristic eye ornaments, make puffins unmistakable in the breeding season. The horny plates are shed in the autumn, and in winter full-grown birds are much

Population sizes and trends of the Atlantic puffin *Fratercula arctica* within the Barents Sea Region.

Sub-region	Most recent no. of breeding pairs		Population trends				Reference
			Short term		Long term		
	Total	Year(s)	Trend	Year(s)	Trend	Year(s)	
NC	2 000 000	1990	0/F	1988-97	-1	1979-88	1-4
MC	< 5000	1995	0	1986-95	-2	1959-85	4-13
WS	1-3	1989	no data	-	no data	-	14
ND	0						
NZ	> 100	1996	no data	-	no data	-	15-18
FJL	0						
SV	10 000	1989	no data	-	no data	-	19
All	2 000 000	1990	0/F	1988-97	-1	1979-88	

1. Anker-Nilssen 1991b, 2. Anker-Nilssen & Øyan 1995, 3. Anker-Nilssen & Brøseth 1998, 4. Krasnov & Barrett 1995, 5. Uspenski 1941, 6. Gerasimova 1962, 7. Skokova 1962, 8. Skokova 1967, 9. Tatarinkova 1990b, 10. Krasnov et al. 1995, 11. V. Karpovich, F. Shklyarevich & N. Pilipas, pers. comm., 12. T.D. Paneva, unpubl. data, 13. I.P. Tatarinkova unpubl. data, 14. Cherenkov & Semashko 1994, 15. Uspenski 1956, 16. Belopolski 1957a, 17. Strøm *et al.* 1995, 18. Strøm *et al.* 1997, 19. Mehlum & Bakken 1994.



less conspicuous with darker head plumage and bill colours (as are juveniles). In north Norway, the puffin usually arrives at its breeding site in late March or early April and lays its single egg in May (Barrett 1983, Anker-Nilssen & Øyan 1995). The egg is incubated for about 6 weeks (Ashcroft 1976, 1979, Myrberget 1962), and the chick stays in the nest until it is fully fledged and independent. The fledging period varies from 5_ to 10 weeks, depending on the food supply (Harris & Birkhead 1985, Barrett & Rikardsen 1992, Anker-Nilssen & Øyan 1995). On Spitsbergen, adults have been observed providing food for chicks in the last week of September (G. Bangjord, pers. comm.). Its age at first breeding is usually 5-8 years, although 3-4 year olds may also breed, and adult survival is high, with most estimates of annual rates in the range of 90-95% (e.g. Hudson 1985). Thus, many birds will achieve a very high age. So far, the oldest Norwegian bird (ringed in Røst in 1965) reached an age of 33 years (Anker-Nilssen 1998b), while an Icelandic bird was 34 years old (A. Petersen, pers. comm.).

The Atlantic puffin is monotypic, but three sub-species have been described, distinguished on size differences (Salomonsen 1944, Dementjev & Gladkov 1951a, Vaurie 1965). Two have been reported from the Barents Sea Region: *F. a. arctica* breeding in north Norway, being replaced by *F. a. naumanni* in colonies farther north and east (Belopolski 1957a, Myrberget 1963, Pethon 1967). However, there is no clear-cut geographical division between Finnmark and the Murman coast (Dementjev & Gladkov 1951a, Kozlova 1957). The existence of a smooth clinal increase in body size along the Norwegian coast (Barrett, Fieler *et al.* 1985), which continues eastwards along the Kola Peninsula (I.P. Tatarinkova, C.G. Chemyakin & F. Shklyarevich, unpubl. data) throws doubt on the justification of sub-species. Birds from Spitsbergen are, however, significantly larger than those of any other populations (Salomonsen 1944).

Breeding distribution and habitat preferences in the Barents Sea Region

In mainland Norway and along the Kola Peninsula, most puffins breed on grassy islands far out on the coast. More than 200 different breeding sites have been recorded in the Barents Sea Region, but in many places they occupy islands situated so close together (e.g. less than 5 km) that it is reasonable to consider them as one colony. This limits the number of Atlantic puffin colonies north of the Arctic Circle to about 100: 22 in north Norway, 4-5 on the Murman coast, 7-8 on Novaya Zemlya, 4-6 on Bjørnøya, 45-50 on Spitsbergen, 3 on Edgeøya/Tusenøyane and 5-6 on Nordaustlandet. In 1988-89, 1-3 pairs were also found breeding on Sennukha Island in Onezhski Bay in the White Sea (Cherenkov & Semashko 1994), which supports the assumption made by Bianki, Kokhanov *et al.* (1975) that puffins were breeding in that area in the 1960s.

Accounting for approximately one third of all breeding seabirds, the Atlantic puffin is the most numerous species in the Barents Sea Region. More than 90% of the approximately 2 million Norwegian puffins breed north of the Arctic Circle (Anker-Nilssen 1991b), the largest colonies being along the Norwegian Sea. The Røst archipelago, farthest out in the Lofoten Islands, has the largest population, which has varied between 500 000 and 660 000 pairs since 1986 (Anker-Nilssen & Øyan 1995, Anker-Nilssen 1998b, unpubl. data). Seven other colonies have more than 50 000 pairs each: Værøy immediately north of Røst (70 000 pairs in 1974, Brun 1979), Fuglenyken in Vesterålen (120-150 000 pairs in 1990 (with an additional 30 000 and 15 000 pairs, respectively, on the neighbouring islands of Måsnyken and Frugga)), Bleiksøy in Vesterålen (80 000 pairs in 1988, R.T. Barrett, unpubl. data), Sør-Fugløy in Troms (175 000 pairs in 1990), Nord-Fugløy in Troms (218 000 pairs in 1967, Brun 1971b), and Hjelmsøy and Gjesværstappan in west Finnmark (approximately 60 000 pairs and more than 400 000 pairs, respectively, in 1990, T. Anker-Nilssen *et al.*, unpubl. data). Unlike the other censuses, the estimate for Nord-Fugløy was based on how frequently chicks were fed and on counts of adults carrying food loads. Besides being very old, it should therefore only be considered as a rough guesstimate. For other colonies, experience from more recent work suggests that many of Brun's population numbers from the 1960s and 1970s (Brun 1966, 1979) were considerably underestimated (Anker-Nilssen 1991b, Anker-Nilssen & Øyan 1995).

The colonies north and east of Finnmark are generally small and widely dispersed. The total Russian population is now less than 10 000 individuals, with only a few hundred birds breeding along the west coast of Novaya Zemlya (Uspenski 1956, Belopolski 1957a, Strøm *et al.* 1995). Svalbard (including Bjørnøya) has about 10 000 pairs (Mehlum & Bakken 1994). It is not known to what extent long-lasting frozen ground limits the availability of breeding sites in these areas. All colonies larger than 10 000 pairs are situated south-west of Nordkapp. An important explanation for the large population of puffins along the coast of the Norwegian Sea is probably the supply of 0-group herring *Clupea* *harengus*. The young herring drift northwards with the coastal current from the spawning grounds of the Norwegian spring-spawning stock off south-western Norway towards the main nursery areas in the Barents Sea (e.g. Hamre 1994), and in good herring years, they constitute a very large proportion of the diet of puffin chicks in Nordland and Troms (see *Feeding ecology*). Only when the fry reach this area in midsummer, have they grown large enough to be adequate prey for puffins to feed to their young (Anker-Nilssen & Øyan 1995). Farther south, puffin colonies are fewer and markedly smaller.

In the Barents Sea Region, puffins breed mainly in deep, complex systems of self-dug burrows on grassy slopes on steep-sided islands, but occasionally on flat ground (e.g. on island tops) and in stony screes (Kaftanovski 1951, Uspenski 1956, Brun 1966, Skokova 1967). Up to three occupied burrows per m^2 have been found in the best areas in Røst, but the most common density is 0.5-1.0 burrows per m^2 (Anker-Nilssen & Røstad 1993, Anker-Nilssen & Øyan 1995). In many colonies, scattered pairs are found in cavities on steep cliffs. On Bol'shoy Aynov Island, some colonies with self-dug burrows are situated up to 400 m from the sea (Skokova 1962, 1967, 1990). The few pairs in Onezhski Bay breed in a boulder scree (Cherenkov & Semashko 1994). On Spitsbergen, most colonies consist of scattered pairs breeding on steep cliffs dominated by Brünnich guillemots *Uria lomvia* and black-legged kittiwakes *Rissa tridactyla*, but some of the largest colonies in Sjuøyane are found in screes. In high-Arctic areas, puffins breeding in self-dug burrows are probably severely limited by the deeply frozen ground. For instance, burrows on Novaya Zemlya are only 0.5-1.5 m deep (Uspenski 1956), compared to 1-3 (4) m in Seven Islands (Kaftanovsky 1951).

Except for two colonies in Finnmark (Omgangsstauran and Syltefjord), all those found along the mainland coasts of Norway and Russia are situated on islands. This probably illustrates the great vulnerability of Atlantic puffins to small mammalian predators. Like most other seabirds, puffins have nitrogen-rich guano that exerts a marked effect on the vegetation and their colonies are characterised by plants that can tolerate the heavy fertilisation, such as scurvy grass *Cochlearia officinalis* and (in north Norway) red campion *Silene dioica*. A detailed description of the ornithogynic vegetation in puffin colonies along the Murman coast is given by Breslina (1987).

Diet of the Atlantic puffin *Fratercula arctica* in the breeding season within the Barents Sea Region.

Sub-region	Colony (ies)/ area(s)	Year(s)	Main prey species/groups	Age group	Reference
NC	Røst	1979-98 (20 yrs)	Herring (39%, range 0-89%) Saithe (22%, range 0-72%) Haddock (14%, range 0-57%) Sandeel (13%, range 0-53%)	Chicks	1-3
	Bleiksøy	1982-88 (5 yrs)	Herring (27%, range 4-45%) Saithe (25%, range 10-45%) Sandeel (13%, range 0-32%) Squid (6%, range 0-19%)	Chicks	3-5
	Hornøy	1980-94 (10 yrs)	Capelin (48%, range 20-76%) Sandeel (35%, range 1-67%) Herring (7%, range 0-34%)	Chicks	3,6-7
MC	Aynov Islands	1967	Herring (71%) Sandeel (29%)	Chicks	8
		1949-50	Herring (in 25%) Capelin (in 13%) Sandeel (in 5%)	Adults (n = 55)	9
	Seven Islands	1935-49 (6 yrs)	Sandeel (in 46%) Capelin (in 17%) Herring (in 16%)	Adults (n = 100)	9
NZ	(not stated)	1948-50	Nereis sp. (in 30%) Four-horn sculpin (in 15%) Sandeel (in 10%)	Adults (n = 20)	10
SV	Spitsbergen	1934	Krill (in 100%) Polar cod (in 70%)	Adults (n = 10)	11

1. Anker-Nilssen 1987b, 2. Anker-Nilssen & Øyan 1995, 3. Anker-Nilssen 1998b, 4. Barrett & Rikardsen 1992, 5. Barrett 1996a, 6. Barrett & Furness 1990, 7. Barrett & Krasnov 1996, 8. I.P. Tatarinkova, unpubl. data, 9. Belopolski 1971, 10. Uspenski 1956, 11. Hartley & Fisher 1936

Movements

The migration pattern of adult Atlantic puffins from colonies in Russia and northern Norway is still poorly known. Despite the ringing of many thousands of birds in both countries, only few recoveries have been made. This suggests that they usually spend the non-breeding season far offshore. Considerable numbers may spend the winter in the western parts of the Barents Sea (Anker-Nilssen, Bakken *et al.* 1988). At that time of year, single birds occasionally also occur near the Murman coast and in Kandalaksha Bay (Kaftanovsky 1951, Bianki 1960, Kurochkin & Gerasimova 1960) and one bird has been reported shot on the Kanin Peninsula (Spangenberg & Leonowich 1960). Birds inside the Barents Sea may also originate from colonies in Nordland. This was demonstrated by three adult birds equipped with satellite transmitters at Røst in 1997-98 which travelled to the north-western and central Barents Sea soon after breeding, and one bird ringed as full-grown at Bleiksøy in 1946 which was found in Varangerfjorden in August 1953 (Anker-Nilssen 1998b and unpubl. data). So far, the only adult Russian Atlantic puffin recovered more than 100 km from its breeding colony, was ringed on Kuvshin Island in the Seven Islands in July 1958 and found in central Norway in January 1959. Outside the breeding season, birds ringed in north Norway have been reported from Iceland (3), western Greenland (3) and Newfoundland (1), but most recoveries have been made in the southern part of the Norwegian Sea, especially around the Faeroe Islands, and in the northern parts of the North Sea (Myrberget 1973, T. Anker-Nilssen, unpubl. data). The four individuals recovered in the north-west Atlantic were all in their first winter and demonstrate the wider dispersion of young birds (T. Anker-Nilssen, unpubl. data). The southernmost winter recovery was a bird ringed as full-grown on Bleiksøy in 1982 and found dead in south-west Sweden in January 1984, while an exhausted adult from Røst was found in eastern Ireland in the middle of July fourteen years later. Two birds ringed as young in Røst and on Bleiksøy were both killed in Iceland in July when five years old, which demonstrates the potential for emigration of immature birds.

Population status and historical trends

North Norway

In 1988, the Røst population was 518 000 pairs (± 5%), but less than 10 years earlier it numbered more than 1.3 million pairs (Anker-Nilssen & Røstad 1993, Anker-Nilssen & Øyan 1995). This steep decline was the direct consequence of a long-lasting reproduction failure that hit this population when the stock of Norwegian spring-spawning herring collapsed in the late 1960s as a combined effect of poor recruitment and extensive overfishing (Lid 1981, Anker-Nilssen 1987b, 1992, Hamre 1994). In the first 20 years following the collapse, the Røst puffins experienced only three successful breeding seasons. In the other years, most chicks starved to death in the nest. Data from 25 years now show that the breeding success of puffins in Røst is largely determined by the abundance of first-year (0-group) herring (see *Feeding ecology*). During 1975-94, 69% of the population change between years was explained by the breeding success 5-7 years earlier (Anker-Nilssen & Øyan 1995), but decreased adult survival in later years has now weakened this relationship (Anker-Nilssen 1998b). Successful breeding in 1983 and 1985 led to a temporary increase in puffin numbers in Røst in 1989-90. Following the increase of herring in 1988, the puffin breeding success was again high in 1989-92. Whereas adult survival rates were high in 1990-94 (95.6% p.a.) they dropped to only 87.5% in 1994-97, i.e. an almost threefold increase in mortality rates (Anker-Nilssen 1998b, Erikstad, Anker-Nilssen *et al.* 1998). Adult survival was probably also poor in 1983-87 when there was no native recruitment and the population dropped by 13.7% p.a. (Anker-Nilssen & Røstad 1993). The breeding numbers recorded in 1996 and 1998 were the lowest ever, and due to the annual breeding failures in 1993-98, the adult population is expected to drop much lower during the first five years of the new century (Anker-Nilssen 1998b).

In 1980-82, extensive mortality of chicks was also registered in several other colonies in Nordland and Troms (Barrett *et al.* 1987). This further substantiates the importance of herring as a key prey for Norwegian puffins and suggests that other populations may also have experienced recruitment problems (Anker-Nilssen 1992), although the slight negative trends on Anda in 1981-88 and Bleiksøy in 1988-93 were not statistically significant (Anker-Nilssen *et al.* 1996). North and east of the problem area, other prey species (mainly capelin *Mallotus villosus* and sandeels *Ammodytes* sp.) have dominated the diet of chicks (Barrett & Krasnov 1996), and the significant population increase on Hornøya between 1967 and 1980 continued at a mean rate of 2.6% p.a. during 1981-93 (Brun 1979, Krasnov & Barrett 1995).

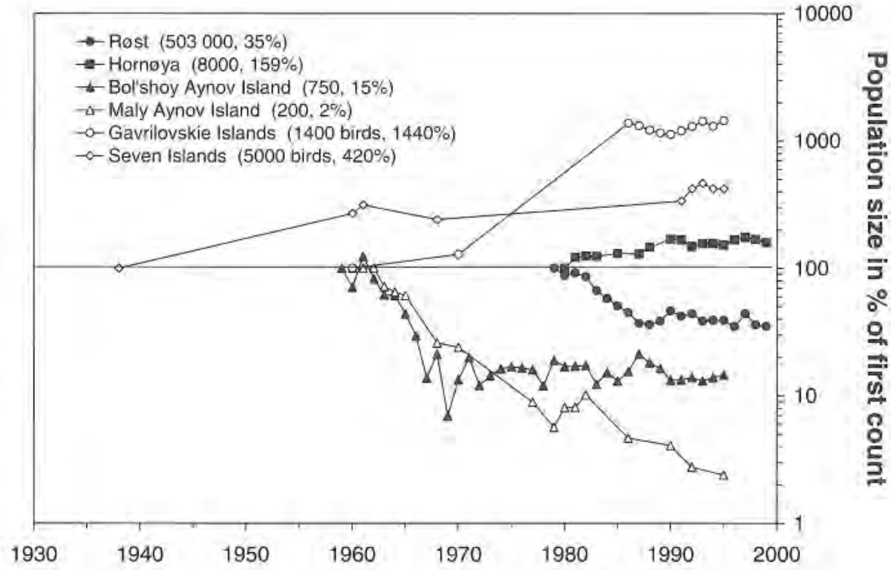
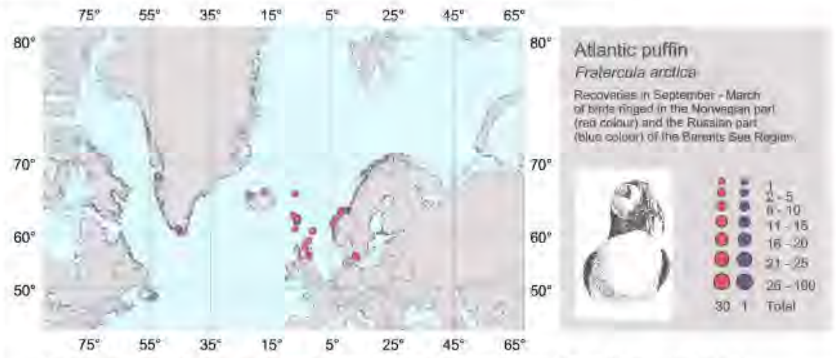


Figure 1. Population trends of Atlantic puffin in colonies within the Barents Sea Region during 1979-99 (two Norwegian colonies) and 1938-95 (three Russian colonies). Numbers in parenthesis are the estimated colony size in the latest year (expressed as the number of apparently occupied burrows unless otherwise stated) and how this compares to the first count in percent (plotted value). Note the logarithmic scale of the y-axis.

Russia

The first complete census of puffins in the Murman area was undertaken in 1960 and the population was estimated to be approximately 17 000 pairs (Gerasimova 1962). Through most of this century, the largest breeding population of Atlantic puffins in Russia has been that of the Aynov Islands, with estimates ranging from about 20 000 pairs in 1928 (Emeis 1929) to 11-12 000 pairs in 1958-60 (Gerasimova 1958, Skokova 1967). The number of occupied burrows (defined as cleared entrances) in the Aynov colonies has been counted annually since 1959. This record-long monitoring has revealed a population collapse of more than 80% during the 1960s, after which the decrease gradually slowed down. The population size now seems to have levelled off at approximately 1000 occupied burrows, which is only 6-7% of its peak number in 1961.

Krasnov *et al.* (1995) attributed the problem for the Aynov puffins to poor feeding conditions in the Barents Sea. However, herring and capelin, which probably were the main food items of Aynov puffins at the time (see *Feeding ecology*), were abundant in the early 1960s (Alekseev & Luka 1986). The decline is much more likely to have been caused by heavy predation on adult puffins by large gulls. Parallel to the dramatic decrease in puffin numbers, there were huge increases in local populations of great black-backed gulls *Larus marinus* and herring gulls *L. argentatus*. On Bol'shoy Aynov Island, great black-backed gulls increased progressively from about 250 breeding pairs in 1957 to a peak of about 3500 pairs in 1974, and their importance as predators on the local population of puffins has been noted repeatedly (Merikallio 1939, Gerasimova 1958, Skokova 1967, Karpovich & Tatarinkova 1968, Tatarinkova 1990). The predation hypothesis is further substantiated by the immediate stabilisation of puffin numbers on Bol'shoy Aynov Island after 1966. From that year, gull numbers have been controlled each spring by eliminating all gulls nesting within the largest puffin colony on the island, as part of a special protection plan. While there was a significant negative relationship between the numbers of puffins and great black-backed gulls during 1959-67 ($r = -0.901$, $n = 9$, $p = 0.001$), there was no correlation in the numbers during 1968-95 ($r = -0.011$, $n = 28$, $p = 0.958$). In the other Aynov colonies, puffin numbers continued to drop and some colonies were even



Data sources: Kandalaksha State Nature Reserve and the Norwegian Ringing Centre (Stavanger Museum)

lost. However, over the last two decades, great black-backed gull numbers have dropped back to around 2000 individuals (in 1995), and puffin numbers on Maly Aynov, which used to hold two-thirds of the Aynov population, now seem more stable, although only 2-3% of their former size. A complete Murman survey carried out in 1992 indicated that the Russian population was less than half the early 1960s figure, mainly due to the dramatic decline on the Aynov Islands (T.D. Paneva, unpubl. data). It is, however, worth noting that 2500 puffin burrows were counted in the nearby colony on the Arsky Islands in 1992, which is five times higher than the number found by Gerasimova (1962) in 1960. Thus, there may well have been a substantial emigration of birds from the Aynov Islands to the Arsky Islands.

In other Russian colonies, Atlantic puffins have only been monitored by single annual counts of birds at sea near the colonies prior to egg laying. Unfortunately, the enormous day-to-day variation in attendance documented for the species (e.g. Myrberget 1959, Ashcroft 1976, Anker-Nilssen & Øyan 1995) makes this method inappropriate and results should be treated with the greatest caution. Nevertheless, when compared with more recent data, the counts made in the Gavrilovskie Islands in 1960 (100 birds, Gerasimova 1962) and 1970 (128 birds, V. Karpovich, F. Shklyarevich & N. Pilipas, pers. comm.) and that from Seven Islands in 1938 (1191 birds, Uspenski 1941) strongly suggest that these populations have increased considerably since then. In 1960-61, Gerasimova (1962) counted 3200-3700 birds in Seven Islands. According to Krasnov & Barrett (1995), numbers in Seven Islands then dropped by over 50% before 1979, but an estimate of close to 3000 individuals in 1968 (V. Karpovich, F. Shklyarevich & N. Pilipas pers. comm.) indicates that most of this decrease took place in the 1970s, i.e. at the same time as young herring disappeared from the Barents Sea (see *Feeding ecology*). Krasnov & Barrett (1995) also reported that numbers later increased from about 3000 individuals in 1986 to 5500 in 1993 (Krasnov *et al.* 1995). The two largest and most frequently counted colonies in Seven Islands are on Kuvshin Island and Bol'shoy Zelenets Island, but only the numbers from Kuvshin may indicate an overall increase during 1960-93 (Monte Carlo simulations, Kuvshin: n = 9, p = 0.033, B. Zelenets: n = 10, p = 0.259). Nor did the data obtained by T.D. Paneva (pers. comm.) indicate any significant change in puffin numbers in the Gavrilovskie Islands during 1986-95 (range 1119-1440 birds, Monte Carlo simulations, n = 10, p = 0.498).

Feeding ecology

The Atlantic puffin feeds mainly on small schooling fish. Crustaceans, squid and polychaete worms (Nereidae) are also taken, especially in the high-Arctic colonies and outside the breeding season, but data on the adult diet is generally poor (e.g. Harris 1984, Bradstreet & Brown 1985, Cramp 1985). During the breeding season, most puffins in the Barents Sea Region search for prey in offshore pelagic waters. Although birds in some colonies occasionally feed in fjords, littoral prey species are almost absent from the diet offered to chicks in north Norway (e.g. Anker-Nilssen 1987b, 1998b, Barrett *et al.* 1987, Anker-Nilssen & Øyan 1995, Anker-Nilssen & Brøseth 1998). Foraging ranges vary greatly, from within a few kilometres (Furness & Barrett 1985) up to at least 137 km offshore (Anker-Nilssen & Lorentsen 1990, Anker-Nilssen & Øyan 1995).

In 1980-83, Barrett *et al.* (1987) collected 1257 bill loads from chick-feeding puffins in seven Norwegian colonies north of the Arctic Circle. Chicks in Finnmark (two colonies) were fed almost entirely on capelin (8-12 cm) and sandeels (9-14 cm). In Troms and northern Nordland (five colonies), young herring (3-7 cm), saithe *Pollachius virens* (6-9 cm) and sandeels (6-12 cm) were the most important food items, but small redfish *Sebastes* sp., cod *Gadus morhua* and the squid *Gonatus fabricii* occasionally contributed a quarter to a third of the diet by weight. These main differences were confirmed by later studies on Hornøya for six years (Barrett & Furness 1990, Barrett & Krasnov 1996) and Bleiksøy in 1985-88 (Barrett & Rikardsen 1992, Barrett 1996a), as well as by annual studies in Røst where also haddock *Melanogrammus aeglefinus* and whiting *Merlangius merlangus* have been important prey in some seasons (Anker-Nilssen 1987b, 1998b, Anker-Nilssen & Øyan 1995, Anker-Nilssen & Brøseth 1998).

However, the long-term data sets from Røst and Hornøya also demonstrate some important relationships between the composition of the chick diet and changes in stocks of prey species. Most prominent is the puffin's strong dependence upon 0-group herring in Røst, where the supply of herring has accounted for most of the great variation in the fledging success of puffins during at least 25 years (Anker-Nilssen 1992, 1998b, Anker-Nilssen *et al.* 1997). Recent evidence also indicates that the adults feed on the same prey as they present to their chicks (T. Anker-Nilssen & P. Fossum, unpubl. data). On Hornøya, I-group herring appeared in puffin loads parallel to the return of young herring to the Barents Sea in 1989-94, and during 10 different years since 1980 there was a positive correlation between the year-class strength of herring and the proportion of herring in the diet of puffin chicks (Barrett & Krasnov 1996). This implies that herring may, in the long run, be a much more common food item for puffins in the Barents Sea than indicated by the studies carried out in the 1970s and 1980s when the herring stock was extremely small and the capelin was prospering (Hamre 1994).

