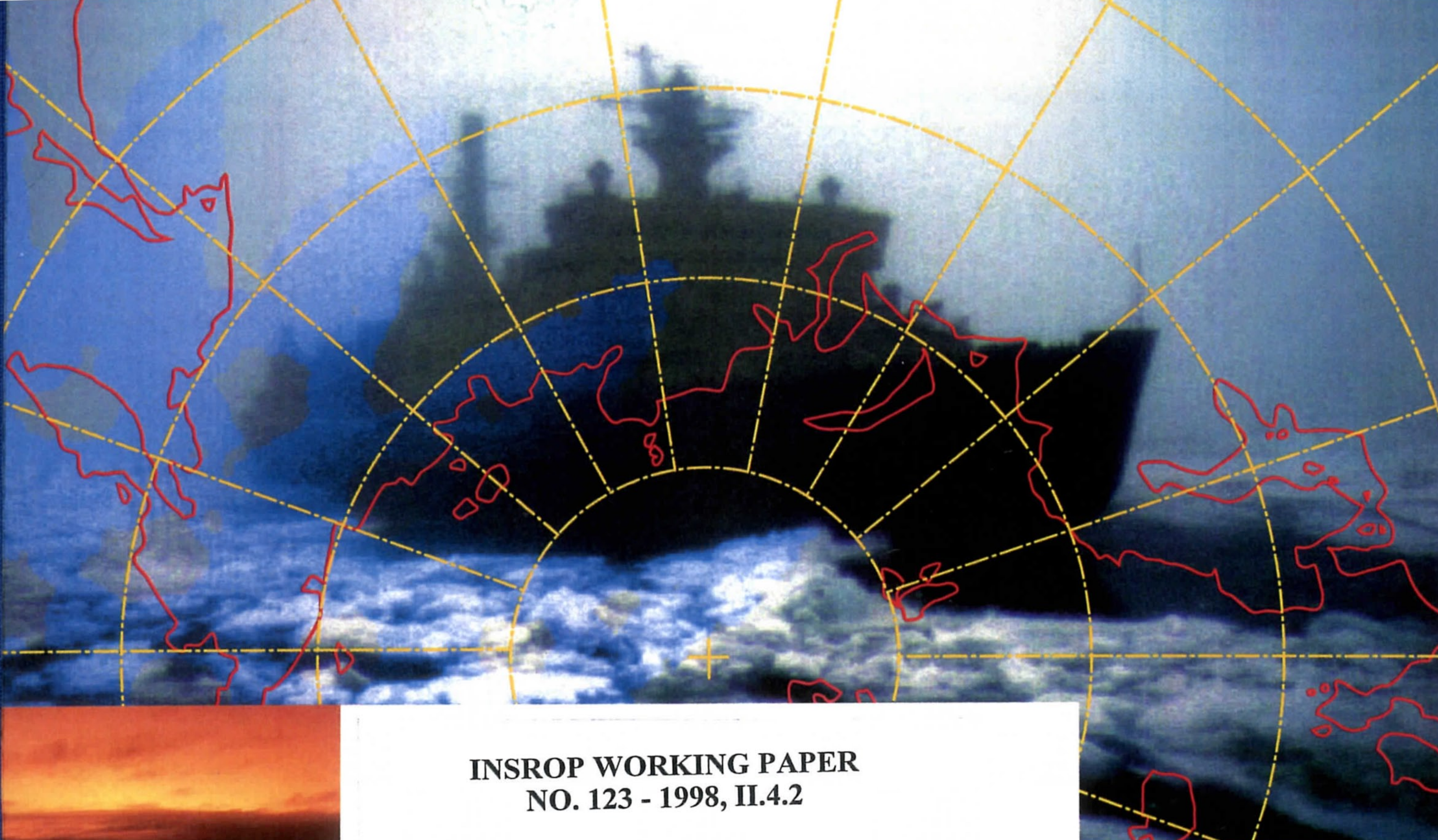

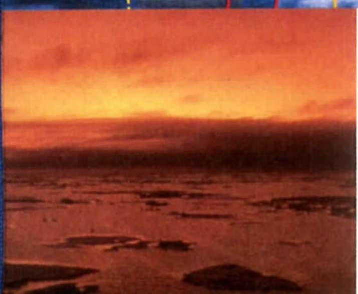

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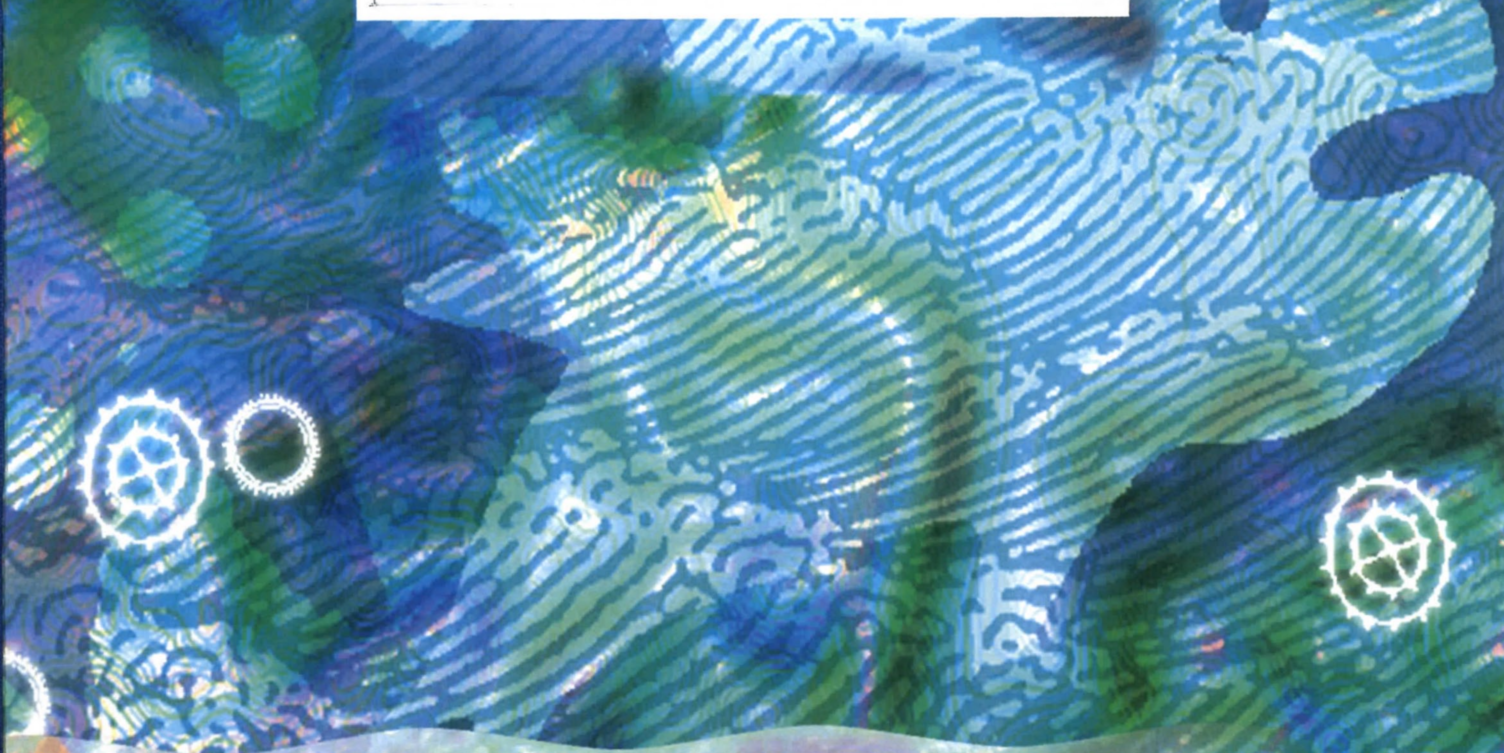
The Distribution, Population Status and Ecology of Marine Birds selected as Valued Ecosystem Components in the Northern Sea Route Area.

Edited by Maria Gavrilo, Vidar Bakken
and Kjell Isaksen



INSROP International Northern Sea Route Programme

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International Northern Sea Route Programme (INSROP)

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Supervisor: Vidar Bakken, Norwegian Polar Institute

Title: **The Distribution, Population Status and Ecology of Marine Birds selected as Valued Ecosystem Components in the Northern Sea Route Area.**

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What is an INSROP Working Paper and how to handle it:

FOREWORD - INSROP WORKING PAPER

INSROP is a five-year multidisciplinary and multilateral research programme, the main phase of which commenced in June 1993. The three principal cooperating partners are **Central Marine Research & Design Institute (CNIIMF)**, St. Petersburg, Russia; **Ship and Ocean Foundation (SOF)**, Tokyo, Japan; and **Fridtjof Nansen Institute (FNI)**, Lysaker, Norway. The INSROP Secretariat is shared between CNIIMF and FNI and is located at FNI.

INSROP is split into four main projects: 1) Natural Conditions and Ice Navigation; 2) Environmental Factors; 3) Trade and Commercial Shipping Aspects of the NSR; and 4) Political, Legal and Strategic Factors. The aim of INSROP is to build up a knowledge base adequate to provide a foundation for long-term planning and decision-making by state agencies as well as private companies etc., for purposes of promoting rational decisionmaking concerning the use of the Northern Sea Route for transit and regional development.

INSROP is a direct result of the normalization of the international situation and the Murmansk initiatives of the former Soviet Union in 1987, when the readiness of the USSR to open the NSR for international shipping was officially declared. The Murmansk Initiatives enabled the continuation, expansion and intensification of traditional collaboration between the states in the Arctic, including safety and efficiency of shipping. Russia, being the successor state to the USSR, supports the Murmansk Initiatives. The initiatives stimulated contact and cooperation between CNIIMF and FNI in 1988 and resulted in a pilot study of the NSR in 