This assumption is supported by the studies of Belopolski (1957a, 1971) who examined the stomach contents of 55 adults from the Aynov Islands in May-June 1949-50 and 100 birds from the Seven Islands in six years during the period of 1935-49. At Aynov, herring were most frequent, occurring in 25% of the stomachs, followed by capelin (13%) and sandeels (5%), but the same species occurred in equal frequencies in the stomachs from Seven Islands (16%, 17% and 16%, respectively). The only other fish found was cod, occurring in two birds (2%) from Seven Islands. The occurrence of fish in male and female diets did not differ significantly. Although Belopolski did not report how many stomachs were empty, fish were the commonest prey in both samples, being present in 38% and 81% of the stomachs, respectively. Invertebrates occurred less frequently, and only polychaetes *Nereis* sp. (in 7% and 2%) and crustaceans (in 0% and 5%) were found, which were obviously taken deliberately.

There is little exact information on the food offered to Atlantic puffin chicks in Russian colonies. On the Aynov Islands, parents usually provide small chicks with small (3-5 cm) fish, shifting gradually to larger (10-12 cm) fish towards the end of the fledgling period (I.P. Tatarinkova, pers. obs.). Of 21 fish dropped by puffins on the Aynov Islands in August 1967, 15 (71%) were herring and the rest were sandeels (I.P. Tatarinkova, unpubl. data). After the herring collapsed in the late 1960s, herring loads have only been seen occasionally and visual observations in the colonies in July and August of most years indicated that chicks were fed almost exclusively sandeels. This was also the case on Kharlov Island in the Seven Islands in 1983-86 and 1989-93 (Barrett & Krasnov 1996). In striking contrast to the situation on Hornøya, capelin were never identified in food loads on the Aynov Islands after the 1960s (I.P. Tatarinkova, pers. obs.), although they were among the commonest fish prey in the stomachs of 55 adults sampled in the Aynov colonies in 1949-50 and of 100 adults sampled in Seven Islands in 1935-49 (Belopolski 1971). A recalculation of Belopolski's (1957a) data from the Aynov Islands indicates that there was a sexual difference in the choice of fish prey ($\chi^2 = 7.01$, df = 2, $p = 0.03$), with females taking capelin more often than males.

Uspenski (1956) examined 20 stomachs of adult puffins from Novaya Zemlya in 1948-50. Fish remains were present in only 5 (25%); three contained four-horn sculpins *Myoxocephalus quadricornis* and two had sandeels. However, six birds contained *Nereis* worms, and he reported that the puffins, there, ate many polychaetes in August. The importance of invertebrate food for Atlantic puffins in high-Arctic areas is also supported by the preponderance of crustaceans (*Thysanoessa, Parathemisto* and *Mysis*) in a sample of 10 adult stomachs collected on Spitsbergen late in the breeding season of 1934, although gadid and stichaeid fish were present in seven of the birds (Hartley & Fisher 1936).

Threats

The most important threat to Atlantic puffins in the Barents Sea Region is the indirect effects of human exploitation of their food resources on their reproduction and survival. The long history of the relationship between Norwegian spring-spawning herring and the puffins in Røst stands out as a clear example of this. However, the depletion of the herring stock also brought about major long-term changes in the Barents Sea ecosystem that are likely to have affected puffins in most other northern colonies in one way or another. Thus, the future development of puffin populations in this region will depend greatly on management policies for fisheries, at both national and international levels.

The potential risk of oil pollution is increasing parallel with the increasing exploration and transportation of oil within the region. At the moment, the rapid development of offshore oil fields along the coast of northern Norway and in the south-eastern Barents Sea seems to involve the greatest risks, especially if Russian oil is to be transported in tankers to petroleum plants in Europe. The risk of major damage to Atlantic puffin populations from an oil spill is far higher in spring and summer (April-August) than at other times of the year, as these puffins, unlike many other auks, probably have a very dispersed and pelagic distribution outside the breeding season.

Beside the effects of fisheries and oil pollution, few real and potential threats are recognised. The traditional and (since 1952) illegal harvest of adults and fledglings in Røst (and possibly also in a few other colonies) is declining, and is now probably insignificant compared to the size of the population. No direct human pressure on puffins has been known to occur in Murman, and any disturbance from human activities has been greatly reduced by the largest colonies being designated as protected territories within the Kandalaksha State Nature Reserve. Similarly, the implementation of protection plans for many Norwegian colonies during the last two decades should also reduce disturbance. Due to their offshore feeding habits, Atlantic puffins also seem to avoid extensive mortality from becoming entangled in salmon nets set close to the colonies (e.g. Bustnes *et al.* 1993)

Although it is being controlled, the predation of Atlantic puffins by great black-backed gulls may still be an important factor regulating puffin numbers on the Aynov Islands and elsewhere, but it is difficult to assess this threat as the reasons for the increase in gull numbers are poorly known (see the description of the great black-backed gull).

Special studies

Besides the census and monitoring work discussed above, the Atlantic puffin has been studied in a variety of research projects in the Barents Sea Region. In Norway, these include a study of the measurements and weight changes of adults in 12 different colonies (Barrett, Fieler *et al.* 1985), discriminant function analyses of body measurements to sex individual live birds (Barrett, Fieler *et al.* 1985, Anker-Nilssen & Brøseth 1998), the annual monitoring of adult survival rates since 1990 by re-sighting of colour-ringed birds in Røst and Hornøya (Anker-Nilssen 1993a, 1998b, Erikstad *et al.* 1994, Anker-Nilssen & Øyan 1995, Erikstad, Anker-Nilssen *et al.* 1998), several experimental studies of the regulation of parental investment in the chick period (Johnsen *et al.* 1994, Erikstad *et al.* 1997), studies of the temperature regulation and energetics of incubating birds (Barrett 1984, Barrett *et al.* 1995) and analyses of the levels of persistent organochlorines and mercury in adult birds and their eggs (Barrett, Skaare *et al.* 1985, Barrett *et al.* 1996, Thompson *et al.* 1992). During a life-long study of seabirds in Røst, B. Tschanz and his co-workers studied many aspects of puffin breeding biology, including the growth and feeding behaviour of chicks, and characteristics of the nest habitat (Tchanz 1979, 1990, Tchanz *et al.* 1989).

In most years, the long-term monitoring of Atlantic puffins in Røst and, partly, that on Hornøya has included detailed studies of seasonal variations in chick growth, composition of chick food, adult attendance and the physical condition of adults and fledglings (Barrett, Fieler *et al.* 1985, Anker-Nilssen 1987b, 1992, 1998b, Anker-Nilssen & Øyan 1995, Barrett & Krasnov 1996). A number of other studies have also been carried out in Røst, including the energy utilisation, growth adaptations and stochastic growth of chicks raised in captivity (Breivik 1991, Øyan & Anker-Nilssen

1996, Brandsæter 1997), photographic surveillance of adult attendance (Otnes & Skjold 1993), the foraging strategies of breeders in relation to food supply (Henriksen 1998), experimental studies of the diet of adults using the stable isotope method (Albertsen 1996), at-sea studies of the diet of adults, their interactions with prey and the location of their foraging areas (Anker-Nilssen & Lorentsen 1990, Anker-Nilssen & Øyan 1995, T. Anker-Nilssen & P. Fossum, unpubl. data), as well as analyses of diet quality (fat, protein and energy) for consumption modelling (Anker-Nilssen 1992, Anker-Nilssen & Øyan 1995). Feeding frequency, chick growth and diet quality were also studied on Hornøya and Bleiksøy in the 1980s (Furness & Barrett 1985, Barrett *et al.* 1987, Barrett & Furness 1990, Barrett & Rikardsen 1992, Barrett 1996a). In 1997-99, satellite transmitters were used for the first time on Atlantic puffins to track the movements of adults breeding in Røst (Anker-Nilssen 1998b, unpubl. data).

In Russia, various aspects of Atlantic puffin ecology have been studied on the Aynov Islands since 1958. Skokova (1967) studied burrow construction, sex ratio, breeding site fidelity (by moving adults to other colonies) and the distribution of colonies within the islands. Korneeva (1967) described the breeding characteristics and chick growth and made an age identification key for chicks based on weight change, feather development and behaviour. Tatarinkova & Chemyakin (1970) studied the attendance patterns of adults during incubation and chick-rearing periods, and also found that the daily feeding frequency of adults was higher early in the 1966 season (range of means 6-14, 3 nests, 3 days) than late in the 1968 season (range of means 2.7-5.9, 10 nests, 15 days). In 1968, feeding rates also decreased significantly as the season progressed ($r = -0.700$, $n = 15$, $p = 0.004$). The sex identification and size variations of adults and fledglings have also been studied (I.P. Tatarinkova, R. Chemyakin & F. Shklyarevich, unpubl. data). In the 1930s and 1940s, Kaftanovski (1951) studied puffin biology in Seven Islands. Although he only reported the mean of parameter estimates and, occasionally, the range of individual values, he documented the morphometry of adults, burrow structure and microclimate, timing of breeding, egg measurements, and thermoregulation and growth of chicks.

Recommendations

The Atlantic puffin has proved to be a robust indicator of important changes in the pelagic food webs of the Norwegian and Barents Seas. Long-term monitoring of puffin numbers, survival, reproductive success and food choice in a selection of colonies is required to take full advantage of this quality. In this context, it is essential to continue the studies in Røst and on Hornøya, and to obtain supplementary information on population trends in colonies between these two sites. The monitoring in Russian colonies should continue, using internationally standardised methods, and be extended to include survival rates, reproductive success and food supply in at least one colony, preferably where fairly long-term data on population trends have already been collected.

As pointed out repeatedly, the monitoring would be greatly improved by better co-ordination with the parallel monitoring of prey stocks carried out by fisheries research institutions (e.g. Anker-Nilssen *et al.* 1996). Multidisciplinary co-operation is also needed to study in more detail the interactions between Atlantic puffins and their main prey, i.e. by focusing on the factors which determine prey availability and puffin distribution at sea. This work should pay special attention to the important role of sandeels, which are not commercially utilised and are therefore very poorly studied in the Barents Sea Region, as well as the significance of young gadoids (Anker-Nilssen & Øyan 1995). Important gaps in our knowledge also include the distribution and diet of Atlantic puffins outside the breeding season, which could be amended by an updated analysis of ring recoveries, the use of satellite telemetry and improved co-operation with fishery research at sea.

Tycho Anker-Nilssen &
Ivetta P. Tatarinkova

4. Threats to marine birds breeding in the Barents Sea Region

The species are evaluated in relation to nine different threats. They relate to competition with fisheries, harvesting, by-catches in fishing gear, oil, other sources of pollution, disturbance, area encroachments, conflicting species and other threats. Each threat is divided into current and potential on a 2-5 year perspective. The threats are categorised in four groups according to their importance for the populations: 0 = None/insignificant, 1 = Slight, 2 = Moderate, 3 = Great.

The authors of the species descriptions were asked to comment on the importance of each threat for the species in question. They made separate assessments of the significance of the current and the potential threats, thereby indicating whether they believed the threat is likely to become more or less important in the foreseeable future. Even though all the authors were scientists within a common field of interest, it was unreasonable to expect they would interpret this very qualitative evaluation principle equally. The editors therefore took the liberty of adjusting some of their values in order to harmonise the evaluations between the species. Although this was always done in agreement with the authors in question, the editors take full responsibility for the very simplistic final tables (Tables 4.1-4.7) and the general discussion of each threat category presented in this chapter.

The threats evaluated are valid for the whole year. This means that, for instance, the hunting of Svalbard Brünnich's guillemots *Uria lomvia* in Greenland in winter is considered a threat to the breeding population in Svalbard. The threats were evaluated for each of the seven sub-regions (Fig. 2.1). The recommendations for mapping, research and monitoring in the next chapter are based mainly on the results of the threat evaluation.

Table 4.1. Indices of current and potential (in a 2-5 year perspective) threats to marine birds breeding on the Norwegian coast north of the Arctic Circle. Categories of importance are: 0 (green) = none or insignificant, 1 (yellow) = slight, 2 (orange) = moderate, 3 (red) = great. Threat categories are: FI = fisheries, HA = harvesting, BY = by-catch, OI = oil, PO = other pollutants, DI = disturbance, AR = area encroachment, CO = conflicting species and OT = other.

Species	Threat category: Current									Potential								
	FI	HA	BY	OI	PO	DI	AR	CO	OT	FI	HA	BY	OI	PO	DI	AR	CO	OT
Great northern diver																		
Northern fulmar	0	0	2	2	1	0	0	0	0	0	0	2	2	1	0	0	0	0
European storm-petrel	0	0	0	1	1	0	0	1	0	1	0	0	2	1	0	0	2	0
Leach´s storm-petrel	0	0	0	1	1	0	0	1	0	1	0	0	2	1	0	0	2	0
Northern gannet	1	0	1	1	0	1	0	2	0	1	0	1	1	1	2	0	2	0
Great cormorant	3	2	3	2	0	1	0	1	0	3	1	3	2	0	0	0	1	0
European shag	3	1	2	2	0	0	0	2	0	2	1	2	2	0	0	0	1	0
Greylag goose	0	1	0	2	0	2	1	2	0	0	2	0	2	0	2	1	1	0
Barnacle goose																		
Brent goose																		
Common eider	1	1	3	3	1	1	2	2	0	2	2	3	3	1	2	3	2	0
King eider																		
Steller's eider																		
Long-tailed duck	1	0	1	1	0	0	1	0	0	0	0	2	3	0	1	1	0	0
Black scoter	0	0	1	1	0	0	1	0	0	0	0	1	2	0	1	1	0	0
Velvet scoter	0	0	1	1	0	0	1	0	0	0	0	1	3	0	1	1	0	0
Red-breasted merganser	0	1	1	1	0	1	0	0	0	0	1	1	2	1	1	1	1	0
Eurasian oystercatcher	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Purple sandpiper	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Ruddy turnstone	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Red-necked phalarope	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Grey phalarope																		
Arctic skua	1	0	0	0	0	0	0	0	0	2	0	0	0	2	1	1	1	0
Great skua	0	0	0	0	2	0	0	1	0	1	0	0	0	2	0	0	1	0
Sabine´s gull																		
Black-headed gull	0	0	0	0	0	1	1	1	0	0	1	0	1	1	2	2	1	0
Mew gull	0	1	0	0	0	1	1	1	0	0	1	0	1	0	2	1	2	0
Lesser black-backed gull	3	2	0	1	2	1	0	1	0	3	1	0	2	2	1	0	1	0
Herring gull	1	2	0	0	2	1	0	0	0	2	2	0	1	2	2	1	0	0
Glaucous gull																		
Great black-backed gull	1	2	0	0	2	1	0	0	0	2	2	0	1	2	2	1	0	0
Black-legged kittiwake	2	0	0	1	0	0	0	0	0	2	0	0	1	1	1	0	0	0
Ivory gull																		
Common tern	2	0	0	1	0	1	0	1	0	2	0	0	2	1	1	1	2	0
Arctic tern	2	0	0	1	0	1	0	1	0	2	0	0	2	1	1	1	2	0
Common guillemot	3	0	2	2	0	1	0	0	0	3	0	2	3	1	2	0	0	0
Brünnich´s guillemot	2	1	1	3	0	1	0	0	0	0	1	1	3	1	1	0	0	0
Razorbill	2	0	2	2	0	0	0	0	0	2	0	2	3	1	2	0	0	0
Black guillemot	0	0	2	2	2	1	0	3	0	0	1	2	3	2	2	1	3	0
Little auk																		
Atlantic puffin	3	1	1	2	0	1	0	1	0	3	1	2	3	1	1	0	1	0

Fisheries

In their search for food, many arctic seabirds face direct or indirect competition with commercial fisheries. This conflict comes in addition to the associated problem of being caught in various types of fishing gear used in these and other fisheries, which will be discussed as a separate issue below.

Over the past few decades, man's depletion of forage fish stocks has been identified as a serious threat to several seabird populations in the Barents Sea Region. Most attention has been drawn to problems arising from the collapses of stocks of Norwegian spring-spawning herring *Clupea harengus* in the late-1960s and Barents Sea capelin *Mallotus villosus* in the mid-1980s. There is little doubt that overfishing played an important role, especially in the case of the herring, although these collapses may also, to some extent, have been induced by natural variation in ocean climate and exacerbated by accompanying shifts in the trophic interactions between herring, capelin and cod *Gadus morhua* in the Barents Sea (eg. Gjøsæter 1998). However, this important predator-prey relationship was (and still is) also directly affected by fisheries regulations, making it extremely difficult to separate the human and natural effects in quantitative terms.

After the collapse of the herring stock, the lack of first-year (0-group) herring drifting northwards along the Norwegian coast in summer led to a long-term breeding failure and subsequent population decline of Atlantic puffins *Fratercula arctica* in Røst (and probably a number of other colonies in that sub-region) (e.g. Anker-Nilssen 1992, Anker-Nilssen & Brøseth 1998). Moreover, the capelin crisis brought about an excessive winter mortality of adult common guillemots *Uria aalge* in the Barents Sea (e.g. Vader *et al.* 1990), which more than halved the population of this species throughout the region between two consecutive breeding seasons (Vader *et al.* 1990, Anker-Nilssen & Barrett 1991, Isaksen & Bakken 1995b, Lorentsen 1998). These examples also clearly demonstrate the different responses by specialised seabirds to changes in stocks of their preferred prey species (Anker-Nilssen *et al.* 1997).

0-group herring are also an important prey during the breeding season for several other seabirds in the south-western parts of the Barents Sea Region. It is therefore possible that the herring crash also contributed to the population declines of black-legged kittiwakes *Rissa tridactyla*, lesser black-backed gulls *Larus fuscus* and common guillemots in colonies to the west of Nordkapp (Tschanz & Barth 1978, Barrett & Vader 1984, Myrberget 1985, Bakken 1989, Strann & Vader 1992, Anker-Nilssen *et al.* 1997).

There is also anecdotal evidence that such prey were far more common prior to the herring collapse. If this is true, it could also explain why complete breeding failures of Atlantic puffins are not known to have occurred in Røst prior to the late-1960s, when Atlantic puffin fledglings were being harvested annually for human consumption. The life history of herring makes it unlikely that a constantly high breeding success of Atlantic puffins was dependent upon herring every year, and higher quality sandeels *Ammodytes* spp. may very well have been the most important alternative food source (Anker-Nilssen &

Table 4.2. Indices of current and potential (in a 2-5 year perspective) threats to marine birds breeding on the Murman coast. Categories of importance are: 0 (green) = none or insignificant, 1 (yellow) = slight, 2 (orange) = moderate, 3 (red) = great. Threat categories are: FI = fisheries, HA = harvesting, BY = by-catch, OI = oil, PO = other pollutants, DI = disturbance, AR = area encroachments, CO = conflicting species and OT = other.

Species	Threat category																	
	Current									Potential								
	FI	HA	BY	OI	PO	DI	AR	CO	OT	FI	HA	BY	OI	PO	DI	AR	CO	OT
Great northern diver																		
Northern fulmar																		
European storm-petrel																		
Leach´s storm-petrel																		
Northern gannet	1	0	0	1	0	2	0	0	0	1	0	1	1	1	2	0	1	0
Great cormorant	3	0	2	2	0	1	0	0	0	3	0	2	3	0	1	0	0	0
European shag	3	1	2	2	0	0	0	0	0	3	1	2	3	0	0	0	0	0
Greylag goose	0	1	0	2	0	1	0	1	0	0	1	0	2	1	1	1	1	0
Barnacle goose																		
Brent goose																		
Common eider	0	1	0	1	2	1	1	1	0	0	2	0	3	2	2	2	2	0
King eider																		
Steller's eider																		
Long-tailed duck	0	0	0	2	1	1	1	0	0	0	1	0	3	2	2	2	1	0
Black scoter	0	0	0	1	0	0	0	0	0	0	0	0	2	1	1	1	0	0
Velvet scoter	0	0	0	1	0	0	0	0	0	0	0	0	3	1	1	1	0	0
Red-breasted merganser	0	0	0	1	0	0	0	0	0	0	0	0	2	1	1	0	0	0
Eurasian oystercatcher	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Purple sandpiper	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Ruddy turnstone	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Red-necked phalarope	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Grey phalarope																		
Arctic skua	1	0	0	0	0	0	0	0	0	2	0	0	0	2	1	1	1	0
Great skua	0	0	0	0	2	0	0	1	0	1	0	0	0	2	0	0	1	0
Sabine´s gull																		
Black-headed gull	0	0	0	1	1	1	1	0	0	0	1	0	3	3	2	2	1	0
Mew gull	0	1	0	0	0	1	1	1	0	0	1	0	1	0	2	1	2	0
Lesser black-backed gull																		
Herring gull	1	2	0	0	2	1	0	0	0	2	2	0	1	2	2	1	0	0
Glaucous gull																		
Great black-backed gull	1	2	0	0	2	1	0	0	0	2	2	0	1	2	2	1	0	0
Black-legged kittiwake	2	0	0	1	0	0	0	0	0	2	0	0	2	1	1	0	0	0
Ivory gull																		
Common tern																		
Arctic tern	1	0	0	0	0	0	0	1	0	2	0	0	1	1	1	1	1	0
Common guillemot	3	2	3	2	0	1	0	0	0	3	3	3	3	1	2	1	0	1
Brünnich´s guillemot	2	2	1	3	0	1	0	0	0	2	3	1	3	1	2	0	0	0
Razorbill	2	0	2	2	0	1	0	1	0	2	0	2	3	1	2	0	1	0
Black guillemot	0	0	2	2	2	1	0	3	0	0	1	2	3	2	2	1	3	0
Little auk																		
Atlantic puffin	2	0	1	2	1	0	0	2	0	3	0	1	3	1	0	0	2	0

Brøseth 1998). From a seabird perspective, this is but one of many reasons for an increasing concern about the lack of good data greatly needed to assess the population development of sandeels in the Norwegian and Barents Seas.

The Barents Sea capelin is an important prey for both cod and immature herring. It seems that, under normal conditions, there is a reasonably large population of immature herring in these waters, but when herring numbers are low, capelin are able to increase rapidly in number (e.g. Hamre 1994). The breeding performance, food choice and population trends of black-legged kittiwakes, Atlantic puffins and common guillemots on Hornøy suggest that the shorter-term capelin periods are more beneficial for fish-eating seabirds breeding to the east of Nordkapp than the longer-lasting herring periods (Krasnov & Barrett 1995, Barrett & Krasnov 1996, Anker-Nilssen *et al.* 1997, Erikstad, Barrett *et al.* 1998). This could be because capelin is a more easily accessible prey than 1-group herring, as was indicated on Hornøy by the fact that only the surface-feeding black-legged kittiwakes experienced reduced breeding success in years when herring, to a large extent, replaced capelin as an important food item (Barrett & Krasnov 1996, Barrett, Aasheim *et al.* 1997).

In this context, it is also important to bear in mind that 0-group herring are much easier prey for black-legged kittiwakes than 1-group herring. However, 0-group herring do not reach the

Table 4.3. Indices of current and potential threats (in a 2-5 year perspective) to marine birds breeding in the *White Sea*. Categories of importance are: 0 (green) = none or insignificant, 1 (yellow) = slight, 2 (orange) = moderate, 3 (red) = great. Threat categories are: FI = fisheries, HA = harvesting, BY = by-catch, OI = oil, PO = other pollutants, DI = disturbance, AR = area encroachments, CO = conflicting species and OT = other.

Species	Threat category																	
	Current									Potential								
	FI	HA	BY	OI	PO	DI	AR	CO	OT	FI	HA	BY	OI	PO	DI	AR	CO	OT
Great northern diver																		
Northern fulmar																		
European storm-petrel																		
Leach´s storm-petrel																		
Northern gannet																		
Great cormorant	2	0	2	1	0	1	0	0	0	2	0	2	1	2	0	0	0	0
European shag																		
Greylag goose																		
Barnacle goose																		
Brent goose																		
Common eider	0	2	0	2	1	2	2	2	0	1	3	1	3	2	3	2	2	0
King eider	0	2	2	3	0	2	2	1	0	0	2	2	3	2	2	3	1	0
Steller's eider	0	0	2	2	0	1	1	1	0	0	0	2	3	0	2	1	0	0
Long-tailed duck	0	0	0	1	1	1	1	1	0	0	1	0	3	2	2	2	2	0
Black scoter	0	0	0	1	0	1	1	0	0	0	0	0	3	1	2	1	0	0
Velvet scoter	0	0	0	1	0	1	1	0	0	0	0	0	3	1	2	1	0	0
Red-breasted merganser	1	0	1	1	0	1	0	0	0	1	0	1	2	1	1	1	0	0
Eurasian oystercatcher	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Purple sandpiper	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Ruddy turnstone	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Red-necked phalarope	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Grey phalarope																		
Arctic skua	1	0	0	0	0	0	0	0	0	2	0	0	0	2	1	1	1	0
Great skua																		
Sabine´s gull																		
Black-headed gull																		
Mew gull	0	0	0	0	0	1	0	2	0	1	2	0	1	2	2	2	2	0
Lesser black-backed gull	3	2	0	0	2	1	0	1	0	3	2	0	0	2	1	0	1	0
Herring gull	1	2	0	0	2	1	0	0	0	2	2	0	1	2	2	1	0	0
Glaucous gull																		
Great black-backed gull	1	2	0	0	2	1	0	0	0	2	2	0	1	2	2	1	0	0
Black-legged kittiwake																		
Ivory gull																		
Common tern	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	0	1	0
Arctic tern	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	0	1	0
Common guillemot																		
Brünnich´s guillemot																		
Razorbill	1	0	2	2	0	0	0	0	0	1	0	2	3	1	2	0	0	0
Black guillemot	0	0	2	2	2	1	0	3	0	0	1	2	3	2	2	1	3	0
Little auk																		
Atlantic puffin																		

Barents Sea in time to be an important prey for seabirds breeding to the east of Nordkapp. This explains why the breeding success of black-legged kittiwakes in Røst was positively correlated to the abundance of 0-group herring, while on Hornøy, it was negatively correlated to the proportion of 1-group herring in the chick diet (Anker-Nilssen *et al.* 1997). For common guillemots, 1-group herring should be relatively easy to catch and their presence in the Barents Sea seems to have ensured the continued breeding success and population increase of the species in eastern Finnmark and along the Kola Peninsula through periods when capelin numbers again crashed (in 1993 and 1996)(Barrett & Krasnov 1996, Barrett & Golovkin, this volume).

It is not known to what extent collapses of polar cod *Boreogadus saida* stocks in the early 1970s and early 1980s were induced by over-fishing. However, this species is an important prey for Brünnich's guillemots wintering along the ice edge and in the south-eastern Barents Sea (e.g. Erikstad 1990), and its collapse may have contributed to the reduction in the numbers of breeding Brünnich's guillemots on Kharlov in 1978-1980 (Krasnov & Barrett 1995). Unfortunately, no parallel monitoring data exist from Novaya Zemlya for the same period. Although Brünnich's guillemots are less specialised in their food choice than, for instance, common guillemots, the polar cod is an important element of the Barents Sea food web and a common prey for many seabirds in the high-arctic parts of this region (e.g. Lønne & Gabrielsen 1992, Barrett 1996b, Mehlum *et al.* 1996, Barrett, Aasheim *et al.* 1997). Along with an increasing interest among fishery biologists to study how the polar cod fishery affects the stock, the significance of polar cod as a food source for high-arctic seabirds in this region also deserves more attention.

The competitive effects of other fisheries on seabirds in the Barents Sea Region are much more difficult to evaluate. The authors of this report have considered the problem to be most relevant for populations breeding along the Norwegian and Murman coasts, but see a clear potential for increasing conflicts in all sub-regions (Fig. 4.1). However, except for the cases already discussed, none of the authors specifically addresses which of the fisheries are of greatest concern in this context. Competition with fisheries is otherwise ranked as the third most important current threat for seabirds breeding in the Barents Sea Region (Fig. 4.1).

For a more general discussion of problems related to seabird populations and commercial fisheries in the Barents Sea, see, for instance, Mendenhall & Anker-Nilssen (1996) and Anker-Nilssen *et al.* (1997)

Harvesting

Harvesting includes hunting, trapping, egging and the collection of down. The harvest of marine birds has a long tradition in the Barents Sea Region, but was much more widespread and important in former times. Nowadays, its extent is reduced and it is strictly regulated in both Norway and Russia.

Egging, down-collection and the catching of adults and chicks were previously important, both as items of trade and for food, for the rural people living along the coast of North Norway (Wold 1981). The local people in Røst and Værøy used a special breed of dogs named puffin dog [lundehund] trained specially to catch Atlantic puffin chicks. Using different techniques, primarily ground and aerial nets, but also landing nets, hooks, noose poles and firearms, it was also common to harvest adult Atlantic puffins, common guillemots, razorbills *Alca torda* and nestling European shags *Phalacrocorax aristotelis* in and near the breeding colonies. The harvesting of eggs of

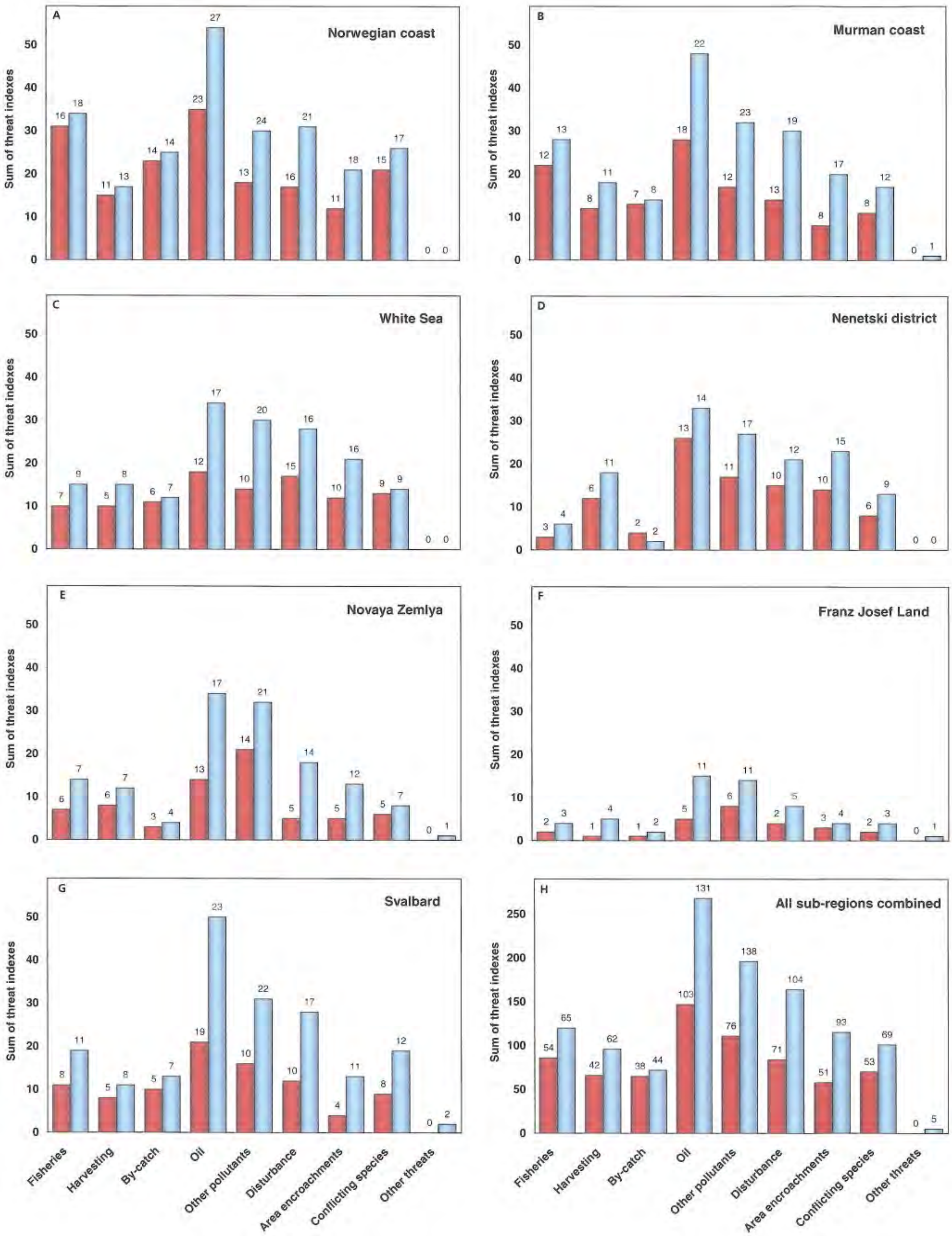


Figure 4.1. Sums of the species-specific indices of current (red columns) and potential (blue columns, 2-5 year perspective) threats to marine birds breeding in the different sub-regions and in the whole Barents Sea Region (cf. Tabs. 4.1-4.7). The number of regional populations contributing to each sum is indicated.

common eiders *Somateria mollissima*, auks, black-legged kittiwakes, other gulls and terns was also important to the coastal people, as was the collecting of common eider down. In Nordland county, land-owners built shelters and nest boxes for the common eiders, protected the breeding birds from predators, and collected eggs and down from the nests. Around 1900, about one tonne of cleaned common eider down was sold in Nordland. Further north, in the counties of Troms and Finnmark, about 250 kg and 200 kg were sold, respectively (Wold 1981). Herring gull *Larus argentatus* and great black-backed gull *Larus marinus* eggs have been harvested from the island of Reinøya in Finnmark for many centuries. In 1971, there were estimated to be some 40 000 gull nests and about 70 000 eggs were collected (Munck 1975). Despite the large numbers of eggs collected every year, no decline in the populations was registered (Munck 1975).

Seabirds have also been harvested along the Murman coast, but the hunting pressure there has been relatively low. In Karelia and the Nenetski district, some 150 000 marine birds were taken annually (Fedosov 1925, Bitirkh 1926). Moulting king eiders *Somateria spectabilis* were caught on Kolguev Island, and 12 000 birds are known to have been taken in three days (Fedosov 1925, Bitirkh 1926). In 1940-1970, the annual bag comprised no more than some hundreds of birds (mainly common guillemots and sea ducks, including Steller's eider *Polysticta stelleri* and common eiders). Although the common eider was protected by law in this period, it was still hunted by local people. Even though egging was illegal, some thousands of seabird eggs were probably taken annually, mainly from herring gulls but also from common guillemots, black-legged kittiwakes and common eiders. No large-scale harvesting of marine birds has taken place around the White Sea, but a current lack of control has led to a recent increase in illegal harvesting in the nature reserves.

The harvesting of adult Brünnich's guillemots and their eggs became commercially important on Novaya Zemlya in the 1930s, and during the Second World War (1941-1945) birds from seabird colonies were an important source of food for people in the provinces of Murmansk and Archangelsk (Uspenski 1956). In these periods, several hundred thousand eggs and adult birds were harvested in Russian seabird colonies, and their populations were much reduced (Nettleship & Evans 1985, Krasnov & Barrett 1995).

In Svalbard, common eiders have been harvested since the 17th century, but reliable data exist from only the mid-19th century onwards (Norderhaug 1982). Both eggs and down were collected on a large scale and the population was much reduced before the species was protected by law in 1963. Hunters also used to visit seabird colonies where they collected eggs and adult birds (Rossnes 1981). And estimated 50 000-60 000 eggs were collected annually on Bjørnøya in 1952-1958, mainly from common and Brünnich's guillemots. This practice was prohibited in 1971 (Rossnes 1981).

In general, the existing harvesting regulations described below apply only to the species dealt with in this report. The hunting regulations in the Barents Sea Region are shown in tables 4.8-4.10. Species not mentioned in the tables are protected throughout the year.

In Norway, landowners are allowed to collect eggs until 14 June from herring gulls, great black-backed gulls, mew gulls *Larus canus* and black-legged kittiwakes. Common eider eggs may only be collected before 1 June in areas where the tradition of providing nests for common eiders is maintained. In Svalbard, egging is, in general, prohibited, but the Governor may issue special permits. Egging is totally prohibited in Russia.

The harvest of common eider down is allowed on the Norwegian coast in summer after the chicks have left the nest. In Svalbard, down may be collected outside protected areas from 16 August to 31 October. In Russia, private individuals may collect common eider down outside protected areas (zapovedniks and zakazniks) after the females and chicks have left the breeding areas.

Because of the relatively strict regulations, harvesting is no longer an important threat to marine birds in the Barents Sea Region. Increased hunting pressure on greylag geese *Anser anser* in Nordland and Finnmark may, however, lead to changes in the timing of the autumn migration (Follestad 1994b). Barnacle geese *Branta leucopsis* are hunted in their wintering areas in Scotland, but this probably has an insignificant effect on the population (this volume). Harvesting of common eiders is recognised as quite a serious threat for the population in the Russian areas. Along the Norwegian coast, eggs of great black-backed and herring gulls are harvested in large numbers early in the egg-laying period, but the birds are usually left undisturbed to incubate later in the season. Egging and hunting of common guillemots almost certainly contributed to the decline of the population on the Norwegian coast.

Poaching still occurs in some colonies and may be a serious threat to the possible recovery of local populations. Many Brünnich's guillemots breeding in the Barents Sea Region migrate to waters off western Greenland and Canada in winter. Hence, intensive hunting there also affects the Barents Sea population, but it is uncertain what effect this has on the population. Little auks *Alle alle* are also hunted in Greenlandic waters. Although at least some of the little auks breeding in the Barents Sea migrate to this area, this has not been recognised as a serious threat to the population.

The authors judge the problem of harvesting today to be relevant for all populations breeding in the subregions, other than Franz Josef Land, and that the problem may increase in the future (Fig. 4.1). Harvesting is currently ranked as the sixth most important threat for seabirds breeding in the Barents Sea Region (Fig. 4.1).

By-catch

The by-catch threat involves incidental bird mortality in different kinds of fishing gear, mostly gill-nets and longlines. Only a few publications report incidental takes of marine birds in fishing gear in the Barents Sea Region (Holgersen 1961, Myrberget 1961, 1980, Brun 1979, Røv 1982, Vader & Barrett 1982, Løkkeborg 1990, Strann *et al.* 1991, Frantzen & Henriksen 1992, BirdLife International 1999). Most documentation of extensive by-catches concerns gill-net fisheries, especially for cod in winter, lumpsucker *Cyclopterus lumpus*, flatfish Pleuronectidae, blue whiting *Micromesistius poutassou* and herring in shallow-water nets, and Atlantic salmon *Salmo salar* in beach seines and drift nets (Follestad & Strann 1991). Pots and creels are known to take a lot of great cormorants *Phalacrocorax carbo*, while longlines for salmon took mainly northern fulmars *Fulmarus glacialis*, northern gannets

Morus bassanus, black-legged kittiwakes, common guillemots and Atlantic puffins (Brun 1979, Follestad & Strann 1991). Longlines for cod and haddock *Melanogrammus aeglefinus* took mainly fulmars (Birdlife International 1999).

Strann *et al.* (1991) reported an extensive incidental take of guillemots in cod nets off Troms in spring 1985. Based on the number of birds caught by two boats, it was estimated that at least 200 000 guillemots were killed. The main food for the cod was capelin, which migrate to the coast in spring to spawn. However, since the precise spawning area differs from year to year, such incidents do not happen regularly, but depend on the location and timing of capelin spawning, the population status of cod, and whether or not the area is accessible to fishing boats. Since most of those caught in 1985 were immature birds originating from several European colonies, the effect on the local guillemot population may not have been as severe as the high number indicates.

Another fishery which previously caused a high seabird mortality was the near-shore salmon drift-net fishery in June-August (Strann *et al.* 1991). This fishery was restricted to the Norwegian coast west of Nordkapp and mostly affected common guillemots from local colonies. Daily maxima of 3000-4000 birds were reported entangled in these drift nets (Strann *et al.* 1991). Pound nets for salmon are also known to have caused major by-catch incidents. During one season, a fisherman caught as many as 10 000 Atlantic puffins and 1000 other auks (common and Brünnich's guillemots, and razorbills) in five pound nets set close to the seabird colony at Gjesværstappan (Strann *et al.* 1991). In order to protect the salmon stocks, the Norwegian drift-net fishery for salmon was banned in 1989 and is therefore no longer a threat to the seabird populations.

The common guillemot population on the Norwegian coast has declined severily (e.g. Vader *et al.* 1990, Anker-Nilssen & Barrett 1991). West of Nordkapp, breeding numbers have decreased by more than 95% since the colonies were first counted in the 1960s (Brun 1971d, Barrett & Vader 1984, Bakken 1989, Anker-Nilssen *et al.* 1996, Lorentsen 1998). Although the capelin crisis in the mid-1980s had a huge impact on the population, the long-term, steady decrease of about 5% annually prior to this event may, to a large extent, be explained by drowning in salmon nets (Brun 1979, Strann *et al.* 1991).

Table 4.4. Indices of current and potential (in a 2-5 year perspective) threats to marine birds breeding in the *Nenetski district*. Categories of importance are: 0 (green) = none or insignificant, 1 (yellow) = slight, 2 (orange) = moderate, 3 (red) = great. Threat categories are: FI = fisheries, HA = harvesting, BY = by-catch, OI = oil, PO = other pollutants, DI = disturbance, AR = area encroachments, CO = conflicting species and OT = other.

Species	Threat category																	
	Current									Potential								
	FI	HA	BY	OI	PO	DI	AR	CO	OT	FI	HA	BY	OI	PO	DI	AR	CO	OT
Great northern diver																		
Northern fulmar																		
European storm-petrel																		
Leach´s storm-petrel																		
Northern gannet																		
Great cormorant																		
European shag																		
Greylag goose																		
Barnacle goose	0	2	0	1	0	0	0	0	0	0	2	0	2	0	1	1	2	0
Brent goose																		
Common eider	0	2	0	2	1	1	1	1	0	0	3	0	3	2	3	3	1	0
King eider	0	2	2	3	0	2	2	1	0	0	2	2	3	2	2	3	1	0
Steller's eider																		
Long-tailed duck	0	2	0	3	1	2	2	1	0	0	2	0	3	2	2	2	2	0
Black scoter	0	0	0	3	0	2	2	0	0	0	1	0	3	1	2	2	0	0
Velvet scoter	0	0	0	3	0	2	2	0	0	0	1	0	3	1	2	2	0	0
Red-breasted merganser	0	0	0	3	0	2	1	0	0	0	0	0	3	1	2	2	0	0
Eurasian oystercatcher	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Purple sandpiper	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Ruddy turnstone	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Red-necked phalarope	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Grey phalarope																		
Arctic skua	1	0	0	0	0	0	0	0	0	2	0	0	0	2	1	1	1	0
Great skua	0	0	0	0	2	0	0	1	0	1	0	0	0	2	0	0	1	0
Sabine´s gull																		
Black-headed gull																		
Mew gull																		
Lesser black-backed gull	1	2	0	2	2	1	0	1	0	1	2	0	2	2	1	0	1	0
Herring gull																		
Glaucous gull	0	0	0	1	3	0	0	0	0	0	1	0	3	3	0	0	0	0
Great black-backed gull	1	2	0	0	2	1	0	0	0	2	2	0	1	2	2	1	0	0
Black-legged kittiwake																		
Ivory gull																		
Common tern																		
Arctic tern	0	0	0	1	0	1	0	0	0	0	1	0	2	1	1	1	1	0
Common guillemot																		
Brünnich´s guillemot																		
Razorbill																		
Black guillemot	0	0	2	2	2	1	0	3	0	0	1	0	3	2	2	1	3	0
Little auk																		
Atlantic puffin																		

Steller's eiders are vulnerable to drowning in fishing gear, especially nets set for lumpsuckers in spring (Frantzen & Henriksen 1992), but the number of birds killed is unknown. A recent study on habitat use (Bustnes & Systad unpublished) indicates that the main feeding areas are close to shore where few fishing nets are set.

A study of the by-catch in longlines in North Norway conducted by Birdlife International and the Norwegian Ornithological Societey in 1997 and 1998, showed that mainly fulmars (>99%) were hooked (Birdlife International 1999). The total Norwegian longlining fleet (including the inshore fleet of smaller vessels) is conservatively estimated to take ca. 20 000 northern fulmars annually, but the actual total may easily be 50 000-100 000. The estimated annual mortality is not thought to be status-threatening, given that the north-east Atlantic breeding population is ca. 2-4 million pairs (Birdlife International 1999).

Based on recoveries of birds ringed in Norway, Follestad & Runde (1995) have demonstrated that, up to now, incidental catches in fishing gear may have been an important mortality factor for several species. It was the most frequently reported cause of death for great cormorants (81%), European

Table 4.5. Indices of current and potential (in a 2-5 year perspective) threats to marine birds breeding at Novaya Zemlya. Categories of importance are: 0 (green) = none or insignificant, 1 (yellow) = slight, 2 (orange) = moderate, 3 (red) = great. Threat categories are: FI = fisheries, HA = harvesting, BY = by-catch, OI = oil, PO = other pollutants, DI = disturbance, AR = area encroachments, CO = conflicting species and OT = other.

Species	Threat category																	
	Current									Potential								
	FI	HA	BY	OI	PO	DI	AR	CO	OT	FI	HA	BY	OI	PO	DI	AR	CO	OT
Great northern diver																		
Northern fulmar	0	0	1	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0
European storm-petrel																		
Leach´s storm-petrel																		
Northern gannet																		
Great cormorant																		
European shag																		
Greylag goose																		
Barnacle goose	0	2	0	1	0	0	0	0	0	0	2	0	2	0	1	1	2	0
Brent goose																		
Common eider	0	1	0	1	2	1	1	1	0	0	2	0	2	2	2	2	1	0
King eider	0	1	0	1	1	1	1	1	0	0	2	0	3	3	2	1	1	0
Steller's eider																		
Long-tailed duck	0	0	0	1	1	0	0	1	0	0	0	0	2	2	1	1	1	0
Black scoter	0	0	0	1	1	0	0	0	0	0	0	0	1	1	1	1	0	0
Velvet scoter																		
Red-breasted merganser	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0
Eurasian oystercatcher																		
Purple sandpiper	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Ruddy turnstone	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Red-necked phalarope	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Grey phalarope																		
Arctic skua	1	0	0	0	0	0	0	0	0	2	0	0	0	2	1	1	1	0
Great skua	0	0	0	0	2	0	0	1	0	1	0	0	0	2	0	0	1	0
Sabine´s gull																		
Black-headed gull																		
Mew gull																		
Lesser black-backed gull																		
Herring gull																		
Glaucous gull	0	0	0	1	3	0	0	0	0	0	0	0	3	3	0	0	0	0
Great black-backed gull	1	2	0	0	2	1	0	0	0	2	2	0	1	2	2	1	0	0
Black-legged kittiwake	1	0	0	1	0	0	0	0	0	2	0	0	2	1	1	0	0	0
Ivory gull	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Common tern																		
Arctic tern	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Common guillemot	1	1	1	1	0	1	0	0	0	2	2	1	3	1	2	1	0	0
Brünnich´s guillemot	1	1	0	1	2	1	0	0	0	2	1	0	3	2	1	0	0	0
Razorbill																		
Black guillemot	0	0	0	1	2	0	0	0	0	0	1	1	3	2	1	0	0	0
Little auk	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	1
Atlantic puffin	2	0	1	2	1	0	0	2	0	3	0	1	3	1	0	0	1	0

shags (55%), common eiders (42%), common guillemots (60%) and black guillemots (49%). It is difficult to evaluate the effects on the populations using recovery data with an inherent bias. However, for some species with declining populations, the data suggest that drowning in fishing gear is one of the most important mortality factors. Nevertheless, in the Barents Sea Region, only the common guillemot population is suspected to have suffered a major decrease as a result of incidental mortality in fishing gear.

Too little is known about the by-catch of seabirds in the Barents Sea Region. There is clearly a need for more effort to improve the data in order to estimate the significance of the by-catch problem for the populations and propose measures to reduce this threat. For more information about status and recommendations, see Bakken & Falk (1998) who present an up-to-date status on this issue for all the Arctic countries, and Birdlife International (1999).

The authors believe that by-catch is most relevant for populations breeding on the Norwegian coast (Fig. 4.1). This threat is least relevant in Nenetski district, Novaya Zemlya and Franz Josef Land. By-catch is currently ranked as the seventh most important threat for seabirds breeding in the Barents Sea Region (Fig. 4.1).

Oil

Oil includes all types of coastal and offshore oil spills originating from blowouts and spills from oil platforms, ships and land-based terminals. The effects of oil pollution on seabirds have been reviewed by a number of authors (e.g. Holmes & Cronshaw 1977, Folkestad 1983, Clark 1984, Leighton *et al.* 1985, Piatt *et al.* 1991, Leighton 1993, Jenssen 1994, Nisbet 1994). See also Isaksen *et al.* (1998) for a summary on the effects of oil pollution on seabirds.

The south-western part of the Barents Sea (i.e. the Norwegian sector south of 74°30'N) was formally opened for exploratory drilling in 1989, with some restrictions in space and time to protect biological resources (The Royal Ministry of Petroleum and Energy 1989). The underlying assessment of impacts on seabirds concluded that, in whatever area or season the activity is conducted, many seabird populations of international conservation value will be in danger of being seriously affected in the event of an oil spill (Anker-Nilssen, Bakken *et al.* 1988). Later, a status report on the current knowledge about vulnerable wildlife and the potential effects of oil exploration was prepared for the north-western part of the Barents Sea (i.e. the Norwegian sector north of 74°N) (Aaserød & Loeng 1997), but this area has not been opened for exploratory drilling. The potential effects on marine birds and mammals are described by Isaksen *et al.* (1998).

Several vulnerability assessments in relation to oil have been conducted for marine birds in the Barents Sea Region (Anker-Nilssen, Bakken *et al.* 1988, Fjeld & Bakken 1993, Strann *et al.* 1993, Anker-Nilssen *et al.* 1994) based on a semi-quantitative method developed by Anker-Nilssen (1987). The general conclusion is that vulnerability in relation to oil varies through the year, but in general, auks and ducks are among the most vulnerable groups risking long-term impacts on populations.

To date, there is no oil or gas production in the Norwegian Sea north of the Arctic Circle, or in the Norwegian part of the Barents Sea. Since 1980 a total of 35 exploration licences have been awarded in the Barents Sea , and a number of small and medium-sized gas structures have been discovered (Gaarde 1998). The production of gas and oil from the Snøhvit field in the south-western part of the Barents Sea is, however, planned to start in the next few years.

The Russian parts of the Barents Sea Region have a large potential for offshore oil exploitation. The oil reserves in the south-eastern Barents Sea and the Pechora Sea are estimated to be 1273 million tonnes and 1925 million tonnes, respectively (Engesæth & Müller 1997). For several years, the Northern Gate project, which consists of Russian and other foreign companies, has been investigating different options for oil and gas transport from offshore exploitation in the south-eastern part of the Barents Sea (EPPR 1997). Four options have been put forward for establishing an oil terminal in the transfer of oil to large tankers, but no final decision has been made. It will apparently be cheaper to build an oil terminal than to transport the oil from the area in pipelines (EPPR 1997). The terminal is also expected to receive oil from western Siberia, mainly from the Yamal Peninsula and the Ob estuary brought by ship through the Kara Gate or round the north tip of Novaya Zemlya (EPPR 1997). The shipping route from the oil terminal to Europe will go along the Norwegian coast.

Today, oil is a current threat primarily to marine birds in the southern part of the Barents Sea Region. Populations in Svalbard and Franz Josef Land are mainly at risk when they migrate southwards to their wintering areas, and the populations threatened on Novaya Zemlya are mainly those breeding in the south-eastern part. However, due to great potential for increased exploration and subsequent production and transportation of oil from the large oil fields in the south-eastern Barents Sea, it is likely that oil will become a much more serious threat to seabirds in the Barents Sea Region in the near future.

In March 1979, two or three small ship spills covering just a few hundred or thousand square metres killed an estimated 10 000–20 000 seabirds (mostly Brünnich's guillemots) off the coast of Finnmark, North Norway (Barrett 1979a).

Habitat deterioration due to oil is believed to have negatively affected the grey phalarope *Phalaropus fulicarius* population in Svalbard. An oil spill in Ny-Ålesund in 1985 flooded the streams, ponds and wet tundra, and the area became less attractive to the

Table 4.6. Indices of current and potential (in a 2-5 year perspective) threats to marine birds breeding in Franz Josef Land. Categories of importance are: 0 (green) = none or insignificant, 1 (yellow) = slight, 2 (orange) = moderate, 3 (red) = great. Threat categories are: FI = fisheries, HA = harvesting, BY = by-catch, OI = oil, PO = other pollutants, DI = disturbance, AR = area encroachments, CO = conflicting species and OT = other.

Species	Threat category																	
	Current									Potential								
	FI	HA	BY	OI	PO	DI	AR	CO	OT	FI	HA	BY	OI	PO	DI	AR	CO	OT
Great northern diver																		
Northern fulmar	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0
European storm-petrel																		
Leach´s storm-petrel																		
Northern gannet																		
Great cormorant																		
European shag																		
Greylag goose																		
Barnacle goose																		
Brent goose	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0
Common eider	0	1	0	1	1	1	0	1	0	0	2	0	3	1	2	1	2	0
King eider																		
Steller's eider																		
Long-tailed duck																		
Black scoter																		
Velvet scoter																		
Red-breasted merganser																		
Eurasian oystercatcher																		
Purple sandpiper	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Ruddy turnstone																		
Red-necked phalarope	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Grey phalarope																		
Arctic skua	1	0	0	0	0	0	0	0	0	2	0	0	0	2	1	1	1	0
Great skua																		
Sabine´s gull																		
Black-headed gull																		
Mew gull																		
Lesser black-backed gull																		
Herring gull																		
Glaucous gull	0	0	0	0	3	0	0	0	0	0	0	0	1	3	0	0	0	0
Great black-backed gull																		
Black-legged kittiwake	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	0	0
Ivory gull	0	0	0	0	0	3	1	0	0	0	1	0	1	1	3	0	1	0
Common tern																		
Arctic tern	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0
Common guillemot																		
Brünnich´s guillemot	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0
Razorbill																		
Black guillemot	0	0	0	1	1	0	0	0	0	0	1	1	3	1	1	0	0	0
Little auk	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1
Atlantic puffin																		

phalaropes (this volume, see also "Conflicting species") below.

The authors of this report have assessed the current threat to be most relevant for populations breeding on the Norwegian coast, the Murman coast and in the Nenetski district, and the potential threat is much higher for all the sub-regions (Fig. 4.1). Oil is the most important current and potential threat for seabirds breeding in the Barents Sea Region (Fig. 4.1).

A lack of detailed impact assessments, background data and monitoring programmes make it difficult to predict and evaluate the effects of potential oil spills in the region. The risk of spills may also be higher in the Barents Sea Region than in the North Sea and the southern Norwegian Sea due to greater technical, economic and climatic challenges.

Other pollutants

This threat includes contamination from heavy metals, radionuclides and persistent organic pollutants compounds such as polychlorinated biphenyls (PCB), dioxins (PCDD), furans (PCDF), hexachlorobenzene (HCB), DDT and any derivatives, toxaphene, chlordane, hexachlorocyclohexane and its isomers (HCH), dieldrin, mirex and tributyltin (TBT). It does not include oil pollution, which is discussed above.

Nearly all of the organochlorines and heavy metals found in the Arctic

Table 4.7. Indices of current and potential (in a 2-5 year perspective) threats to marine birds breeding in *Svalbard*. Categories of importance are: 0 (green) = none or insignificant, 1 (yellow) = slight, 2 (orange) = moderate, 3 (red) = great. Threat categories are: FI = fisheries, HA = harvesting, BY = by-catch, OI = oil, PO = other pollutants, DI = disturbance, AR = area encroachments, CO = conflicting species and OT = other.

Species	Threat category																	
	Current									Potential								
	FI	HA	BY	OI	PO	DI	AR	CO	OT	FI	HA	BY	OI	PO	DI	AR	CO	OT
Great northern diver	0	0	2	1	0	3	0	1	0	1	0	2	2	0	3	2	2	0
Northern fulmar	0	0	2	1	1	0	0	0	0	0	0	2	2	1	0	0	0	0
European storm-petrel																		
Leach´s storm-petrel																		
Northern gannet																		
Great cormorant																		
European shag																		
Greylag goose																		
Barnacle goose	0	0	0	0	0	0	0	1	0	0	0	0	3	0	1	0	2	0
Brent goose	0	0	0	1	0	1	0	1	0	0	0	0	3	0	3	0	2	0
Common eider	0	1	0	1	0	1	0	1	0	0	1	0	3	2	3	1	2	0
King eider	0	0	0	1	0	1	0	1	0	0	1	0	2	1	2	1	2	0
Steller's eider																		
Long-tailed duck	0	0	0	1	0	1	0	1	0	0	0	0	2	1	2	1	2	0
Black scoter	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Velvet scoter																		
Red-breasted merganser																		
Eurasian oystercatcher																		
Purple sandpiper	0	0	0	1	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Ruddy turnstone	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Red-necked phalarope	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
Grey phalarope	0	0	0	1	2	1	1	1	0	0	0	0	2	2	2	2	2	0
Arctic skua	1	0	0	0	0	0	0	0	0	2	0	0	0	2	1	1	1	0
Great skua	0	0	0	0	2	0	0	1	0	1	0	0	0	2	0	0	1	0
Sabine´s gull	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0	0	0	0
Black-headed gull																		
Mew gull																		
Lesser black-backed gull																		
Herring gull	1	2	0	0	2	1	0	0	0	2	2	0	1	2	2	1	0	0
Glaucous gull	0	0	0	1	3	0	0	0	0	0	0	0	3	3	0	0	0	0
Great black-backed gull	1	2	0	0	2	1	0	0	0	2	2	0	1	2	2	1	0	0
Black-legged kittiwake	1	0	0	1	0	0	0	0	0	1	0	0	1	1	1	0	0	0
Ivory gull	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0
Common tern																		
Arctic tern	0	0	0	1	0	0	0	0	0	0	0	0	2	1	1	0	1	0
Common guillemot	3	0	3	2	0	1	0	0	0	3	1	3	3	1	1	0	0	0
Brünnich´s guillemot	1	2	0	1	0	1	0	0	0	1	2	0	3	1	1	0	0	0
Razorbill	2	0	2	2	0	0	0	0	0	3	0	3	3	1	0	0	0	0
Black guillemot	0	0	0	1	0	0	0	0	0	0	1	1	2	1	1	0	0	0
Little auk	0	1	0	1	0	0	0	0	0	1	1	1	2	2	1	0	1	1
Atlantic puffin	1	0	1	1	1	0	0	1	0	2	0	1	3	1	0	0	1	0

are transported to the region by air, rivers and ocean currents (Savinova, Gabrielsen *et al.* 1995). Growing industrial production and the establishment of new settlements in the Arctic have, however, increased the local release of such contaminants.

So far, fallout from atmospheric testing of nuclear weapons has been the most important anthropogenic source of radioactivity in the Barents Sea Region, exacerbated by routine releases from European nuclear fuel reprocessing plants and the Chernobyl incident of 1996. In addition, several accidents within the region have caused local contamination. In the eastern part of the Barents Sea and in the Kara Sea, the dumping of nuclear waste and the storage of radioactive waste and spent nuclear fuels are also local sources (AMAP 1997).

Little is known about how marine birds are affected by radioactivity, and radioactivity is not specifically mentioned as a threat for any of the species described in this report. Measurements of seabirds in Svalbard and Franz Josef Land in 1992 showed low levels of radiocaesium (0.5-1.5 Bq/kg) (Mathisov *et al.* 1994). Overall, the radioactive load documented for seabirds breeding within the Barents Sea Region is virtually at the natural background level and represents no threat to the vital functioning of the birds (Mathisov *et al.* 1996). However, three test sites on the west coast of Novaya Zemlya, where both atmospheric tests of nuclear weapons and underground nuclear tests have been conducted, may represent a local threat to seabirds. In Chernaya Bay, one of the test sites on the south-west coast, underwater nuclear bombs were tested in 1955 and 1957. The bottom sediments are contaminated with elevated levels of radioactive plutonium and caesium, and other radioactive isotopes (AMAP 1997). Such areas may be a threat for seabirds feeding in shallow waters close to the shore. There is also a possibility that seabirds breeding near the test sites on Novaya Zemlya are, or have been, affected by radioactive contamination, but no data are available.

Organic contaminants accumulate in the upper trophic levels, resulting in heavier loads in species at the top of the food chain. For marine birds, this means that gulls and skuas are likely to be the most vulnerable. Many organic contaminants are highly fat-soluble and accumulate in fatty tissues. Birds may be affected when their fat reserves are depleted and the full load of contaminants is released over a short period. Consequently, they are particularly vulnerable when work loads are high (e.g. in the chick-rearing period and during migration) or when food becomes scarce (e.g. Bogan & Newton 1977).

Chlorinated hydrocarbons have been detected in many seabird species in the Barents Sea Region (Bourne & Bogan 1972, Bourne 1976, Fimreite & Bjerk 1979, Holt *et al.* 1979, Norheim & Kjos Hansen 1984, Ingebrigtsen *et al.* 1984, Barrett, Skaare *et al.* 1985, Carlberg & Böhler 1985, Norheim 1987, Savinova 1991, 1992, Daelemans *et al.* 1992, Daelemans 1994, Mehlum & Bakken 1994, Savinova & Gabrielsen 1994, Gabrielsen *et al.* 1995, Mehlum & Daelemans 1995, Savinova, Gabrielsen *et al.* 1995, Savinova, Polder *et al.* 1995 and Barrett *et al.* 1996). In general, the levels were lower in the 1990s than in the previous decades (Savinova, Polder *et al.* 1995, Barrett *et al.* 1996). However, particularly high levels of organochlorines have been (and still are) found in glaucous gulls *Larus hyperboreus* on Bjørnøya, and it is likely that this contamination has caused direct adult mortality in the population (Bourne & Bogan 1972, Bourne 1976, Gabrielsen *et al.* 1995, Bustnes *et al.* in prep.).

The contamination levels of heavy metals found in seabirds in the Barents Sea are generally low compared with those in other northern seas (i.e. off

Table 4.8. Hunting regulations for marine birds in the Norwegian part of the Barents Sea Region, excluding Svalbard.

Species	Open season
Great cormorant and European shag	1 October – 30 November
Greylag goose	21 August – 30 October
Long-tailed duck and red-breasted merganser	10 September – 23 December
Black-headed gull	21 August - 28 February
Mew gull, herring gull, great black-backed gull and black-legged kittiwake	10 September – 28 February

Table 4.9. Hunting regulations for marine birds in Svalbard.

Species	Open season
Northern fulmar	21 September – 31 October
Brünnich's guillemot	1 September – 31 October
Black guillemot	1 September – 31 October
Glaucous gull	11 August – 31 April

Table 4.10. Hunting regulations for marine birds in the Russian areas of the Barents Sea Region.

Species	Open season
Marine ducks (other than common eider)	September and October (only on lakes). Open season and bag limits may vary from one year to the next.

Canada and Greenland). However, the heavy metal content in arctic seabirds is not so well investigated as that of chlorinated hydrocarbons, although a number of studies from the Barents Sea Region document levels of heavy metals in marine birds (Norheim & Kjos-Hansen 1984, Barrett, Skaare *et al.* 1985, Carlberg & Böhler 1985, Norheim 1987, Norheim & Borch Johnsen 1990, Savinova 1992 and Barrett *et al.* 1996). In general, levels were found to be fairly low compared to other northern seas (e.g. off Canada and Greenland) (Savinova & Gabrielsen 1994). One exception was a high concentration of copper (Cu) in common eiders on Spitsbergen, which was 40 times higher than in other species (Norheim & Kjos-Hansen 1984, Norheim 1987).

The situation for the future as regards chlorinated hydrocarbons, heavy metals and radionuclides is not clear. Positive signs are the recent drop in the levels of chlorinated hydrocarbons and just one incident of high levels of heavy metals being found in marine birds in the Barents Sea Region. However, the increasing human activity in the area may increase the risk of future contamination.

So far, most biological research on chlorinated hydrocarbons and heavy metals has included the measurement and monitoring of contamination levels in tissues of various organisms (AMAP 1997). Very little is known about the effects of these contaminants at the population level. Recently, a study performed by the Norwegian Polar Institute and the Norwegian Institute for Nature Research of glaucous gulls breeding on Bjørnøya was started to document the effects of PCB on selected population parameters such as adult survival, phenology, clutch size and breeding success. The analyses of the results are not yet complete.

The authors consider the threat to be relevant for all populations breeding in the sub-regions, and there is a clear higher potential (Fig. 4.1). This threat is currently ranked as the second most important threat for seabirds breeding in the Barents Sea Region (Fig. 4.1).

Disturbance

This threat involves any disturbance caused by humans affecting the behaviour or population parameters of marine birds. Examples are harvesting (e.g. hunting) and industrial activities, including air traffic, shipping and tourism. Disturbance can arise from area encroachments, noise or traffic in the habitats of the birds. Human disturbance of breeding seabirds is recognised as a conservation concern world-wide (Vermeer & Rankin 1984, Burger & Gochfeld 1994). It is often closely connected with other threats, such as harvesting and the actions of conflicting species. There is no doubt that marine birds are easily disturbed by human activities. However, it is not easy to demonstrate that the disturbance has an effect on the population level, i.e. that it significantly affects survival, reproduction or recruitment rates.

Seabird colonies are located in such a way as to reduce predation and disturbance caused by land-based predators. Many of the marine birds in the Barents Sea Region breed on islands or on mainland sites that are relatively inaccessible to terrestrial mammals and man. Colonial seabirds tend to react strongly to unexpected disturbances, and readily leave their nests despite the risk of losing their eggs or chicks. This reaction can also be caused by natural disturbance factors such as falling ice, snow or rocks, especially in the colder, northern parts of the Barents Sea Region. Non-colonial birds are also vulnerable to disturbance during the breeding period (see Korschgen & Dahlgren 1992a, b), but the relative impact at the population level is probably much smaller.

There are many levels of response to disturbance, from changes in behaviour such as adopting alert postures and increased metabolic rate (Wilson *et al.* 1991, Nimon *et al.* 1995), to exposure of eggs and chicks to predation when the adults leave the nest (Olsson & Gabrielsen 1990). Marine birds can also be disturbed outside the breeding season. Examples are geese and waders in feeding and resting areas (e.g. Madsen 1984, Morrison 1984, Senner & Howe 1984, Bélanger & Bédard 1989, Pfister *et al.* 1992).

Disturbance problems identified for

seabirds in the Barents Sea Region include helicopter flights, supersonic booms from fighter planes, and people visiting seabird areas for various purposes (hunting, harvesting, research, tourism or recreation). Visits by people probably explain the abandonment of the recently-established northern gannet colony in Lofoten in 1978 (Barrett 1979a). Increased hunting pressure on greylag geese in Troms and Finnmark may lead to changes in the timing of their autumn migration, as seen in central Norway (Follestad 1994a). In the White Sea, disturbance was the most important factor reducing the nesting success of common eiders (Koryakin 1986). Whether tourists visiting the large ivory gull *Pagophila eburnea* colonies on Franz Josef Land reduce the breeding success of the birds is not known, but possible. Tourism is likely to increase in the near future, especially in the northern parts of the Barents Sea Region. It may also involve the use of helicopters and thus become an important threat for marine birds. Another threat is increased traffic connected with the establishment of new industries and settlements.

The authors consider this threat to be most relevant for populations breeding in all the sub-regions other than Novaya Zemlya and Franz Josef Land (Fig. 4.1). Disturbance is currently ranked as the fourth most important threat for seabirds breeding in the Barents Sea Region, and it is a greater potential problem in all the sub-regions (Fig. 4.1).

Area encroachments

This threat includes industrial development and activities (e.g. oil platforms, pipelines, fishing, factories, etc.) and the construction of new infrasructure (towns, villages, harbours, roads, etc.), which may restrict the access of birds to, or alter the quality of, important seabird habitats in the coastal zone. In general, this is not recognised as an important threat (current or potential) to marine birds in the Barents Sea Region. Only the common eider and king eider are considered to be seriously threatened by area encroachments.

As far as we know, there are no definite plans for the construction of new towns and bases in the Barents Sea Region. Moreover, it is difficult to see that such activities will have more than a local effect on seabirds, although the associated area encroachments may constitute a significant problem to populations whose distribution within the region is very limited. Area encroachments related to industrial development and activities are a much more realistic threat. It is not easy to predict the extent of new industrial activity over the next 5-10 years, but it is most likely to occur in the southern part of the region.

Obviously, most concern is directed towards the potentially rapid development of the oil and gas exploration and production in the south-eastern Barents Sea. In terms of area encroachments, associated effects will include the building of new platforms at sea, the establishment of shipping routes for oil and gas tankers and supply vessels, and/or the construction of pipelines (sub-sea and on land). If carried out, the opening of the Northern Sea Route for shipping may also influence parts of the Barents Sea.

On the whole, fishing in the Barents Sea Region will probably not increase a lot in the near future, although fishing areas and target species are likely to change significantly from year to year. Spatial conflict between fisheries and seabird distribution has hardly been studied, but there are no indications that current activities limit seabird access to important feeding grounds.

In Norway, mud flats that were once important for rearing common eider broods have been lost to industry (this volume). However, again the overall effect on the population is dependent on the proportion of the available habitat being affected by the change. Usually, the impact is only local, but it is important to be aware of the additive effects of habitat fragmentation. The use of small areas scattered throughout a region over a number of years may have a more severe effect on a population than a single large-scale encroachment.

The authors consider this threat to be most relevant for populations breeding on the Norwegian coast, on the Murman coast, in the Nenetski district and in the White Sea, and to a lesser degree on Novaya Zemlya, in Franz Josef Land and Svalbard (Fig. 4.1.). The potential threat is higher in all the sub-regions (Fig. 4.1). Area encroachments are currently ranked as the least important threat for seabirds breeding in the Barents Sea Region (Fig. 4.1).

Conflicting species

A number of other organisms may represent a threat to marine birds. Most typical are the effects of naturally occurring or introduced predators, but this threat category also includes the infestation of birds by internal and external parasites.

As for most animals, marine bird populations can sustain a certain level of predation. Usually, predation only becomes a problem when other factors have severely depressed population or caused the abundance of predators to increase beyond their normal level.

Many marine bird species are dependent on breeding sites that are reasonably secure from predators, and often breed in dense colonies on remote islands and steep cliffs. In general, this provides sufficient protection against most predators, especially mammals.

Predators may, however, arrive in new areas, either introduced by people (intentionally or by accident) or as a result of normal dispersal. In the Arctic, the sea ice often acts as a "bridge", enabling mammals to reach otherwise inaccessible areas. The resulting increase in predation pressure can be devastating for the local bird populations. Brown rats *Rattus norvegicus*, several musteline species *Mustela* spp., red foxes *Vulpes vulpes*, arctic foxes *Alopex lagopus*, as well as domestic cats and dogs can all cause significant damage to marine bird populations, either by killing incubating birds or by taking a large proportion of the eggs and chicks.

Although very few studies have investigated the effect of avian predation on marine birds in the Barents Sea Region, avian predators may also represent an important threat. No raptors (Accipitriformes, Falconiformes or Strigiformes) breed in the northernmost areas (Svalbard and Franz Josef Land), but they are common in southern parts of the region. Compared to most marine bird species, however, birds of prey usually occur in small populations and rarely constitute a major threat. Predation by ravens *Corvus corax* and hooded crows *Corvus corone* is probably more significant. Nevertheless, the most important avian predators are most likely to be other marine bird species, in particular the larger gulls *Larus* spp. Circumstantial evidence makes it reasonable to assume that both the great black-backed and herring gull are important predators on small and medium-sized adult seabirds along the Norwegian coast and the Kola Peninsula (see, for example, the section on Atlantic puffin). Farther north and east, the glaucous gull and partly the great skua *Catharacta skua* may play a similar role in some areas, although the latter species is not yet common.

The great skua is a new immigrant to the Barents Sea Region. The first breeding record was made on Bjørnøya (Svalbard) in 1970, and since then the species has established itself along the Norwegian coast, Murman coast, on Vaigach, Novaya Zemlya and in the western part of Svalbard (Vader 1980, Isaksen & Bakken 1995a, Kalyakin 1995, Krasnov 1995b, Krasnov & Nikolaeva 1995). It will probably continue to settle in new areas in the Barents Sea Region. Adult common eiders, black-legged kittiwakes ducklings and gull chicks have been shown to be frequent constituents of the diet of great skuas (Vader 1980, Krasnov *et al.* 1995). Based on data from Strann (1998) and Jerstad & Bakken (1999), the population on Bjørnøya is now probably close to 100 pairs. As a potential predator of eggs and chicks, it could easily become a serious threat to the very few great northern divers *Gavia immer* that probably breed on the northern part of the island.

Marine birds may be expected to be relatively free of microbial and protozoan pathogens, and the same holds true for metazoan parasites. They have an indigenous helminthoid fauna, which mainly comprises nematodes and cestodes but numbers few species. Marine birds may also become carriers of non-avian parasites as they share food with the marine mammals and may accidentally acquire stages of mammalian parasites transmitted by fish (Lauckner 1985). Little information concerning parasites is available from the Barents Sea Region, but it has been found that 90% of all common eider ducklings in the White Sea may be killed by trematodes of the genus *Microphallus* (Kulachkova 1979, Karpovich 1987).

Examples of species conflicts which may represent potential threats to marine birds in the Barents Sea Region are the predation by white-tailed eagles *Haliaeetus albicilla* on northern gannets, and the predation by North-American mink *Mustela vison* on European shags and black guillemots *Cepphus grylle* on the Norwegian coast. Competition between two or more species may also be a possible threat. An unverified theory is that barnacle geese are able to displace brent geese *Branta bernicla* and common eiders from their breeding sites (Bustnes *et al.* 1995a). Habitat deterioration is believed to have negatively affected the grey phalarope *Phalaropus fulicarius* population in Svalbard. One explanation for the decline in phalarope numbers is the loss of suitable nesting sites due to intensive grazing by reindeer (this volume). If this is the case, an increase in the reindeer population could be a significant threat to the phalaropes in this archipelago (see also "Oil").

The authors view this threat as being relevant for populations breeding on all the sub-regions, but to a lesser degree on Novaya Zemlya and in Franz Josef Land (Fig. 4.1). The potential threat is higher in all the sub-regions (Fig. 4.1). Conflicting species is currently ranked as the fifth most important threat for seabirds breeding in the Barents Sea Region (Fig. 4.1).

Other threats

Few threats to marine birds in the Barents Sea Region other than those already described in the previous sections are mentioned by the authors of the species accounts. It is, however, difficult to foresee all the factors that may significantly affect the seabird populations in the future.

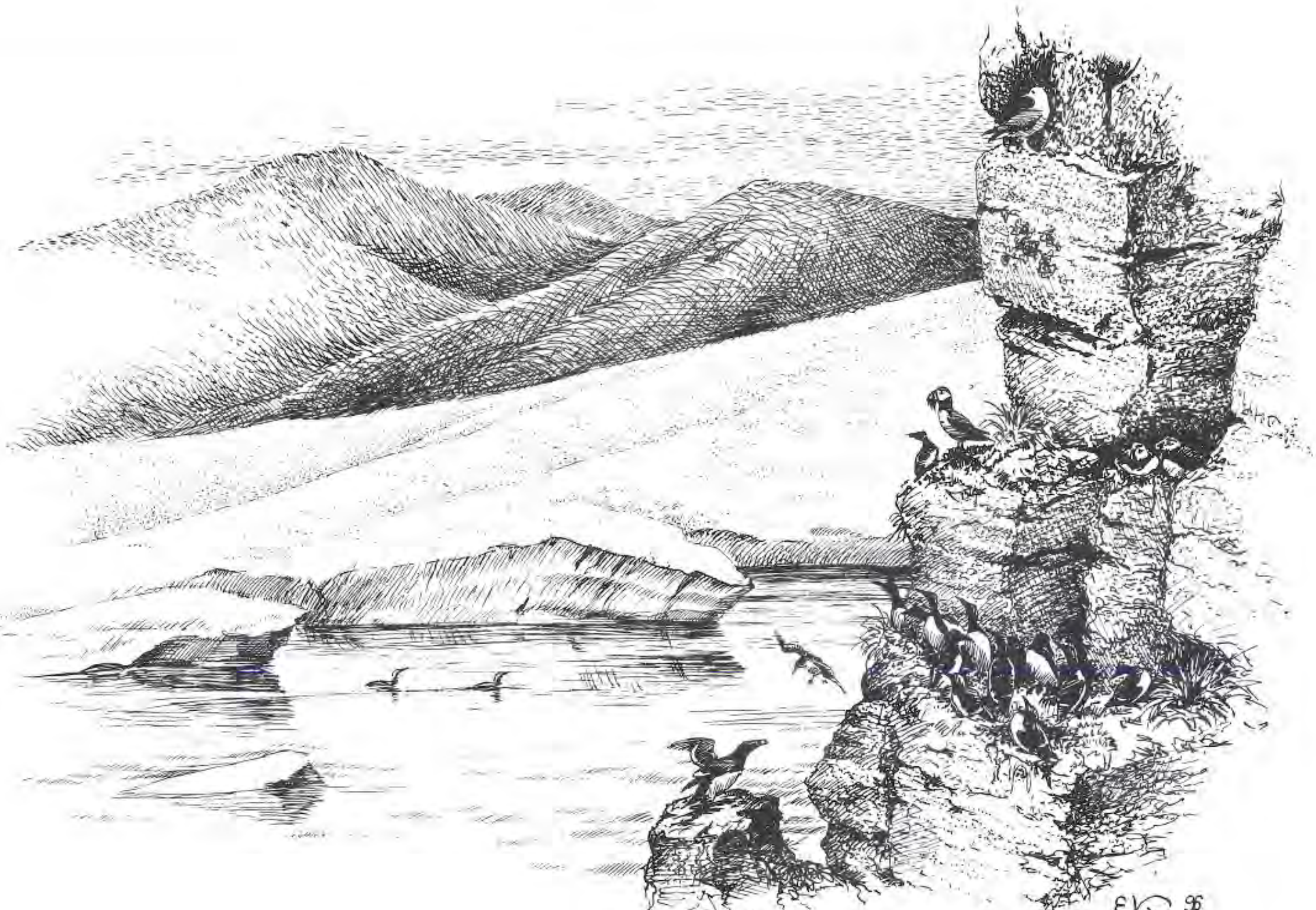
One concern is climatic warming, which may lead to dramatic changes in numbers and distributions of marine birds (Brown 1991). This is a more long-term effect than the other threats considered in this report, but probably very important for the marine birds. There is an ongoing dispute as to how a significant global warming will affect the arctic environment. Irrespective of whether it will cause temperatures to rise or fall, it will most likely bring about a long-lasting shift in the climatic regime of the Barents Sea Region, which again will be accompanied by a corresponding change in the diversity of the marine avifauna. How dramatic these changes may be, largely depends on both the magnitude and the speed of the climatic shift. As all parts of the ecosystem will be affected one way or another, it is a huge task to predict the outcome of any given scenario with a reasonable degree of certainty.

The ice cover in April in the north-east Atlantic has been reduced by ca. 35% over the past 135 years, although nearly half this reduction took place between 1860 and 1900, before the warming of the Arctic (Vinje, pers. comm.). The mean temperature in the Northern Hemisphere was at a minimum around 1790 and has since increased by about 0.7°C, the rate being three times higher during the 20th century than the 19th century (Vinje 1997). In a climatic sense, we are about to leave the Little Ice Age (Vinje 1997).

Changes in sea temperatures, ocean currents, the distribution of sea ice and the position of the polar front will inevitably be accompanied by changes in the distribution, abundance and availability of prey species for marine birds. One example is the high-Arctic ivory gull, which is probably dependent on foraging in partly ice-covered waters during the breeding season. A change in the ice distribution may thus make traditional breeding localities unsuitable for this species. Climatic warming could also encourage the spread northwards of species breeding further south, thus increasing the level of competition between species. Moreover, species adapted to colder climatic regimes may be forced to abandon southern areas or, in some cases, disappear from the whole region. A possible rise in sea level can, furthermore, seriously alter or eliminate important low-lying habitats for marine birds, such as mud flats used by staging shorebirds (Brown 1991), but the significance of such a threat will, of course, depend on how rapid the changes take place and nature's ability to produce new habitats of equal quality.

Plastic particles have frequently been found in stomachs of northern fulmars and Leach's storm-petrels *Oceanodroma leucorhoa* (van Franeker 1985, Furness 1985, Camphuysen 1993), but it is not known to what extent such particles affect the birds' survival and reproductive performance (van Franeker 1985). The phenomenon is most common among Procellariiform seabirds (e.g. Ryan 1987), and there is some evidence that it may, under certain circumstances, represent a significant problem for the birds (Ryan 1988a, b, Ryan *et al.* 1988, Sievert & Sileo 1993). In sharp contrast to Wilson's storm-petrels *Oceanites oceanicus* in the Antarctic (van Franeker & Bell 1988), ingested plastic particles were not found in Scottish storm-petrels (Furness 1985). To our knowledge, no one has yet studied plastic ingestion by seabirds in the Barents Sea Region. The striking differences between Scottish Procellariiformes (Furness 1985) suggest that the particles in the Antarctic birds are mainly digested during migration or in the wintering areas.

Another possible threat needs to be mentioned, although it is not reported for any of the populations discussed in this report. In 1991-1993, chicks of lesser black-backed gull in Finland were found to be dying from a disease during their first three weeks of life (Hario & Rudbäck 1996). Degeneration and inflammation of various internal organs were important causes of death, but the main reason for the mortality is not known. Although it is difficult to judge their overall impact, it is important to be aware of the existence of such phenomena. The main reasons for the severe decline of the lesser black-backed gull population in the Barents Sea Region are, unfortunately, still largely unknown.



5. Recommendations

The recommendations given here are mainly based upon the need for additional knowledge to protect and maintain the diversity and numbers of marine birds breeding in the Barents Sea Region. They are mainly derived from the anthropogenic threats identified and discussed for each species in Chapter 3 and summarised in Chapter 4, and the most important gaps in our knowledge relating to these threats. Focus is put on the needs of management authorities for information and actions necessary for implementing internationally agreed environmental strategies (Appendix 5). As a continuation of the simple index system used to summarise the threats in Chapter 4, most recommendations were identified following a stepwise procedure. Firstly, only populations assigned an index of 2 or 3 for a current or potential threat in any sub-region were considered (Tab. 4.1-4.7). Consequently, no priorities were identified for species not included in the tables. Secondly, the gaps in our knowledge were assessed species by species in relation to three main categories of priorities: mapping, research and monitoring for each identified threat.

Most recommendations were identified in this way by the editors, who ranked their importance using a simple 1-3 scale, indicating low, medium and high priority. The tabulated priorities were then presented to the authors of the species descriptions for comments and adjustments. Nevertheless, we stress that the final recommendations given below are entirely the responsibility of the editorial group.

It should also be pointed out that, beyond a five-year perspective, the validity of each recommendation should be evaluated in relation to the development of the various threats considered (cf. Chapter 4). The three main groups of recommendations are commented on below in relatively general terms. The number of recommendations are far too many to be discussed separately here, but the background for each indexed statement presented in

Table 5.1. Status and priorities for mapping breeding populations of marine birds in the Barents Sea Region. Only the highest of the threat-specific priority values (Tabs. 5.2-5.9) are shown. Grey colour indicates the species is not found breeding, with a question mark added if the sub-region is considered to be a possible breeding area. Status categories are: 3 (red) = no quantitative data, 2 (orange) = poor data, 1 (yellow) = incomplete data, 0 (green) = adequately mapped. Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low. Sub-regions are: NC = Norwegian coast, MC = Murman coast, WS = White Sea, ND = Nenetski district, NZ = Novaya Zemlya, FJL = Franz Josef Land, SV = Svalbard.

Species	Mapping status							Mapping priorities						
	NC	MC	WS	ND	NZ	FJL	SV	NC	MC	WS	ND	NZ	FJL	SV
Great northern diver							2					3		
Northern fulmar	1				3	2	1	1				1	1	1
European storm-petrel	2	?						2	2					
Leach's storm-petrel	2	?						2	2					
Northern gannet	0	0						1	1					
Great cormorant	1	0	0					3	2	1				
European shag	1	0						2	2					
Greylag goose	2	1						2	2					
Barnacle goose				2	2	2	1				2	3	3	2
Brent goose						2	1						3	3
Common eider	1	0	0	2	2	2	1	1	3	3	2	1	1	2
King eider			1	3	3		2			2	3	2		3
Steller's eider		2	2	3					3	3	3			
Long-tailed duck	2	2	1	2	2		2	1	1	1	1	1		1
Black scoter	2	2	2	2	2		2	1	1	1	1	1		1
Velvet scoter	2	2	2	2	2		2	1	1	1	1	1		1
Red-breasted merganser	2	2	2	2	2			1	1	1	1	1		
Eurasian oystercatcher	1	2	1					1	1	1				
Purple sandpiper	1	3		2	2	2	2	1	1		1	1	1	1
Ruddy turnstone	2	2	1	2			2	1	1	1	1			1
Red-necked phalarope	2	3	3	2			2	1	1	1	1			1
Grey phalarope					3		2					2		3
Arctic skua	2	2	0	2	2	2	2	1	1	1	1	1	1	1
Great skua	1	1		2	2	2	1	1	1		1	1	1	1
Sabine's gull							1					2		
Black-headed gull	2	2						1	1					
Mew gull	1	2	1					1	1	1				
Lesser black-backed gull	2		0	2	?			3		1	1	?		
Herring gull	1	1	1				3	1	1	1				1
Glaucous gull				2	2	2	1				2	2	2	2
Great black-backed gull	1	1	0	2	3		2	1	1	1	1	1		1
Black-legged kittiwake	1	0			2	2	1	1	1			3	3	2
Ivory gull					3	2	1					2	3	2
Common tern	1		3					1		1				
Arctic tern	1	2	1	2	2	2	2	1	1	1	1	1	1	1
Common guillemot	1	0			2		0	2	1			3		1
Brünnich's guillemot	1	1			1	1	1	2	2			3	2	2
Razorbill	2	1	0		?		2	3	2	1		?		2
Black guillemot	2	1	0	2	2	2	2	2	2	1	2	2	2	2
Little auk					2	2	1					2	2	3
Atlantic puffin	0	1	0		2		2	1	2	1		2		3

Species	Research priorities								Mapping priorities							
	Food choice and food availability	Foraging areas	Migration routes and winter areas	Demographic parameters	Censusing and monitoring methods	Genetic studies	The influence of the threat to the population	Actions to reduce the threat	Norwegian coast	Murman coast	White Sea	Nenetski district	Novaya Zemlya	Franz Josef Land	Svalbard	Monitoring priorities
Great cormorant	3	2	3	3	1	1	3	1	1	1	1					3
European shag	3	2	3	3	1	1	3	1	1	1						3
Common eider	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Arctic skua	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Lesser black-backed gull	3	3	1	1	1	2	3	1	3		1	1	?			3
Herring gull	2	1	1	1	1	1	2	1	1	1	1				1	2
Great black-backed gull	2	1	1	1	1	1	2	1	1	1	1	1	1		1	2
Black-legged Kittiwake	2	1	1	2	1	1	2	1	1	1			1	1	1	2
Common tern	1	1	1	1	1	1	2	1	1		1					1
Arctic tern	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Common guillemot	3	3	3	3	1	1	3	1	1	1			1		1	3
Brünnich's guillemot	2	2	2	2	1	1	2	1	1				1	1	1	3
Razorbill	2	1	1	2	1	1	2	1	1	1	1		?		1	2
Atlantic puffin	2	3	3	3	1	1	3	1	1	1	1		1		1	3

Table 5.2. Priorities for research, mapping and monitoring of marine birds breeding in the Barents Sea Region assessed in relation to threats from *fisheries*. Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low. Grey colour indicates the species is not found breeding, with a question mark added if the sub-region is considered to be a possible breeding area. Only species assigned to threat categories 2 or 3 for this threat (actual or potential) are considered (cf. Tabs. 4.1-4.7).

the tables is often explained in the respective species descriptions.

Mapping

It is of basic importance to have adequate knowledge of the distribution and numbers of marine birds in all parts of the Barents Sea Region. Such data are essential, for instance when making impact assessments and setting up management plans for any human actions in coastal or offshore areas. In general, the breeding areas and some wintering areas of marine birds in the Barents Sea Region are relatively well known, but there are great variations between species and regions (Table 5.1). Colonial seabirds are generally better covered than species breeding in a more scattered fashion. Likewise, the occurrence of species that aggregate in well-defined areas outside the breeding season (e.g. some ducks and geese) is often better mapped than is the case for those that are more dispersed in this period. A great deal of seabird mapping, both in the breeding colonies and offshore, has been done in the Barents Sea Region over the last two decades. In the Norwegian part, much of it was performed in the 1980s and the early 1990s in connection with governmental impact assessments of offshore oil exploration.

The recommendations for mapping apply mainly to the breeding populations. A summary of the mapping status for each sub-region is presented in table 5.1. This table also includes a summary of the mapping priorities, which indicates the highest recommendations found in each sub-region for any threat.

Due to the complex logistics and high costs involved, it is strongly recommended that the mapping of several species should be combined when remote areas are being surveyed. Pechora Bay, Kolguev Island and adjacent areas will probably be important areas for exploitation and transportation of oil in the near future. Unfortunately, the occurrence and distribution of seabirds in these areas are poorly known. In this part of the Barents Sea, the greatest risks are probably associated with the large concentrations of moulting ducks and swans found in autumn along the southern coasts between the Kara Gate and Kolguev Island (Strøm *et al.* 2000). It is also important to map the seabird colonies in the south-western part of Novaya Zemlya, which lies within the risk area for oil spills from the Pechora area. At the same time, a comprehensive monitoring programme should be established as an integrated part of a large-scale monitoring programme for marine birds in the Barents Sea Region for a reasonable selection of species that are vulnerable to oil pollution (see below).

Research

The specific recommendations for future seabirds research are here divided into eight topics:

1. Identify food choice and food availability, also outside the breeding season.
2. Identify the most important foraging areas during the breeding period.
3. Identify migratory routes and wintering areas.
4. Measure important demographic parameters.
5. Develop methods to census and monitor breeding populations.
6. Conduct genetic studies to identify population structures.
7. Document the influence of a threat to the population.
8. Identify actions to reduce the threat in question.

The last topic applies to research only, and involves, for instance, technical modifications of fishing gear to reduce the by-catch of seabirds. More detailed proposals for research tasks may be found in the species accounts.

Altogether, the tables 5.2-5.9 list 83 species-specific research tasks that should be given high priority and another 152 of medium priority (a summary of the research recommendations is shown in table 5.10). Even

Table 5.3. Priorities for research, mapping and monitoring of marine birds breeding in the Barents Sea Region assessed in relation to threats from *harvesting*. Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low. Grey colour indicates the species is not found breeding, with a question mark added if the sub-region is considered to be a possible breeding area. Only species assigned to threat categories 2 or 3 for this threat (actual or potential) are considered (cf. Tabs. 4.1-4.7).

Species	Research priorities								Mapping priorities							
	Food choice and food availability	Foraging areas	Migration routes and winter areas	Demographic parameters	Censusing and monitoring methods	Genetic studies	The influence of the threat to the population	Actions to reduce the threat	Norwegian coast	Murman coast	White Sea	Nenetski district	Novaya Zemlya	Franz Josef Land	Svalbard	Monitoring priorities
Great cormorant	1	1	1	1	1	1	2	1	1	1	1					2
Greylag goose	1	1	1	1	1	1	2	1	2	2						2
Barnacle goose	1	1	1	1	1	1	2	1				1	1	1	1	2
Common eider	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	2
King eider	1	1	1	1	1	1	2	1			1	1	1		1	2
Long-tailed duck	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Mew gull	1	1	1	1	1	1	2	1	1	1	1					1
Lesser black-backed gull	1	1	1	1	1	1	2	1	1		1	1	?			1
Herring gull	1	1	1	1	1	1	2	1	1	1	1				1	1
Great black-backed gull	1	1	1	1	1	1	2	1	1	1	1	1	1		1	1
Common guillemot	1	1	1	2	1	1	2	1	1	1			1		1	2
Brünnich's guillemot	1	1	3	3	1	1	3	1	1	1			1	1	1	3

Table 5.4. Priorities for research, mapping and monitoring of marine birds breeding in the Barents Sea Region assessed in relation to threats from *by-catch*. Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low. Grey colour indicates the species is not found breeding, with a question mark added if the sub-region is considered to be a possible breeding area. Only species assigned to threat categories 2 or 3 for this threat (actual or potential) are considered (cf. Tabs. 4.1-4.7).

Species	Research priorities								Mapping priorities							
	Food choice and food availability	Foraging areas	Migration routes and winter areas	Demographic parameters	Censusing and monitoring methods	Genetic studies	The influence of the threat to the population	Actions to reduce the threat	Norwegian coast	Murman coast	White Sea	Nenetski district	Novaya Zemlya	Franz Josef Land	Svalbard	Monitoring priorities
Great northern diver	1	2	1	1	1	1	2	1							2	2
Northern fulmar	2	1	2	1	1	1	2	2	1				1	1	1	1
Great cormorant	1	3	3	3	1	1	3	3	1	1	1					3
European shag	1	2	2	2	1	1	2	2	1	1						2
Common eider	1	1	3	3	1	1	3	3	1	1	1	1	1	1	1	3
King eider	1	1	2	1	1	1	2	3			1	1	1		1	1
Steller's eider	1	1	2	1	1	1	2	3		1	1	1				1
Long-tailed duck	1	1	1	1	1	1	2	2	1	1	1	1	1		1	1
Common guillemot	1	3	3	3	1	1	3	3	1	1			1		1	3
Razorbill	1	2	2	2	1	1	2	2	1	1	1		?		1	2
Black guillemot	1	1	2	1	1	1	2	2	1	1	1	1	1	1	1	2
Atlantic puffin	1	1	2	1	1	1	2	1	1	1	1		1		1	1

Species	Research priorities								Mapping priorities							Monitoring priorities
	Food choice and food availability	Foraging areas	Migration routes and winter areas	Demographic parameters	Censusing and monitoring methods	Genetic studies	The influence of the threat to the population	Actions to reduce the threat	Norwegian coast	Murman coast	White Sea	Nenetski district	Novaya Zemlya	Franz Josef Land	Svalbard	
Great northern diver	1	2	2	1	1	1	1	1							2	1
Northern fulmar	1	2	2	1	1	1	1	1	1				1	1	1	1
European storm-petrel	1	2	2	1	2	1	1	1	2	2						1
Leach's storm-petrel	1	2	2	1	2	1	1	1	2	2						1
Great cormorant	1	1	3	3	1	1	1	1	3	2	1					3
European shag	1	1	3	3	1	1	1	1	2	2						3
Greylag goose	1	1	2	2	1	1	1	1	2	2						1
Barnacle goose	1	1	1	3	1	1	1	1				2	3	3	1	3
Brent goose	1	1	1	3	1	1	1	1						3	3	3
Common eider	1	1	3	3	1	1	1	1	1	3	3	2	1	1	2	3
King eider	1	1	2	1	1	1	1	1			2	3	2		3	2
Steller's eider	1	2	3	1	1	1	1	1		3	3	3				3
Long-tailed duck	1	1	2	1	1	1	1	1	1	1	1	1	1		1	1
Black scoter	1	1	2	1	1	1	1	1	1	1	1	1	1		1	1
Velvet scoter	1	1	2	1	1	1	1	1	1	1	1	1	1		1	1
Red-breasted merganser	1	1	2	1	1	1	1	1	1	1	1	1	1			1
Grey phalarope	1	1	1	1	2	1	1	1					2		3	2
Sabine's gull	1	2	2	1	1	1	1	1							2	2
Black-headed gull	1	1	2	1	1	1	1	1	1	1						1
Lesser black-backed gull	1	3	1	1	1	2	1	1	2		1	1	?			2
Glaucous gull	1	2	3	3	1	1	1	1				2	2	2	2	3
Black-legged kittiwake	1	2	2	3	1	1	1	1	1	1			3	3	2	3
Ivory gull	1	2	2	2	1	1	1	1					2	3	2	2
Common tern	1	2	2	1	1	1	1	1	1		1					1
Arctic tern	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Common guillemot	1	3	3	3	1	1	1	2	2	1			3		1	3
Brünnich's guillemot	1	3	3	3	1	1	1	2	2	2			3	2	2	3
Razorbill	1	3	3	3	3	1	1	2	3	2	1		?		2	3
Black guillemot	1	1	3	3	2	1	1	1	2	2	1	2	2	2	2	2
Little auk	1	3	3	3	3	1	1	2					2	2	3	3
Atlantic puffin	1	3	3	3	1	1	1	1	1	2	1		2		3	3

Table 5.5. Priorities for research, mapping and monitoring of marine birds breeding in the Barents Sea Region assessed in relation to threats from *oil*. Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low. Grey colour indicates the species is not found breeding, with a question mark added if the sub-region is considered to be a possible breeding area. Only species assigned to threat categories 2 or 3 for this threat (actual or potential) are considered (cf. Tabs. 4.1-4.7).

without considering the various options for the design and effectuation of these studies, it is obviously a huge task to fulfil them all. Nevertheless, the exercise of splitting up the alternative handful of very generalised recommendations into many indices relating to species and fields of research will hopefully increase their value as a tool for management and other authorities when deciding what research is most needed.

In contrast to the priorities for mapping, the research recommendations are not specified by region but are in general valid for the whole Barents Sea Region. However, among the recommendations that are given highest priority five relate, directly or indirectly, to conflicts with fisheries or oil pollution. Great cormorants *Phalacrocorax carbo* and auks are the most important in this context, but the vulnerability of marine ducks and some gull species to oil also deserves special attention. Using the number of recommendations of medium and high priority as a pointer, oil pollution is the most important problem (68 recommendations), followed by competition with fisheries (43) and the by-catch problem (43). The 81 recommendations related to other threats were largely associated with the possibility of impact from pollutants other than oil and comprised only 15 in the highest priority class. However, the impact of the harvest of Brünnich's guillemots *Uria lomvia* in the north-west Atlantic in winter, and the effect of disturbance on great northern divers *Gavia immer*, brent goose *Branta leucopsis*, common eiders *Somateria mollissima* and ivory gulls *Pagophila eburnea*, are emphasised as important research topics.

Monitoring

When identifying the most important species for monitoring, consideration was given to the extent to which this is an effective way of discovering any changes to a threatened population. How far the species is a suitable indicator in that context and whether the monitoring is feasible were also taken into account, although monitoring parameters and methods were not addressed in any detail.

Altogether, it is recommended that 16 species (one diver, both cormorants, two geese, two ducks, four gulls and five auks) are given the highest priority in the future monitoring of marine birds breeding in the Barents Sea Region (Table 5.11). An additional eight species also deserve attention (medium priority). The remaining 13 species covered by this report should

Species	Research priorities								Mapping priorities							Monitoring priorities
	Food choice and food availability	Foraging areas	Migration routes and winter areas	Demographic parameters	Censusing and monitoring methods	Genetic studies	The influence of the threat to the population	Actions to reduce the threat	Norwegian coast	Murman coast	White Sea	Nenetski district	Novaya Zemlya	Franz Josef Land	Svalbard	
Great cormorant	1	1	1	2	1	1	2	1	1	1	1					1
Common eider	2	1	2	2	1	1	2	1	1	1	1	1	1	1	1	1
King eider	1	1	1	1	1	1	2	1			1	1	1		1	1
Long-tailed duck	1	1	1	1	1	1	2	1	1	1	1	1	1		1	1
Grey phalarope	1	1	1	1	1	1	2	1					1		1	1
Arctic skua	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Great skua	2	1	2	1	1	1	2	1	1	1		1	1	1	1	1
Black-headed gull	1	1	1	1	1	1	2	1	1	1						1
Mew gull	1	1	1	1	1	1	2	1	1	1	1					1
Lesser black-backed gull	2	1	2	2	1	1	2	1	1		1	1	?			1
Herring gull	1	1	1	1	1	1	2	1	1	1	1				1	1
Glaucous gull	3	1	3	3	1	1	3	1				1	1	1	1	3
Great black-backed gull	2	1	2	2	1	1	2	1	1	1	1	1	1		1	1
Brünnich's guillemot	1	1	1	2	1	1	2	1	1	1			1	1	1	1
Black guillemot	2	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Little auk	1	1	1	1	1	1	1	1					1	1	1	1

Table 5.6. Priorities for research, mapping and monitoring of marine birds breeding in the Barents Sea Region assessed in relation to threats from *pollutants other than oil*. Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low. Grey colour indicates the species is not found breeding, with a question mark added if the sub-region is considered to be a possible breeding area. Only species assigned to threat categories 2 or 3 for this threat (actual or potential) are considered (cf. Tabs. 4.1-4.7).

Species	Research priorities								Mapping priorities							Monitoring priorities
	Food choice and food availability	Foraging areas	Migration routes and winter areas	Demographic parameters	Censusing and monitoring methods	Genetic studies	The influence of the threat to the population	Actions to reduce the threat	Norwegian coast	Murman coast	White Sea	Nenetski district	Novaya Zemlya	Franz Josef Land	Svalbard	
Great northern diver	1	3	1	1	1	1	3	1							3	2
Northern gannet	1	1	1	1	1	1	2	1	1	1						2
Greylag goose	1	1	1	1	1	1	2	1	2	2						1
Brent goose	1	1	1	3	1	1	3	1						3	3	3
Common eider	1	1	1	3	1	1	3	1	1	1	1	1	1	1	1	3
King eider	1	1	1	1	1	1	1	1			1	1	1		1	1
Steller's eider	1	1	2	1	1	1	2	1		2	2	2				1
Long-tailed duck	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Black scoter	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Velvet scoter	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Red-breasted merganser	1	1	1	1	1	1	1	1	1	1	1	1	1			1
Grey phalarope	1	1	1	1	1	1	1	1					1		1	1
Black-headed gull	1	1	1	1	1	1	1	1	1	1						1
Mew gull	1	1	1	1	1	1	1	1	1	1	1					1
Herring gull	1	1	1	1	1	1	1	1	1	1	1				1	1
Great black-backed gull	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Ivory gull	1	1	1	3	1	1	3	1					1	3	2	3
Common guillemot	1	1	1	1	1	1	2	1	1	1			1		1	2
Brünnich's guillemot	1	1	1	1	1	1	2	1	1	1			1	1	1	2
Razorbill	1	1	1	1	1	1	2	1	1	1	1		?		1	2
Black guillemot	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 5.7. Priorities for research, mapping and monitoring of marine birds breeding in the Barents Sea Region assessed in relation to threats from *disturbance*. Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low. Grey colour indicates the species is not found breeding, with a question mark added if the sub-region is considered to be a possible breeding area. Only species assigned to threat categories 2 or 3 for this threat (actual or potential) are considered (cf. Tabs. 4.1-4.7).

Species	Research priorities								Mapping priorities							
	Food choice and food availability	Foraging areas	Migration routes and winter areas	Demographic parameters	Censusing and monitoring methods	Genetic studies	The influence of the threat to the population	Actions to reduce the threat	Norwegian coast	Murman coast	White Sea	Nenetski district	Novaya Zemlya	Franz Josef Land	Svalbard	Monitoring priorities
Great northern diver	1	2	1	1	1	1	2	1							2	2
Common eider	1	1	1	2	1	1	2	2	1	1	1	1	1	1	1	2
King eider	1	1	1	1	1	1	2	1			1	1	1		1	1
Long-tailed duck	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Black scoter	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Velvet scoter	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Red-breasted merganser	1	1	1	1	1	1	1	1	1	1	1	1	1			1
Grey phalarope	1	1	1	1	1	1	2	1					1		1	2
Black-headed gull	1	1	1	1	1	1	1	1	1	1						1
Mew gull	1	1	1	1	1	1	1	1	1	1	1					1
Common guillemot	1	1	1	1	1	1	2	1	1	1			1		1	1

Table 5.8. Priorities for research, mapping and monitoring of marine birds breeding in the Barents Sea Region assessed in relation to threats from *area encroachments*. Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low. Grey colour indicates the species is not found breeding, with a question mark added if the sub-region is considered to be a possible breeding area. Only species assigned to threat categories 2 or 3 for this threat (actual or potential) are considered (cf. Tabs. 4.1-4.7).

Species	Research priorities								Mapping priorities							
	Food choice and food availability	Foraging areas	Migration routes and winter areas	Demographic parameters	Censusing and monitoring methods	Genetic studies	The influence of the threat to the population	Actions to reduce the threat	Norwegian coast	Murman coast	White Sea	Nenetski district	Novaya Zemlya	Franz Josef Land	Svalbard	Monitoring priorities
Great northern diver	1	1	1	1	1	1	2	1							2	2
European storm-petrel	1	1	1	1	1	1	2	1	1	?						1
Leach's storm-petrel	1	1	1	1	1	1	2	1	1	?						1
Northern gannet	1	1	1	1	1	1	2	1	1	1						2
European shag	1	1	1	1	1	1	2	1	1	1						1
Barnacle goose	1	1	1	1	1	1	2	1				1	1	1	2	2
Brent goose	1	1	1	1	1	1	2	1						1	2	2
Common eider	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
King eider	1	1	1	1	1	1	1	1				1	1		1	1
Long-tailed duck	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1
Grey phalarope	1	1	1	1	1	1	1	1					1		1	1
Mew gull	1	1	1	1	1	1	1	1	1	1	1					1
Common tern	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Arctic tern	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Black guillemot	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1
Atlantic puffin	1	1	1	1	1	1	2	1	1	1	1		1		1	1

Table 5.9. Priorities for research, mapping and monitoring of marine birds breeding in the Barents Sea Region assessed in relation to threats from *conflicting species*. Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low. Grey colour indicates the species is not found breeding, with a question mark added if the sub-region is considered to be a possible breeding area. Only species assigned to threat categories 2 or 3 for this threat (actual or potential) are considered (cf. Tabs. 4.1-4.7).

not be given priority unless it can be argued that they fulfil an ecological quality that is essential for the monitoring and which is not adequately covered by any of the other species.

The extent to which marine birds are currently monitored in the Barents Sea Region is presented in Appendix 4. Unfortunately, the monitoring efforts on the Norwegian coast, in Svalbard and in Russian areas constitute separate programmes that are not fully compatible in terms of common aims, species, parameters, methods and effort. At present, several initiatives are being taken to establish new monitoring programmes in the Barents Sea Region that should include marine birds. These should be co-ordinated in order to design a comprehensive monitoring programme, which includes a representative selection of marine birds with respect to ecological and geographical variations within the region. Beside giving special attention to threatened and vulnerable populations, the programme should also focus on species that are suitable indicators of changes in marine ecosystems.

The life history of most marine

Table 5.10. Maximum scores of the research priorities recommended (cf. Tabs. 5.2-5.9). Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low.

Species	Research priorities							
	Food choice and availability	Foraging areas	Migration routes and winter areas	Demographic parameters	Censusing and monitoring methods	Genetic studies	The influence of the threat to the population	Actions to reduce the threat
Great northern diver	1	3	2	1	1	1	3	1
Northern fulmar	2	2	2	1	1	1	2	2
European storm-petrel	1	2	2	1	2	1	2	1
Leach's storm-petrel	1	2	2	1	2	1	2	1
Northern gannet	1	1	1	1	1	1	2	1
Great cormorant	3	3	3	3	1	1	3	3
European shag	3	2	3	3	1	1	3	2
Greylag goose	1	1	2	2	1	1	2	1
Barnacle goose	1	1	1	3	1	1	2	1
Brent goose	1	1	1	3	1	1	3	1
Common eider	2	1	3	3	1	1	3	3
King eider	1	1	2	1	1	1	2	1
Steller's eider	1	2	3	1	1	1	2	3
Long-tailed duck	1	1	2	1	1	1	2	2
Black scoter	1	1	2	1	1	1	1	1
Velvet scoter	1	1	2	1	1	1	1	1
Red-breasted merganser	1	1	2	1	1	1	1	1
Grey phalarope	1	1	1	1	2	1	2	1
Arctic skua	1	1	1	1	1	1	2	1
Great skua	2	1	2	1	1	1	2	1
Sabine's gull	1	2	2	1	1	1	1	1
Black-headed gull	1	1	2	1	1	1	2	1
Mew gull	1	1	1	1	1	1	2	1
Lesser black-backed gull	3	3	2	2	1	2	3	1
Herring gull	2	1	1	1	1	1	2	1
Glaucous gull	3	2	3	3	1	1	3	1
Great black-backed gull	2	1	2	2	1	1	2	1
Black-legged kittiwake	2	2	2	3	1	1	2	1
Ivory gull	1	2	2	3	1	1	3	1
Common tern	1	1	1	1	1	1	2	1
Arctic tern	1	2	2	1	1	1	2	1
Common guillemot	3	3	3	3	1	1	3	3
Brünnich's guillemot	2	3	3	3	1	1	3	2
Razorbill	2	3	3	3	3	1	2	2
Black guillemot	2	1	3	3	2	1	2	1
Little auk	1	3	3	3	3	1	1	2
Atlantic puffin	2	3	3	3	1	1	3	1

birds is characterised by a long lifespan, delayed maturity and low reproductive rates. As a consequence, it may often be too late to address the causes of a recorded change in breeding numbers *post facto* unless contemporary information on the most important population parameters and environmental factors is available. For the same reason, it is also necessary to develop in advance a strategy for how to distinguish between changes induced by natural variation (e.g. in ocean climate, predation and infestation rates) and human interference (e.g. fisheries, pollution and harvesting). This is probably the greatest challenge in the conservation and management of marine birds, as well as for most other living resources.

The Norwegian monitoring programme for seabirds, which covers the entire mainland coast of Norway, has been run by NINA since 1988. It was recently evaluated and revised to ensure that its most important goals are met as far as possible. The general conclusions drawn from this exercise were published by Anker-Nilssen *et al.* (1996) and will be used as guidelines when undertaking a similar evaluation of the seabird monitoring carried out by the Norwegian Polar Institute in Svalbard. This evaluation should aim at producing a set of recommendations on how to bring the monitoring in Svalbard in better harmony with that on the Norwegian mainland.

As this report clearly demonstrates, most marine birds breeding in the Barents Sea Region belong to populations with international distribution patterns. Obviously, a radical standardisation of aims, methods and effort is essential if we want to improve our ability to compare monitoring results across national borders, populations and species. We therefore strongly recommend that all monitoring of marine birds within the region is systematised within a common framework. This is no easy task, and it is far beyond the scope of this report to present a detailed sketch of a bilateral monitoring programme (see also Krasnov & Barrett (1999) for a proposal of a seabird monitoring programme in the Barents Sea Region). When such a programme is being designed, it is, however, essential to address the following challenges:

- Define the principal objectives for the monitoring of marine birds in the Barents Sea Region.
- Standardise the selection of species for monitoring in relation to their ecological roles, representativeness, distribution patterns, conservation status and environmental sensitivity, as well as their suitability as indicators of changes induced by natural variation and human interference. In this context, it is especially important to take into account the spatial and temporal scales of environmental factors affecting the populations, including the most important current and potential threats.
- Standardise the selection of parameters to monitor, paying special attention to population size, survival rates, reproduction, trophic processes (e.g. feeding ecology and

Table 5.11. Summary of the monitoring priorities by species with indication of maximum score assigned to one or several sub-regions under each threat category (FI = fisheries, HA = harvesting, BY = by-catch, OI = oil, PO = other pollutants, DI = disturbance, AR = area encroachments and CO = conflicting species). Priority categories are: 3 (red) = high, 2 (orange) = medium, 1 (yellow) = low.

Species	Threat								Max
	FI	HA	BY	OI	PO	DI	AR	CO	
Great northern diver			2	1		3	2	2	3
Northern fulmar			1	1					1
European storm-petrel				1				1	1
Leach's storm-petrel				1				1	1
Northern gannet						2		2	2
Great cormorant	3	2	3	3	1				3
European shag	3		2	3				1	3
Greylag goose		2		1		1			2
Barnacle goose		2		3				2	3
Brent goose				3		3		2	3
Common eider	1	2	3	3	1	3	2	1	3
King eider		2	1	2	1	1	1	1	2
Steller's eider			1	3		1			3
Long-tailed duck		1	1	1	1	1	1	1	1
Black scoter				1		1	1		1
Velvet scoter				1		1	1		1
Red-breasted merganser				1		1	1		1
Grey phalarope				2	1	1	2	1	2
Arctic skua	1				1				1
Great skua					1				1
Sabine's gull				2				2	2
Black-headed gull				1	1	1	1		1
Mew gull		1			1	1	1	1	1
Lesser black-backed gull	3	1		2	1				3
Herring gull	2	1			1	1			2
Glaucous gull				3	3				3
Great black-backed gull	2	1			1	1			2
Black-legged kittiwake	2			3					3
Ivory gull				2		3			3
Common tern	1			1				1	1
Arctic tern	1			1				1	1
Common guillemot	3	2	3	3		2	1		3
Brünnich's guillemot	3	3		3	1	2			3
Razorbill	2		2	3		2			3
Black guillemot			2	2	1	1		1	2
Little auk				3	1				3
Atlantic puffin	3		1	3				1	3

predation rates) and contamination levels.

- Standardise the monitoring methods to be used, seeking to implement internationally accepted methods as far as possible.
- Standardise the monitoring effort with respect to representativeness and numbers of monitoring sites, size and numbers of counting plots, intra- and inter-annual counting frequency and the statistical soundness required for analytical purposes (e.g. the detectability of trends).
- Develop a system that ensures proper quality control and routine evaluation of the results at an international level.
- Seek to co-ordinate the activity with any ongoing or future monitoring of other organisms, processes and physical factors in the marine environment.
- Communicate the aims and principles applied in the monitoring of marine birds in order to influence the design of other programmes (including any new initiatives) of special relevance to the marine ecosystems within the region.

Unless a species is of particular interest with respect to its ecological role, representativeness or likeliness to be affected by a specific threat, it should fulfil at least one of the following criteria in order to qualify for monitoring:

- Exhibit one or more qualities that are recognised as sensitive indicators of changes in the marine ecosystem.
- Be recognised as threatened or vulnerable (e.g. as defined by IUCN (1996)).
- Be associated with a special conservation responsibility stated by national or international conventions.

To summarise, the monitoring of marine birds in the Barents Sea Region needs to be extensive and focused, foresighted and sensitive, representative and rational, standardised and methodologically sound, multidisciplinary and processes-oriented, result-oriented and productive, and regularly evaluated. To what extent it is possible to fulfil all these ideals will depend on the available logistic and economic resources. In a broader perspective, one should also explore the possibilities for using marine birds more actively as indicators of changes in Arctic marine ecosystems, for instance by adopting the model used in the CCAMLR Ecosystem Monitoring Programme (CEMP) for Antarctica (Agnew 1997). Obviously, this must be done in co-operation with the other CAFF (Conservation of Arctic Flora and Fauna) countries, and may be considered a suitable task for CAFF's Circumpolar Seabird Working Group (CSWG).

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Appendix 1. Marine bird species treated in this report

(English – scientific – Norwegian – Russian)

Great northern diver – *Gavia immer* – Islom – Chernoklyuvaya gagara
Northern fulmar (Fulmar) – *Fulmarus glacialis* – Havhest – Glupysh
European storm-petrel (Storm petrel) – *Hydrobates pelagicus* – Havsvale – Pryamokhvostaya kachurka
Leach's storm-petrel (Leach's petrel) – *Oceanodroma leucorhoa* – Stormsvale – Severnaya kachurka
Northern gannet (Gannet) – *Morus bassanus* – Havsule – Severnaya olusha
Great cormorant (Cormorant) – *Phalacrocorax carbo* – Storskarv – Bol'shoy baklan
European shag (Shag) – *Phalacrocorax aristotelis* – Toppskarv – Khokhlaty baklan
Greylag goose – *Anser anser* – Grågås – Sery gus
Barnacle goose – *Branta leucopsis* – Hvitkinngås – Beloshchekaya kazarka
Brent goose – *Branta bernicla* – Ringgås – Chyernaya kazarka
Common eider (Eider) – *Somateria mollissima* – Ærfugl – Obyknovennaya gaga
King eider – *Somateria spectabilis* – Praktærfugl – Gaga-grebenushka
Steller's eider – *Polysticta stelleri* – Stellerand – Sibirskaya gaga
Long-tailed duck – *Clangula hyemalis* – Havelle – Moryanka
Black scoter (Common scoter) – *Melanitta nigra* – Svartand – Sin'ga
Velvet scoter (White-winged scoter) – *Melanitta fusca* – Sjøorre – Turpan
Red-breasted merganser – *Mergus serrator* – Siland – Dlinnonosy krokhal'
Eurasian oystercatcher (Oystercatcher) – *Haematopus ostralegus* – Tjeld – Kulik-soroka
Purple sandpiper – *Calidris maritima* – Fjæreplytt – Morskoy pesochnik
Ruddy turnstone (Turnstone) – *Arenaria interpres* – Steinvender – Kamnesharka
Red-necked phalarope – *Phalaropus lobatus* – Svømmesnipe – Kruglonosy plavunchik
Grey phalarope (Red phalarope) – *Phalaropus fulicarius* – Polarsvømmesnipe – Ploskonosyi plavunchik
Arctic skua – *Stercorarius parasiticus* – Tyvjo – Korotkokhvosty pomornik
Great skua – *Catharacta skua* – Storjo – Bol'shoy pomornik
Sabine's gull – *Xema sabini* – Sabinemåke- Vilokhvostaya chayka
Black-headed gull (Common black-headed gull) – *Larus ridibundus* – Hettemåke – Ozernaya chayka
Mew gull (Common gull) – *Larus canus* – Fiskemåke – Sizaya chayka
Lesser black-backed gull – *Larus fuscus* – Sildemåke – Klusha
Herring gull – *Larus argentatus* – Gråmåke – Serebristaya chayka
Glaucous gull – *Larus hyperboreus* – Polarmåke – Burgomistr
Great black-backed gull – *Larus marinus* – Svartbak – Morskaya chayka
Black-legged kittiwake (Kittiwake) – *Rissa tridactyla* – Krykkje – Moevka
Ivory gull – *Pagophila eburnea* – Ismåke – Belaya chayka
Common tern – *Sterna hirundo* – Makrellterne – Rechnaya krachka
Arctic tern – *Sterna paradisaea* – Rødnebbterne – Polyarnaya krachka
Common guillemot (Guillemot, Common murre) – *Uria aalge* – Lomvi – Tonkoklyuvaya kayra
Brünnich's guillemot (Thick-billed murre) – *Uria lomvia* – Polarlomvi – Tolstoklyuvaya kayra
Razorbill – *Alca torda* – Alke – Gagarka
Black guillemot – *Cepphus grylle* – Teist – Chistik
Little auk (Dovekie) – *Alle alle* – Alkekonge – Lyurik
Atlantic puffin (Puffin) – *Fratercula arctica* – Lunde – Tupik

Appendix 2. Conservation status of marine birds breeding in the Barents Sea Region

Species	National red list[1]		Global Red List (IUCN)[1]	Bern Convention[4]	Bonn Convention[4]
	Norway	Russia			
Great northern diver *Gavia immer*	R[2]			II	II
Northern fulmar *Fulmarus glacialis*				III	
European storm-petrel *Hydrobates pelagicus*				II	
Leach's storm-petrel *Oceanodroma leucorhoa*				II	
Northern gannet *Morus bassanus*				III	
Great cormorant *Phalacrocorax carbo*				III	
European shag *Phalacrocorax aristotelis*		R		III	
Greylag goose *Anser anser*				III	II
Barnacle goose *Branta leucopsis*				II	II
Brent goose *Branta bernicla*	V[2]	R		III	II
Common eider *Somateria mollissima*				III	II
King eider *Somateria spectabilis*				II	II
Steller's eider *Polysticta stelleri*			V	II	I/II
Long-tailed duck *Clangula hyemalis*	DM			III	II
Black scoter *Melanitta nigra*	DM			III	II
Velvet scoter *Melanitta fusca*	DM			III	II
Red-breasted merganser *Mergus serrator*				III	II
Eurasian oystercatcher *Haematopus ostralegus*				III	
Purple sandpiper *Calidris maritima*				II	II
Ruddy turnstone *Arenaria interpres*	R[2]			II	II
Red-necked phalarope *Phalaropus lobatus*				II	II
Grey phalarope *Phalaropus fulicarius*	V[2]			II	II
Arctic skua *Stercorarius parasiticus*				III	
Great skua *Catharacta skua*				III	
Sabine's gull *Xema sabini*	R[2]			II	
Black-headed gull *Larus ridibundus*				III	
Mew gull *Larus canus*				III	
Lesser black-backed gull *Larus fuscus*	E[3]				
Herring gull *Larus argentatus*					
Glaucous gull *Larus hyperboreus*				III	
Great black-backed gull *Larus marinus*					
Black-legged kittiwake *Rissa tridactyla*				III	
Ivory gull *Pagophila eburnea*	DM[2]	R		II	
Common tern *Sterna hirundo*				II	II
Arctic tern *Sterna paradisaea*				III	II
Common guillemot *Uria aalge*	V			III	
Brünnich's guillemot *Uria lomvia*				III	
Razorbill *Alca torda*	R[2]			III	
Black guillemot *Cepphus grylle*	DM			III	
Little auk *Alle alle*				III	
Atlantic puffin *Fratercula arctica*	DC			III	

[1] Categories: E (Endangered), V (Vulnerable), R (Rare), DC (Declining, care demanding), DM (Declining, monitor species). See the Norwegian Red List 1998 (Directorate for Nature Management 1999) and Anon (1983) for details.

[2] Included in the Red List for Svalbard only

[3] The sub species *Larus fuscus fuscus* only

[4] Species on List II of the Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats) are animals that should be protected against all harvesting, including egging and any form of hunting, whereas those on List III, which includes most other European bird species, should not be exploited in a way that may threaten their populations. List I of the Bonn Convention (Convention on Migratory Species) includes species or sub-species of migratory animals that are considered to be threatened by extinction. Those on List II are not threatened by extinction, but international co-operation is needed to ensure that they are properly protected.

Appendix 3. Geographic names and locations

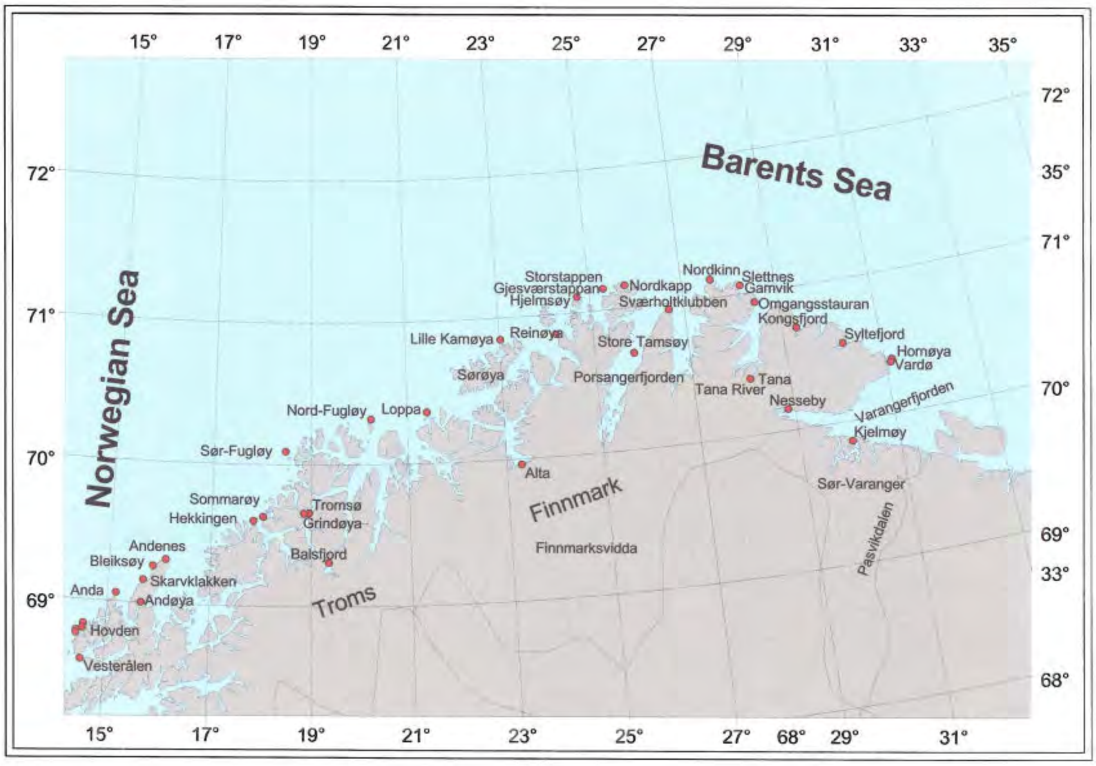
This appendix lists the names of the geographical sites used in this report and their geographical location (latitude and longitude). Regional maps of the Barents Sea Region showing the locations are also presented with detailed maps of important breeding areas of seabirds: Røst (Norway), Solovetski State Nature Reserve and Seven Islands Nature Reserve (both on the Murman coast). These maps may include geographical names not mentioned elsewhere in this report.

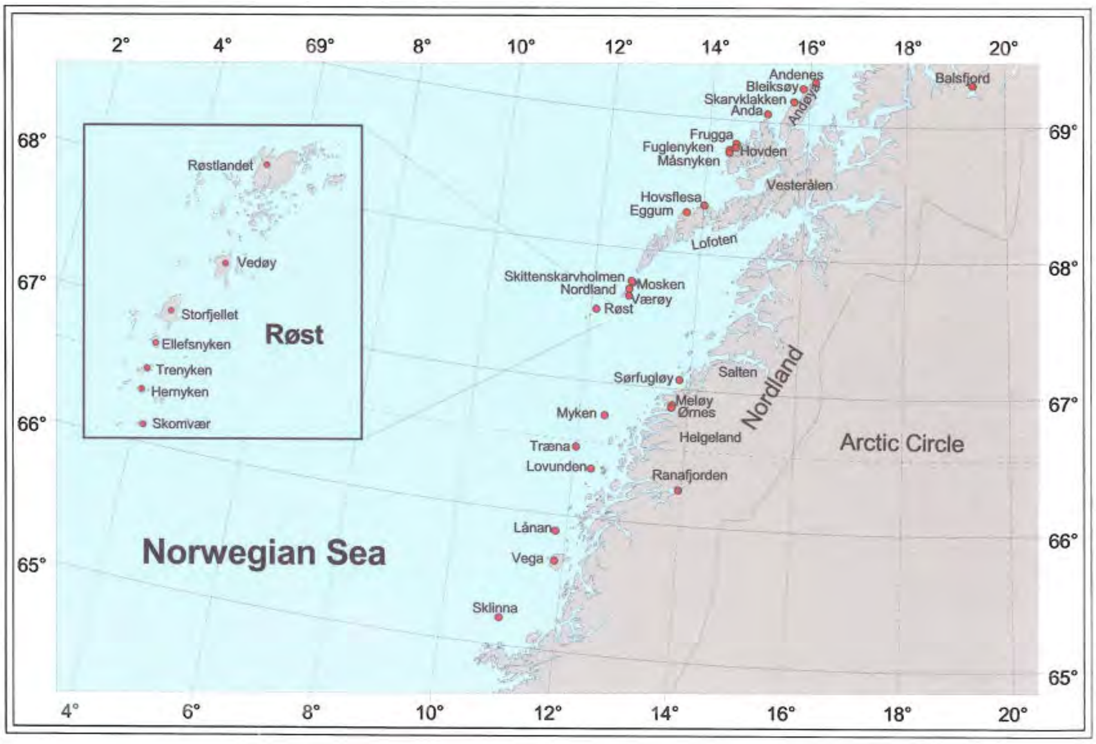
Geographical co-ordinates of localities on the Norwegian coast and in Svalbard mentioned in this report.

Geographical name	Latitude	Longitude
Adventdalen	78°11'N	15°55'E
Alta	69°58'N	23°18'E
Anda	69°04'N	15°10'E
Andenes	69°19'N	16°07'E
Andøya	69°00'N	15°40'E
Balsfjord	69°19'N	19°21'E
Barentsøya	78°22'N	20°54'E
Bellsund	77°39'N	13°51'E
Billefjorden	78°31'N	16°20'E
Bjørndalen	78°10'N	15°17'E
Bjørnøya	74°24'N	19°13'E
Bleiksøy	69°16'N	15°52'E
Edgeøya	77°51'N	22°13'E
Eggum	68°18'N	13°41'E
Erkna	62°33'N	5°57'E
Finnmark	70°10'N	27°30'E
Finnmarksvidda	69°30'N	25°00'E
Flø	62°25'N	5°53'E
Frugga	68°50'N	14°34'E
Fuglenyken	68°47'N	14°26'E
Gamvik	71°04'N	28°15'E
Gipsvika	78°26'N	16°27'E
Gjesvær	71°06'N	25°23'E
Gjesværstappan	71°08'N	25°01'E
Grindøya	69°38'N	18°52'E
Hekkingen	69°36'N	17°50'E
Helgeland	66°42'N	13°49'E
Hjelmsøy	71°07'N	24°44'E
Holmevatnet	74°28'N	19°08'E
Hopen	76°34'N	25°13'E
Hornsund	76°57'N	15°11'E
Hornøya	70°23'N	31°09'E
Hovden	68°48'N	14°33'E
Hovsflesa	68°22'N	14°01'E
Isfjorden	78°09'N	13°55'E
Ismåsefjellet	79°41'N	21°02'E
Kapp Linne	78°04'N	13°28'E
Kjelmøy	69°52'N	30°03'E
Kongsfjord	70°43'N	29°18'E
Kongsfjorden	79°01'N	11°33'E
Kovalskifjella	77°04'N	17°07'E
Krossfjorden	79°05'N	11°33'E
Kvitøya	80°11'N	32°11'E
Laksvatnet	74°29'N	19°05'E
Lille Kamøy	66°41'N	12°58'E
Lofoten	67°43'N	15°33'E
Lomvatnet	74°30'N	19°07'E
Longyearbyen	78°14'N	15°39'E
Loppa	70°22'N	21°25'E

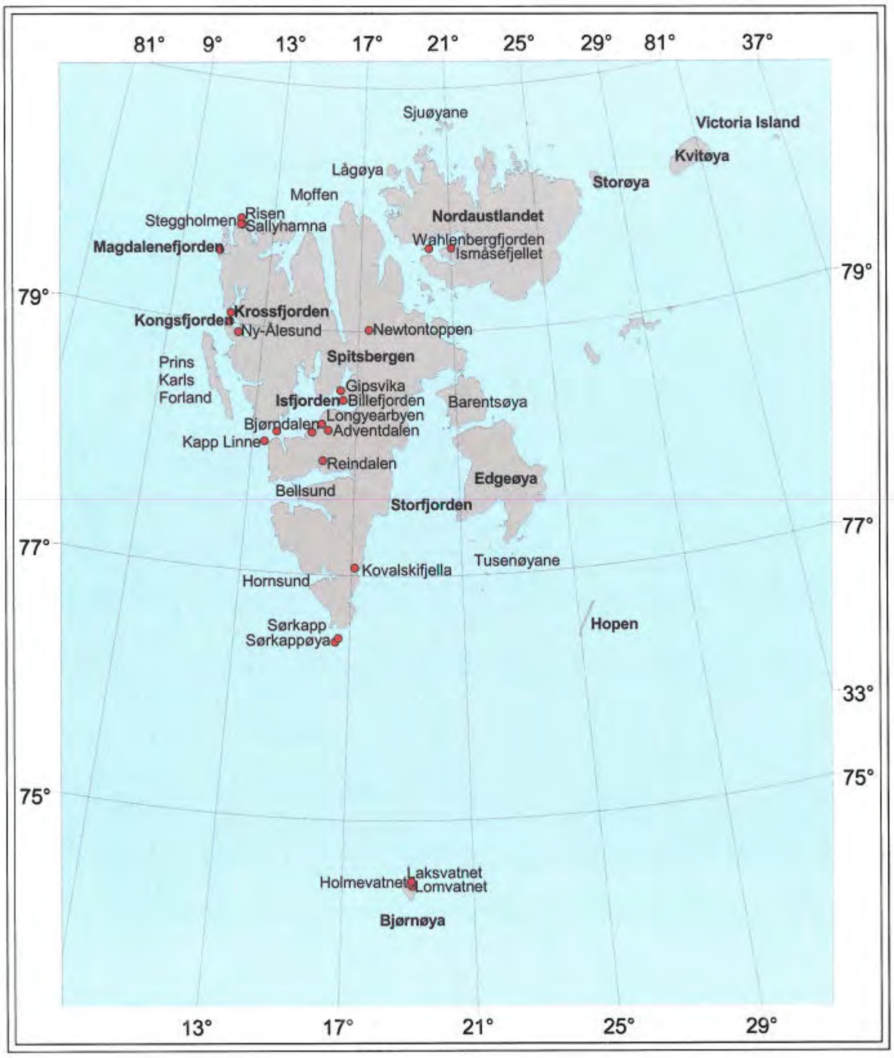
Geographical name	Latitude	Longitude
Lovunden	66°22'N	12°20'E
Lågøya	80°20'N	18°20'E
Lånan	65°53'N	11°49'E
Magdalenefjorden	79°35'N	10°44'E
Meløy	66°53'N	13°43'E
Moffen	80°01'N	14°34'E
Mosken	67°45'N	12°46'E
Myken	66°46'N	12°29'E
Måsnyken	68°46'N	14°26'E
Nesseby	70°09'N	28°52'E
Newtontoppen	79°01'N	17°25'E
Nordaustlandet	79°50'N	21°08'E
Nord-Fugløy	67°04'N	13°51'E
Nordkapp	71°10'N	25°47'E
Nordkinn	71°08'N	27°38'E
Nordland	67°42'N	12°42'E
Ny-Ålesund	78°56'N	11°58'E
Omgangsstauran	70°56'N	28°31'E
Pasvikdalen	69°49'N	30°34'E
Porsangerfjord	70°58'N	26°28'E
Prins Karls Forland	78°23'N	11°36'E
Ranafjord	66°16'N	13°57'E
Reindalen	77°56'N	15°46'E
Reinøya	70°52'N	24°13'E
Risen	79°52'N	11°30'E
Runde	62°24'N	5°37'E
Røst	67°32'N	12°07'E
Sallyhamna	79°49'N	11°35'E
Salten	67°10'N	15°10'E
Sjuøyane	80°42'N	20°26'E
Skarvklakken	69°10'N	15°41'E
Skittenskarvholmen	67°46'N	12°44'E
Sklinna	65°12'N	11°00'E
Slettnes	71°04'N	28°15'E
Sommarøy	69°38'N	18°02'E
Spitsbergen	78°47'N	20°43'E
Steggholmen	79°49'N	11°30'E
Store Tamsøy	70°41'N	25°50'E
Storfjorden	78°01'N	20°42'E
Storstappen	71°09'N	25°19'E
Storøya	80°04'N	28°15'E
Sværholtklubben	70°57'N	26°42'E
Syltefjord	70°33'N	30°13'E
Sør-Fugløy	67°03'N	13°47'E
Sørkapp	76°27'N	16°30'E
Sørkappøya	76°29'N	16°37'E
Sør-Varanger	69°52'N	28°55'E
Tana	70°24'N	28°11'E
Tana River	69°29'N	25°52'E

Geographical name	Latitude	Longitude	Geographical name	Latitude	Longitude
Tromsø	69°40'N	18°57'E	Vega	65°40'N	11°51'E
Træna	66°31'N	12°01'E	Vesterålen	68°35'N	14°33'E
Tusenøyane	77°12'N	21°21'E	Værøy	67°39'N	12°43'E
Varangerfjord	70°02'N	30°23'E	Wahlenbergfjorden	79°41'N	20°02'E
Vardø	70°22'N	31°07'E	Ørnes	66°52'N	13°42'E
Vedøy	67°30'N	12°00'E			





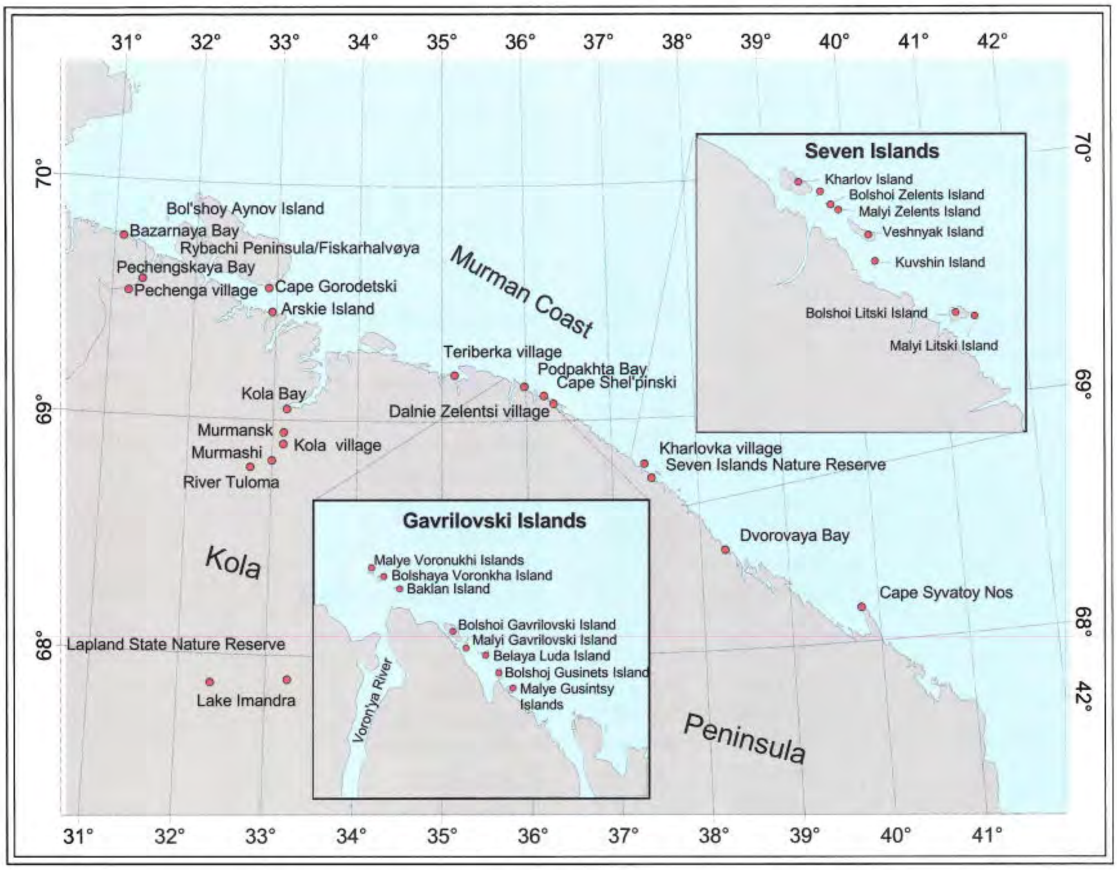
Maps of the Norwegian coast with localities mentioned in this report



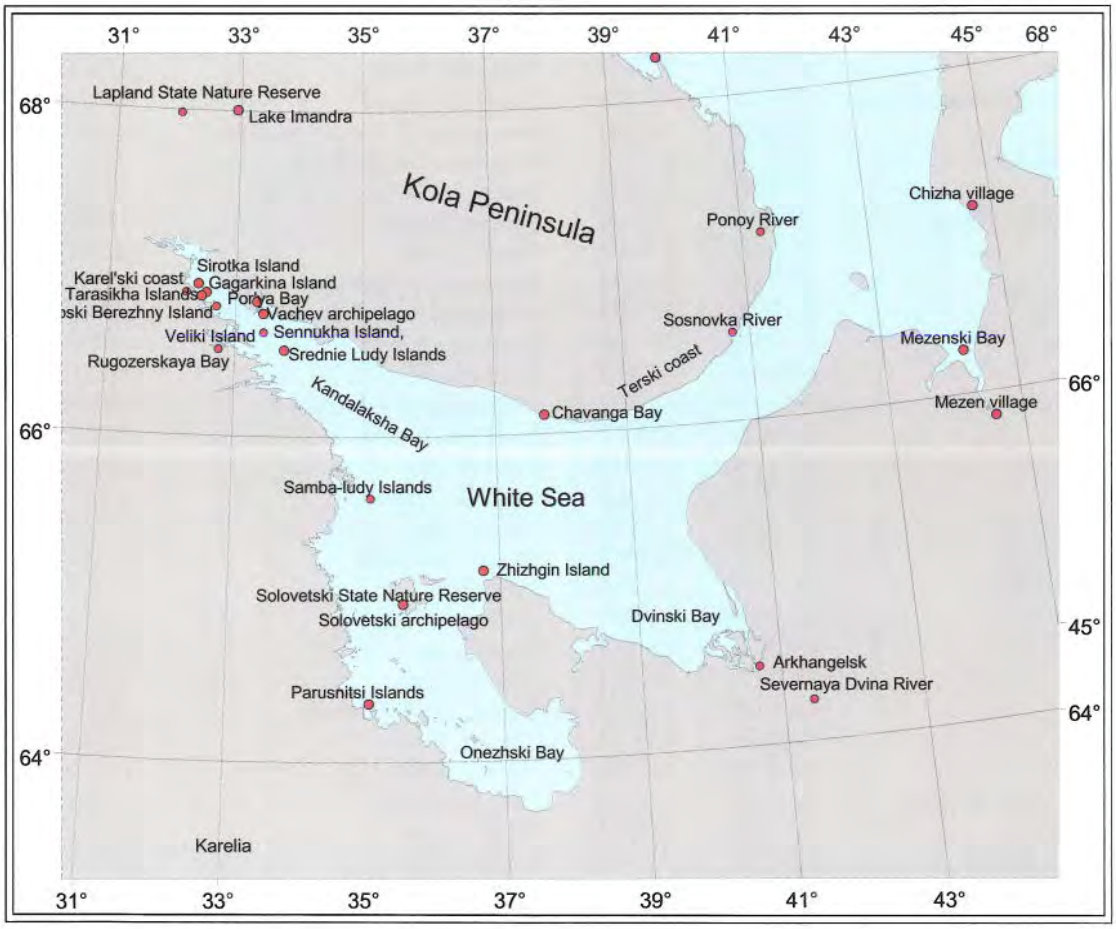
Map of Svalbard with localities mentioned in this report

Geographical co-ordinates of localities in the Russian parts of the Barents Sea Region mentioned in this report.

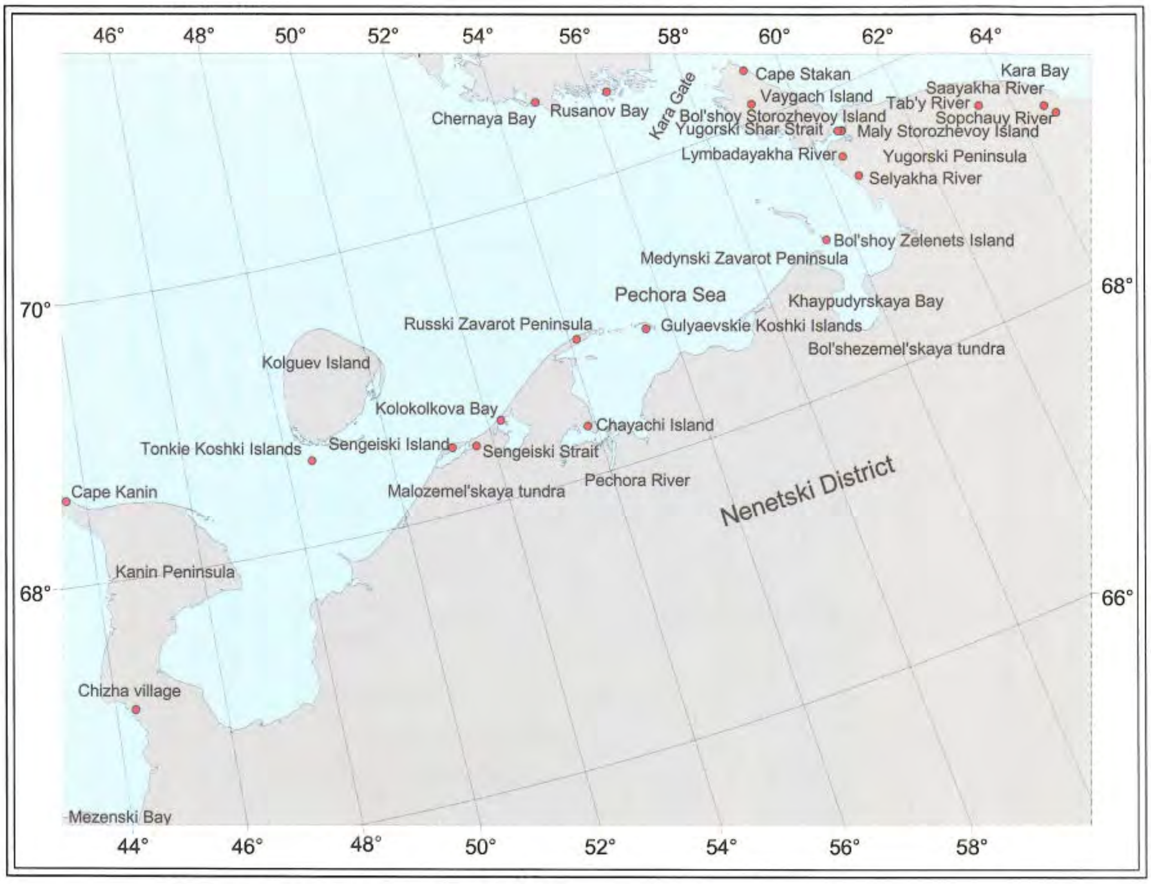
Geographical name	Latitude	Longitude
Alexandra Land	80°78'N	47°41'E
Arkhangelsk	64°33'N	40°33'E
Arkhangel'skaya Bay	75°83'N	58°76'E
Bazarnaya Bay	69°46'N	31°03'E
Bell Island	79°98'N	49°28'E
Bezymyannaya Bay	72°90'N	53°10'E
Bol'shezemel'skaya tundra	68°00'N	60°00'E
Bol'shoy Aynov Islands	69°50'N	31°35'E
Bol'shoy Storozhevoy Island	69°70'N	60°65'E
Bol'shoy Zelenets Island	69°03'N	59°48'E
Cape Bystrov	81°31'N	55°50'E
Cape Dillon	80°05'N	55°50'E
Cape Fischer	81°01'N	54°26'E
Cape Flora	79°96'N	50°10'E
Cape Germania	81°81'N	58°00'E
Cape Gorodetski	69°56'N	32°85'E
Cape Grant	80°05'N	47°71'E
Cape Kanin	68°65'N	43°28'E
Cape Konstantin	76°51'N	69°00'E
Cape Lil'e	71°46'N	52°30'E
Cape Morozov	71°46'N	52°45'E
Cape Prokof'ev	74°23'N	55°18'E
Cape Shel'pinski	69°07'N	36°10'E
Cape Stakan	70°22'N	59°15'E
Cape Syvatoy Nos	68°15'N	39°75'E
Chavanga Bay	66°10'N	37°75'E
Chayachi Island	68°35'N	53°83'E
Chernaya Bay	70°65'N	54°85'E
Chizha village	67°08'N	44°35'E
Dvorovaya Bay	68°43'N	38°23'E
Gagarkina Island	66°83'N	32°80'E
Gavrilovskie Islands Nature Reserve	69°10'N	32°48'E
George Island	80°30'N	49°00'E
Graham Bell Island	80°54'N	64°00'E
Gribovaya Bay	73°00'N	53°20'E
Gulyaevskie Koshki Islands	68°88'N	55°50'E
Hooker Island	80°10'N	53°00'E
Imandra Lake	67°90'N	33°20'E
Jackson Island	81°15'N	57°00'E
Kandalaksha Bay	67°00'N	32°30'E
Kanin Peninsula	68°00'N	45°00'E
Kara Gate	70°26'N	57°57'E
Kara Sea	76°00'N	78°00'E
Karelia	63°20'N	34°00'E
Karel'ski Coast	66°50'N	32°30'E
Kharlovka village	68°49'N	37°20'E
Khaypudyrskaya Bay	68°50'N	60°00'E
Kholmisty Peninsula	81°13'N	64°58'E
Kola village	68°90'N	33°08'E
Kola Bay	69°05'N	33°11'E
Kolguev Island	69°00'N	49°00'E
Kolokolkova Bay	68°56'N	52°25'E
Krestovaya Bay	74°13'N	55°63'E
Krivosheina Bay	75°60'N	58°26'E
Lapland State Nature Reserve	67°53'N	32°20'E
Lymbalayakha River	69°53'N	60°45'E
Malozemel'skaya tundra	68°00'N	51°30'E
Maly Aynov Island	69°50'N	31°35'E
Maly Karmakul'ski Island	72°40'N	52°68'E
Maly Storozhevoy Island	69°70'N	60°63'E
McClintock Island	80°05'N	56°30'E
Medynski Zavarot Peninsula	68°50'N	59°00'E
Mezen village	65°85'N	44°25'E
Mezenski Bay	66°25'N	43°91'E
Mezhdusharski Bay	71°17'N	52°55'E
Mityushikha Bay	73°43'N	54°08'E
Murmansk	68°57'N	33°05'E
Murmashi	68°50'N	32°57'E
Northbrook Island	80°00'N	51°00'E
Onezhski Bay	64°10'N	37°00'E
Oranskie Islands	77°03'N	67°70'E
Parusnitsi Islands	64°26'N	35°12'E
Pechenga village	69°53'N	31°15'E
Pechengskaya Bay	69°58'N	31°31'E
Pechora River	67°40'N	52°30'E
Pechora Sea	69°30'N	56°00'E
Petersen glacier	76°53'N	67°00'E
Ploski Berezhny Island	66°45'N	32°58'E
Podpakhta Bay	69°09'N	35°56'E
Ponoy River	67°05'N	41°08'E
Por'ya Bay	66°78'N	33°56'E
Pukhovoy Bay	72°65'N	52°58'E
Pukhovoy Island	72°61'N	52°65'E
Rubini Rock	80°31'N	52°81'E
Rugozerskaya Bay	66°30'N	33°00'E
Rusanov Bay	70°56'N	56°36'E
Russkaya Gavan Bay	76°21'N	62°58'E
Russki Zavarot Peninsula	68°96'N	54°13'E
Sakhanikha River	71°60'N	51°60'E
Samba-ludy Islands	65°38'N	35°14'E
Selyakha River	69°36'N	60°60'E
Sengeiski Strait	68°43'N	51°66'E
Sennukha Island	66°71'N	33°66'E
Seven Islands Nature Reserve	68°45'N	37°25'E
Severnaya Dvina River	64°20'N	41°15'E
Severnaya Sul'meneva Bay	74°41'N	55°75'E
Severny Island	75°40'N	61°00'E
Sirotka Island	66°88'N	32°68'E
Solovetski archipelago	65°01'N	35°68'E
Solovetski State Nature Reserve	65°01'N	35°41'E
Sopchauy River	69°18'N	64°71'E
Sosnovka River	66°31'N	40°35'E
Srednie Ludy Islands	66°36'N	33°40'E
Stolichka Island	81°10'N	58°20'E
Svyatoy Nos	68°09'N	39°45'E
Saayakha River	69°26'N	64°56'E
Tab'yu River	69°28'N	63°23'E
Tarasikha Islands	66°81'N	32°73'E
Teriberka	69°20'N	35°10'E
Teriberka village	69°12'N	35°06'E
Terski coast	66°10'N	39°00'E
Tikhaya Bay	80°20'N	53°00'E
Tonkie Koshki Islands	68°60'N	48°48'E
Tuloma River	68°48'N	32°42'E
Vachev archipelago	66°45'N	32°58'E
Vaygach Island	70°00'N	60°00'E
Veliki Island	66°30'N	33°00'E
Vil'kitski Bay	75°55'N	57°98'E
Yugorski Shar Strait	69°71'N	60°56'E
Yuzhni Island	72°00'N	54°00'E
Zhizhgin Island	65°20'N	36°81'E



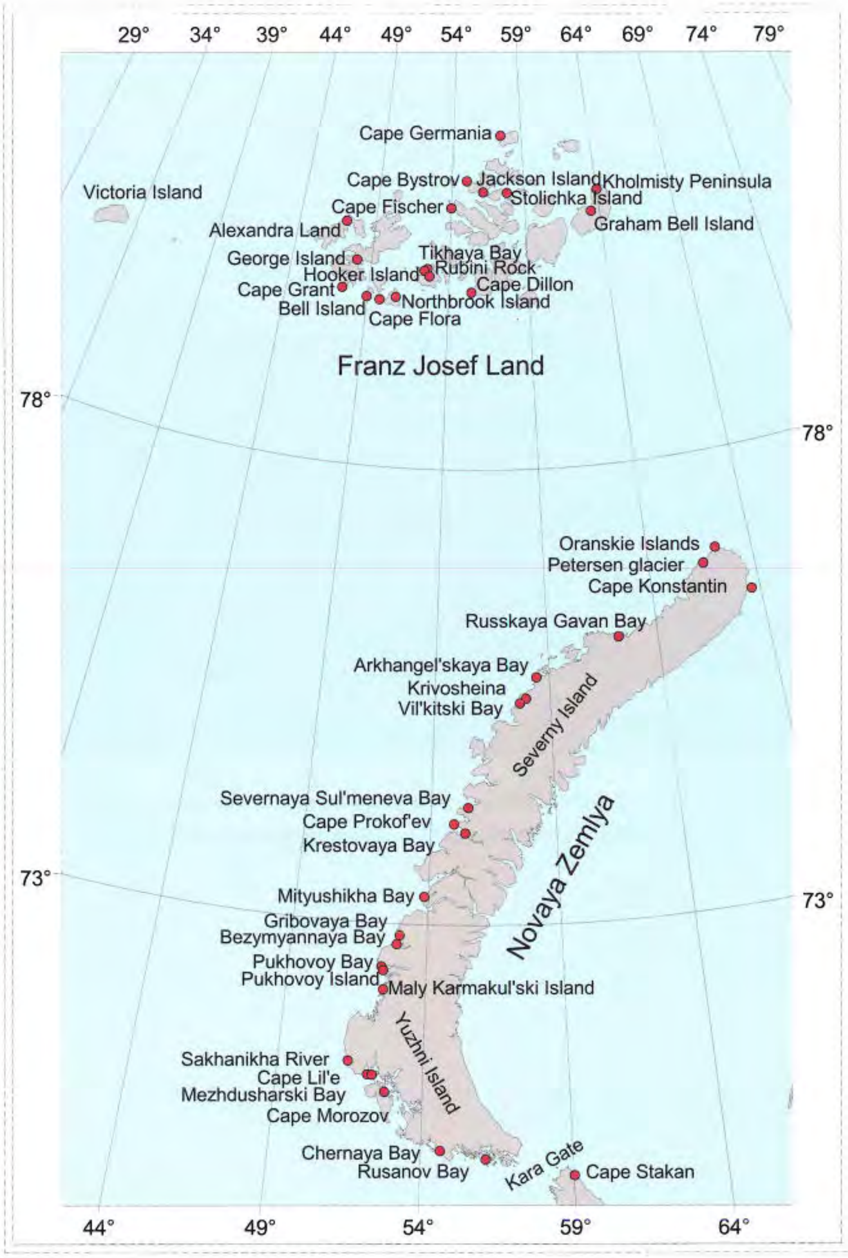
Map of the Murman coast with localities mentioned in this report



Map of the White Sea with localities mentioned in this report



Map of the Nenetski district with localities mentioned in this report



Map of Novaya Zemlya and Franz Josef Land with localities mentioned in this report

Appendix 4. Status of the marine bird monitoring in the Barents Sea Region

Monitoring of marine birds on the Norwegian coast

The monitoring programme for breeding marine birds on the Norwegian coast started in 1988 (Lorentsen 1998). It was partly based on monitoring begun during the Norwegian Seabird Project run from 1979-1984 by the Wildlife Research Division of the Directorate for Wildlife and Freshwater Fish (DVF), the predecessor of the Directorate for Nature Management (DN) (Røv *et al.* 1984). In 1995, the monitoring of wintering marine birds, carried out annually since 1980, was merged with the breeding seabirds' programme to form the "National Monitoring Programme for Seabirds". This is being co-ordinated by the Norwegian Institute for Nature Research (NINA), which was founded in 1988 as the successor of DN's two research divisions.

The species whose breeding population size is being monitored along the Norwegian coast north of the Arctic Circle are listed in Table 1. Most colonies are monitored annually. During the 1990s, adult survival rates have been monitored annually by colour-banding schemes for Atlantic puffins *Fratercula arctica* and (from 1996) black guillemots *Cepphus grylle* in Røst (Nordland), common eiders *Somateria mollissima* on Grindøy (Troms), and black-legged kittiwake *Rissa tridactyla*, common guillemots *Uria aalge*, Brünnich's guillemots *Uria lomvia*, razorbills *Alca torda* (from 1995) and Atlantic puffins on Hornøy (Finnmark). The breeding success of some auk species (primarily Atlantic puffin and guillemots) and the food they give their chicks, as well as several other population parameters, are also being monitored annually in Røst and Hornøy as aspects of other projects (see e.g. Anker-Nilssen 1998b, Erikstad, Anker-Nilssen *et al.* 1998).

The national monitoring programme was evaluated in 1996 (Anker-Nilssen *et al.* 1996) and a revised plan for the future monitoring was drawn up (Anker-Nilssen & Lorentsen 1997).

Table 1. Species monitored in the counties along the Norwegian coast north of the Arctic Circle. The number of colonies monitored within each county is indicated.

Species	County		
	Nordland	Troms	Finnmark
Northern fulmar	1	–	1
Northern gannet	5	–	2
Great cormorant	Several	–	Several
European shag	1	–	Several
Great skua	–	–	1
Gulls/terns	Several	–	–
Black-legged kittiwake	1	–	2
Razorbill	1	–	1
Common guillemot	1	–	2
Brünnich's guillemot	–	–	2
Atlantic puffin	1	–	2

One result of the evaluation was the realisation that some populations can be monitored adequately with a somewhat reduced input of effort. More importantly, however, the evaluation clearly demonstrated how inadequately population parameters, other than numerical trends, were being monitored. Special emphasis needed to be put on determining survival and recruitment rates (including reproduction), which are essential parameters when attempts are to be made to discern the mechanisms that explain the most obvious population changes. Unfortunately, the conservation authorities have still not raised the funds needed to improve the programme as recommended.

The monitoring of wintering marine birds is primarily motivated by a concern for Norway's internationally important wintering populations of species that do not breed on the Norwegian coast, namely the great northern diver *Gavia immer*, white-billed diver *G. adamsii*, red-necked grebe *Podiceps grisegena*, king eider *Somateria spectabilis*, Steller's eider *Polysticta stelleri*, and the inland breeding long-tailed duck *Clangula hyemalis* and velvet scoter *Melanitta fusca* (Røv *et al.* 1984). This part of the programme includes four areas north of the Arctic Circle (in Salten, Vesterålen, Troms and Varanger) where a census takes place every winter in close co-operation with the regional and local ornithological societies and environmental authorities.

Monitoring of marine birds in Russia

Monitoring of marine birds in the Russian part of the Barents Sea Region only takes place in the White Sea and along the Murman coast, and is organised by the Kandalaksha State Nature Reserve. This reserve has been collecting data on eider numbers in the protected parts of the White Sea since the 1930s. The number of breeders among various other species of marine birds has also been monitored in Kandalaksha Bay and on the Murman coast since the 1930s or the beginning of the 1950s.

The Kandalaksha State Nature Reserve has started to systematise and analyse the monitoring data stored in its archives. In contrast to monitoring data on marine birds elsewhere, some of these data sets are unique as they cover a period of more than 60 years! High priority should be given to continuing the effort to make these available for extensive, long-term analyses. Unfortunately, no details concerning which species and colonies are being monitored were compiled for this report.

Monitoring of marine birds in Svalbard

The monitoring of marine birds in Svalbard is being co-ordinated by the Norwegian Polar Institute. It began on Bjørnøya in 1986 and in other parts of Svalbard in 1988. In addition to those on Bjørnøya, nine colonies are now included in the monitoring of population trends. Most of them are situated on western Spitsbergen, where the common eider population is also being monitored in one area (Kongsfjorden). On Bjørnøya, monitoring plots are located around the southern part of the island.

A few very remote colonies are not visited every year due to high transport costs and logistic difficulties, but most other colonies are monitored annually. Other population parameters than population size are only monitored on Bjørnøya and include annual adult survival rates and the food given to common and Brünnich's guillemot chicks. Organising long stays is a problem in the other colonies, and the number of counts in the study plots is therefore much smaller than recommended, especially for Brünnich's guillemots.

Plans now exist for having the monitoring programme in Svalbard evaluated. Northern fulmars *Fulmarus glacialis*, common eiders, black-legged kittiwakes, common guillemots (only Bjørnøya) and Brünnich's guillemots are the species now being monitored in Svalbard (Table 2).

Table 2. Species monitored in Svalbard. The number of colonies monitored on each island is given.

Species	Island		
	Bjørnøya	Spitsbergen	Edgeøya
Northern fulmar	1	3	–
Common eider	–	13	–
Black-legged kittiwake	1	11	1
Common guillemot	1	–	–
Brünnich's guillemot	1	11	–

Appendix 5. International strategies

A number of international processes on conservation issues and research in the Arctic have recently been established. The largest is the Arctic Environmental Protection Strategy (AEPS) adopted by Canada, Denmark/Greenland, Finland, Iceland, Norway, Russia, Sweden and the United States through a Ministerial Declaration at Rovaniemi, Finland, in 1991 (information from AEPS' web-site). Greater awareness of anthropogenic pollution in the Arctic, and concern over its possible effects, led to the adoption of the AEPS. Its objectives are:

- to protect the Arctic ecosystems, including humans
- to provide for the protection, enhancement and restoration of natural resources, including their use by local populations and indigenous peoples of the Arctic
- to recognise and, as far as possible, seek to accommodate the traditional and cultural needs, values and practices of the indigenous peoples as determined by themselves, related to the protection of the Arctic environment
- to review regularly the state of the Arctic environment
- to identify, reduce and, as a final goal, eliminate pollution.

The following programmes have been established to meet the AEPS objectives: Conservation of Arctic Flora and Fauna (CAFF), Arctic Monitoring and Assessment Programme (AMAP), Emergency Prevention, Preparedness and Response (EPPR) and Protection of the Arctic Marine Environment (PAME). At the AEPS Ministerial meeting held in Alta, Norway, in June 1997, the existing working groups of the AEPS were integrated within the Arctic Council (AC).

The AC was established on September 19th, 1996 in Ottawa, Canada. The main activities of the Council focus on the protection of the Arctic environment and sustainable development as a means of improving the economic, social and cultural well-being of the north. The Council meets at the ministerial level biennially. The Chair and Secretariat of the Council rotates every two years among the eight Arctic States.

Conservation of Arctic Flora and Fauna (CAFF)

The CAFF programme was established to address the special needs of Arctic species and their habitats in the rapidly developing Arctic region (information from CAFF's web-site). Its main goals, which are being achieved in keeping with the concepts of sustainable development and utilisation, are:

- to conserve Arctic flora and fauna, their diversity and their habitats
- to protect the Arctic ecosystem from threats
- to seek to develop improved conservation management, laws, regulations and practices for the Arctic
- to collaborate for more effective research, sustainable utilisation and conservation
- to integrate Arctic interests into global conservation fora.

The majority of CAFF's activities are directed at species and habitat conservation and at integrating indigenous peoples and their knowledge into CAFF. Its work is grouped under several main themes, including habitat conservation, species conservation, biodiversity conservation in the Arctic region, integrating indigenous people and their knowledge, and programme management. CAFF works in co-operation with other international organisations and associations to achieve common conservation goals in the Arctic.

The CAFF Circumpolar Seabird Working Group (CSWG) was established in 1993 under the leadership of the USA. It meets annually and publishes the Circumpolar Seabird Bulletin. The CSWG has identified 43 species of colonial nesting seabirds which have breeding distributions that are substantially Arctic or sub-Arctic. Eight species of seabirds are included in CAFF's List of Indicator Species. The CSWG has identified the main causes of the steady population decline in some seabird species:

- heavy hunting pressure
- mortality in commercial fishing operations
- human disturbances at seabird colonies (development activities, shipping, tourism)
- oil pollution
- introduced predators (e.g. mink, cats)
- competition with fisheries

The Seabird Group is designing a circumpolar seabird monitoring network to provide more accurate data on the population, productivity, distribution and status of seabirds at the circumpolar level. It will be based on current national monitoring efforts.

At the inaugural meeting of CAFF in 1992, participants expressed concern over the conservation of several seabird species and agreed to focus attention on the common guillemot *Uria aalge* and the Brünnich's guillemot *Uria lomvia* to prepare a circumpolar conservation strategy for which they received ministerial concurrence at Nuuk. Guillemots (murres in North America) were selected because they have a circumpolar distribution, are migratory, are vulnerable to the effects of many human activities and are used as food in many Arctic countries. The International Murre Conservation Strategy and Action Plan (CSWG 1996) has been completed and received ministerial approval at Inuvik in 1996. Later, a similar strategy for eiders (common eider *Somateria molissima*, king eider *Somateria spectabilis*, spectacled eider *Somateria fischeri* and Steller's eider *Polysticta stelleri*) has been prepared (CSWG 1997). These strategies are of great importance for planning future work on guillemots and eiders in the Barents Sea Region.

The other Arctic Council programmes

The Arctic Monitoring and Assessment Programme (AMAP) is an international organisation established to measure levels and assess effects of anthropogenic pollutants in the Arctic environment (information from AMAP's web-site). An important aspect is the design and implementation of a co-ordinated programme to monitor the levels of pollutants and assess the effects of pollution in all compartments of the Arctic environment, the marine environment being one of the main ones.

The programme for Emergency Prevention, Preparedness and Response (EPPR) is a network for information on Arctic accidents and for facilitating co-operation among the Arctic states in the areas of emergency prevention, preparedness and response. Having a joint plan is crucial for ensuring that many marine birds are not affected by accidents, but the programme is not important for planning future work on seabirds in the Barents Sea Region. The programme for the Protection of the Arctic Marine Environment (PAME) addresses policy and non-emergency response measures related to the protection of the arctic marine environment from land- and sea-based activities. This programme, too, is important for protecting marine birds, but it is working on a higher level than the joint Russian-Norwegian seabird group. The Working Group on Sustainable Development (SDWG) was established by Arctic Ministers at the first Arctic Council Ministerial meeting in 1998. The objective of the SDWG is to protect and enhance the economies, culture and health of the inhabitants of the Arctic, in an environmentally sustainable manner.

Appendix 6. Joint Russian-Norwegian seabird projects 1990-1999

This appendix gives a brief summary of 14 joint Russian-Norwegian projects on seabirds carried out in the Barents Sea Region and the Kara Sea in the 1990s. Only projects dealing with species having a year-round marine distribution are described. Each project summary has the following arrangement: year started, year concluded, aims, description, publications and the names and addresses of contact persons (usually the Russian and Norwegian project leaders).

Except for the International Northern Sea Route Programme (INSROP), all the projects were organised by the bilateral Seabird Expert Group established in 1989 under the Joint Norwegian Russian Commission on Environmental Co-operation. The projects are presented in chronological order according to their year of initiation.

Project 1: Environmental pollutants in arctic seabirds

Project start: 1990
Duration: Long-term study

Project aims: Monitor the environmental contaminants in seabirds breeding in the Barents Sea Region.

Project description: Tissues samples (liver, muscle, fat and brain) were collected from seabirds in northern Norway, Bjørnøya, Svalbard, Franz Josef Land, Novaya Zemlya and the Murman coast. Northern fulmar *Fulmarus glacialis*, common eider *Somateria mollissima*, herring gull *Larus argentatus*, glaucous gull *L. hyperboreus* black-legged kittiwake *Rissa tridactyla*, common guillemot *Uria aalge*, Brünnich's guillemot *U. lomvia*, black guillemot *Cepphus grylle* and little auk *Alle alle* feeding at different trophic level have been analysed for heavy metals, organochlorines and radionuclides.

Publications:

Savinova, T. N., Polder, A., Gabrielsen, G. W. & Skaare, J. U. 1995: Chlorinated hydrocarbons in seabirds from the Barents Sea area. *Sci. Total Environm. 160/161*, 497-504.

Savinova, T. N., Gabrielsen, G. W. & Falk-Petersen, S. 1995: Chemical Pollution in the Arctic and Sub-Arctic Marine Ecosystems: an Overview of Current Knowledge. *NINA Fagrapport 1*, 68pp. Norwegian Institute for Nature Research, Tromsø.

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Project 2: Food, breeding success and population dynamics of seabirds breeding in the southern Barents Sea

Project start: 1990
Duration: Long-term study

Project aims: Evaluate the effect of changes in stocks of preferred harvest fish (capelin, herring, sandeels) on the breeding phenology, breeding success, diet and numbers of seabirds breeding in eastern Finnmark, North Norway and off the Murman coast. Studies include annual sampling of black-legged kittiwake and common and Brünnich's guillemot food, plus data concerning the timing of breeding, clutch size and breeding success. Breeding populations of black-legged kittiwakes and guillemots are monitored annually.

Publications:

Anker-Nilssen, T., Barrett, R. T. & Krasnov, Yu. V. 1997: Long- and short-term responses of seabirds in the Norwegian and Barents Seas to changes in stocks of prey fish. *Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosytems.* Alaska Sea Grant College Program Report No. 97-01, Pp. 683-698.

Barrett, R. T., Anker-Nilssen, T. & Krasnov, Y. V. 1997: Can Norwegian and Russian Razorbills *Alca torda* be identified by their measurements? *Mar. Ornithol. 25*, 5-8.

Barrett, R. T., Bakken, V. & Krasnov, Yu. V. 1997: The diets of common and Brünnich's guillemots *Uria aalge* and *U. lomvia* in the Barents Sea Region. *Polar Research 16*, 73-84.

Barrett, R. T. & Krasnov, Yu. V. 1996: Recent responses to changes in stocks of prey species by seabirds breeding in the southern Barents Sea. *ICES J. Mar. Sci. 53*, 713-722.

Krasnov, Yu. V. & Barrett, R. T. 1995: Large-scale interactions among seabirds, their prey and humans in the southern Barents Sea. In Skjoldal, H. R., Hopkins, C. C. E., Erikstad, K.-E. & Leinaas, H. P. (eds.): *Ecology of fjords and coastal waters.* Pp. 443-456. Amsterdam: Elsevier Science B.V.

Krasnov, Yu. V. & Barrett, R. T. 1997: Status and behaviour of the gannet *Sula bassana* on islands and coast of Murman. *Russ. J. Ornithol., Express Issue 12*, 3-8 (In Russian)

Krasnov, Yu. V. & Barrett, R. T. 1997: The first record of North Atlantic Gannets *Morus bassanus* breeding in Russia. *Seabird 19*, 54-57.

Nikolaeva, N. G., Krasnov, Yu. V. & Barrett, R. T. 1996: Movements of Common *Uria aalge* and Brünnich's guillemots *U. lomvia* breeding in the southern Barents Sea. *Fauna norv. Ser. C, Cinclus. 19*, 9-20.

Nikolaeva, N. G., Krasnov, Yu. V. & Barrett, R. T. 1997: Movements of kittiwakes *Rissa tridactyla* breeding in the southern Barents Sea. *Fauna norv. Ser. C, Cinclus 20*, 9-16.

Nikolaeva, N. G., Krasnov, Yu. V. & Barrett, R. T. 1997: The ringing results of Brünnich's (*Uria lomvia*) and common (*Uria aalge*) guillemots in the colonies of the southwestern part of the Barents Sea. In Matishov, G. G. (ed.): *Ecology of Birds and Seals in the north-western Russian Seas.* Pp. 12-44. Apatity: Kola Science Centre

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Project 3: Environmental atlas and impact assessment of the opening of the Northern Sea Route for regular ship traffic

Project start: 1992
Duration: 1997

Project aims: Register of all existing data on distribution of selected marine birds occurring along the Northern Sea Route (between the Kara and Bering Straits) in a Geographical Information System (GIS). Analysis of potential effects of ship traffic on the marine birds and proposal of efforts to reduce negative effects on seabird populations.

Project description: Co-operation has been established between Norwegian Polar Institute and Arctic and Antarctic Research Institute in St. Petersburg. Other co-partners were the Norwegian Institute for Nature Research and several Russian institutions. The project was based on a mutual agreement of co-operation between three principal partners: Ship & Ocean Foundation (Japan), Central Marine Research & Design Institute (Russia) and the Fridtjof Nansen Institute (Norway). One of the sub-programmes dealt with environmental factors, marine birds being one of the projects.

Publications:
Bakken, V. & Gavrilo, M. 1995: Registration of Seabirds in the Laptev, Kara and Barents Seas. In Grönlund, E. & Melander, O. (eds.): *Swedish-Russian Tundra Ecology-Expedition -94, A Cruise Report.* Pp. 264-270.

Bakken, V., Brude, O. W., Larsen, L-H., Moe, K. A., Wiig, Ø., Sirenko, B., Gavrilo, M., Belikov, S. Y. & Garner, G. W. 1996: INSROP Dynamic Environmental Atlas. In Kitagawa, H. (ed.): *Northern Sea Route; Future and Perspective.* Proceedings of INSROP Symposium Tokyo '95. Pp. 213-221.

Brude, O. W., Bakken, V., Hansson, R., Larsen, L. H., Løvås, S. M., Moe, K. A., Thomassen, J. & Wiig, Ø. 1998: Northern Sea Route Dynamic Environmental Atlas. *INSROP Working Paper No. 99,* 58pp. Oslo: The Fridtjof Nansen Institute.

Gavrilo, M., Bakken, V., Firsova, L., Kalyakin, V., Morozov, V., Pokrovskaya, I. & Isaksen, K. 1998: Oil Vulnerability Assessment for Marine Birds occurring along the Northern Sea Route Area. *INSROP Working Paper No. 97,* 50pp. Oslo: The Fridtjof Nansen Institute.

Gavrilo, M., Bakken, V. & Isaksen, K. (eds.). 1998: The distribution, Population Status and Ecology of Marine Birds selected as Valued Ecosystem Components in the Northern Sea Route Area. *INSROP Working Paper No. 123, II.4.2,* 136pp+Appendix.

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Maria Gavrilo, State Russian Museum of Arctic and Antarctic, Marata street 24A, 191049 St.Petersburg, Russia. E-mail: maria@yai.usr.pu.ru

Project 4: Seabird colony register for the Barents and the White Seas

Project start: 1992
Duration: Long-term study

Project aims: Gather information about seabird colonies (description, total counts, counts in study plots, photo documentation and references) in the Barents Sea Region.

Project description: Co-operation among twelve institutions (nine Russian) which are contributing data. The project is administered by the Norwegian Polar Institute.

Publications:
Bakken, V. (ed.) *in press:* Seabird colony databases of the Barents Sea Region and the Kara Sea. *Norsk Polarinst. Rapportserie.*

Contact persons:
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Project 5: Migration routes and population size of ivory gulls in the European Arctic

Project start: 1993
Duration: Long-term study

Project aims: Map the migration routes and estimate the population size of the ivory gull in the European Arctic.

Project description: About 450 ivory gulls *Pagophila eburnea* have been ringed in the Barents- and Kara seas with coloured plastic rings. Recoveries of these birds will provide the basis for mapping the migration routes. Population size will be estimated from the proportion of recovered birds and counts in important breeding colonies.

Publications:
Volkov, A.E. & de Korte, J. 1998: Distribution and numbers of breeding ivory gulls *Pagophila eburnea* in Severnaja Zemlja. *Polar Research 15,* 11-21.

Contact persons:
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Project 6: Bibliography for marine birds breeding in the Russian part of the Barents Sea

Project start: 1994
Duration: 1995

Project aims: Prepare a bibliography for marine birds breeding in the Russian part of the Barents Sea Region.

Project description: References of literature on marine birds from the eastern Barents Sea Region were stored in a bibliographic database (*Pro-Cite*). A hard copy containing all references (731) with indexes of authors and keywords has been printed

Publications:
Golovkin, A. N. & Bakken, V. 1997: Seabird Bibliography 1773-1994 - Northwest region of Russia. *Norsk Polarinst. Medd. No. 152*, 94pp.

Contact persons:
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E-mail: golovkin@golovkin.msk.ru

Project 7: Seabird censuses on Novaya Zemlya

Project start: 1994
Duration: 1996

Project aims: Estimate the size of the breeding populations of auks and gulls in the largest seabird colonies on the west coast of Novaya Zemlya, establish a monitoring program for long term studies of black-legged kittiwake and Brünnich's guillemot population dynamics, map the migration routes and wintering areas of Brünnich's guillemots breeding on Novaya Zemlya, map the genetic characteristics of Brünnich's guillemots through blood sampling and morphometrical studies, and identify its food preferences.

Project description: Five seabird colonies on the west coast of Novaya Zemlya were censused (Bezymyannaya Bay in 1994-1995, Gribovaya Bay in 1995 and Arkhangel'skaya Bay and Vil'kitski Bay in 1996). Monitoring plots for black-legged kittiwake and Brünnich's guillemot were established in all colonies and food were sampled. About 7000 chicks and adults of Brünnich's guillemot were ringed and blood samples and body measurements were collected.

Publications:
Strøm, H., Øien, I. J., Opheim, J., Kuznetsov, E. A. & Khakhin, G. V. 1994: Seabird Censuses on Novaya Zemlya 1994. *Norw. Ornithol. Soc. Report No. 2-1994*, 38pp. Klæbu: Norwegian Ornithological Society.

Strøm, H., Øien, I. J., Opheim, J., Kuznetsov, E. A. & Khakhin, G. V. 1995: Seabird Censuses on Novaya Zemlya 1995. *Norw. Ornithol. Soc. Report No. 3-1995*, 24pp. Klæbu: Norwegian Ornithological Society.

Strøm, H., Øien, I. J., Opheim, J., Khakhin, G. V, Cheltsov, S. N. & Kuklin, V.1996: Seabird Censuses on Novaya Zemlya 1996. *Norw. Ornithol. Soc. Report No. 1-1997*, 23pp. Klæbu: Norwegian Ornithological Society.

Contact persons:
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E-mail: hallvard.strom@npolar.no

Gennady V. Khakhin, All-Russian Research Institute for Nature Protection (VNII Priroda), Znamenskoye - Sadki, Moscow 113 628, Russia

Project 8: Fauna registrations on Troynoy

Project start: 1994
Duration: 1994

Project aims: Increase awareness of the fauna on the islands in the Kara Sea, in particular the ivory gull including their population size and nesting biology. In addition, provide an overview of the human activities in the area, and propose management strategies for the protection of fauna and environment in these endangered areas. Document the present situation in relation to the impacts of human activity on the environment in the Great Arctic Reserve.

Project description: The study undertaken on Troynoy started with a general inventory of the birds, and with special emphasis on ivory gull because of the general lack of knowledge about the ivory gulls' biology. The ivory gull is on the Russian «Red List», and an important species in relation to the International Northern Sea Route Programme (INSROP). Information concerning the traditional hunting and trapping by the crews of the polar stations was collected from the station crew on Troynoy. This information, seen in relation to the game resources, was collected to aid the development of a proposal for management strategies for hunting and trapping.

Publications:
Bangjord, G., Korshavn, R. & Nikiforov, V. 1994: Fauna at Troynoy and Influence of Polar Stations on Nature Reserve, Izvestiya Tsik, Kara Sea, July 1994. Working report. *Norw. Ornithol. Soc. Report No. 3-1994*, 55pp. Klæbu: Norwegian Ornithological Society.

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E-mail: vnikiforov@wwfnet.org

Project 9: Ornithological registrations in the Uboynaya area, Taymyr

Project start: 1994
Duration: 1994

Project aims: The main objective of the expedition was to identify breeding grounds of Steller's eider *Polysticta stelleri* and carry out ornithological registrations in the area of Uboynaya (ca. 73°38N-82°00'E), NW Taymyr.

Project description: Only a few Steller's eiders were nesting in this area, but a total of 16 Steller's eider nests found in NW Taymyr are described in the report. One incubating female was caught at the nest and ringed. The eggs and the bird were measured, and the nest surroundings were described. More general ornithological registrations were also carried out, and a total of 131 birds of 13 species were ringed.

Publications:
Mork, K., Holstad, R. L., Sætre, S. & Kalinin, A. 1994: Ornithological registrations in the Uboynaya area. NW-Taymyr, July 1994. Working report. *Norw. Ornithol. Soc. Report No. 4-1994,* 32 pp. Klæbu: Norwegian Ornithological Society.

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Project 10: Mapping of the parasitic fauna in seabirds

Project start: 1994
Duration: 1995

Project aims: Mapping of the distribution, amount and diversity among parasites on seabirds in the Barents Sea Region and mapping of factors influencing on the dispersal of the parasitic species.

Project description: Work was focused on the trematods (Trematoda) which occur throughout the study area. The knowledge of these species is poor in Norway. Many of the trematods have birds as their final hosts, and many species have complicated life cycles. The project focused mainly on intermediate hosts such as snails and amphipods. In 1994, data were collected in about 70 Norwegian localities. In Russia, data from ca. 200 stations has been collected during recent years and will be included in a database.

Publications:
Galaktionov, K. & Bustnes, J. O. 1995: Species composition and prevalence of seabird trematode larvae in periwinkles at two littoral sites in North-Norway. *Sarsia 80,* 187-191.

Bustnes, J. O. & Galaktionov, K. 1999: Anthropogenic influences on the infestation of intertidal gastropods by seabird trematodes larvae in the southern Barents Sea coast. *Marine Biology 13,* 449-454.

Galaktionov, K. & Bustnes, J. O. 1999: Distribution patterns of marine bird trematode larvae in periwinkles along the coast of the southern Barents Sea. *Diseases of Aquatic Organisms 3,* 221-230.

Galaktionov, K. & Bustnes, J. O. 1996: Diversity and prevalence of seabird parasites in intertidal zones of the southern Barents Sea. *NINA•NIKU Project report No. 004,* 27pp. Tromsø: Norwegian Institute for Nature Research.

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Project 11: Survey of the wintering populations of marine ducks and other seabirds on the western Murman coast and eastern Kola Peninsula areas

Project start: 1994
Duration: 1996

Project aims: Map numbers and distribution of wintering sea-ducks and other seabirds on the coast of western Murman and the Kola Peninsula.

Project description: Counts of sea-ducks wintering along this coastline were made from Russian helicopters in March 1994. The area from Varangerfjorden in eastern Finnmark to Gremukha, NE Kola was a wintering ground for ca. 100 000 sea-ducks. A total of 22 000 Steller's eiders were counted, which may constitute as much as one fourth of the world population.

Publications:
Nygård, T., Jordhøy, P., Kondakov, A. & Krasnov, Y. 1994: A survey of waterfowl and seal on the coast of the southern Barents Sea in March 1994. *NINA Oppdragsmelding 361,* 24pp. Trondheim: Norwegian Institute for Nature Research.

Nygård, T., Frantzen, B. & Svazas, S. 1995: Steller's Eiders *Polysticta stelleri* wintering distribution in Europe: numbers, distribution and origin. *Wildfowl 46,* 140-155.

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Project 12: Seabird colony register for the Kara Sea

Project start: 1995
Duration: Long-term study

Project aims: Gather information about seabird colonies (description, total counts, counts in study plots, photo documentation and references) in the Kara Sea area.

Project description: Co-operation has been established between Norwegian Polar Institute and Arctic and Antarctic Research Institute in St. Petersburg. The project is administered by the Norwegian Polar Institute.

Publications:
Bakken, V. (ed.) *in press:* Seabird colony databases of the Barents Sea Region and the Kara Sea. *Norsk Polarinst. Rapportserie.*

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Project 13: Status report of the marine birds breeding in the Barents Sea

Project start: 1995
Duration: 2000

Project aims: Prepare a status report for marine bird species breeding in the Barents Sea Region.

Project description: A total of 41 breeding species were described in relation to their distribution, population numbers, habitat preferences, movements, population trends, and feeding ecology within the region. Current and potential threats to the populations were also evaluated. The report will serve as a basis for future planning of seabird conservation and research in the Barents Sea Region and plans have been made to print a Russian version.

Published results (This volume):
Anker-Nilssen, T., Bakken, V., Strøm, H., Golovkin, A. N., Bianki, V. V. & Tatarinkova, I. P. (eds.) 2000: The status of marine birds breeding in the Barents Sea Region. *Norsk Polarinst. Rapportserie No. 113.*

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Project 14: Seabird and wildfowl surveys in the Pechora Sea during August 1998

Project start: 1998
Duration: 1998

Project aims: The aim of the study was to map the spatial distribution of seabirds and wildfowl in the Pechora Sea, with special focus on post-breeding aggregation of ducks at sea.

Project description: The Pechora Sea south-east in the Barents Sea Region is part of the East-Atlantic Flyway and supports large concentrations of waterfowl. Large oil and gas deposits have been discovered in the Pechora Sea and offshore production is planned in near future. The information on marine birds in this area is fragmentary and there is a need for surveys covering larger parts of the Pechora Sea and compare information from different sub-areas. This is, for instance, relevant when evaluating the potential impacts of petroleum activities.

Publications:
Strøm, H., Isaksen, K. & Golovkin, A. N. (eds.). 2000: Seabird and wildfowl surveys in the Pechora Sea during August 1998. *Norw. Ornithol. Soc. Report No. 2-2000. 62 pp.* Klæbu: Norwegian Ornithological Society.

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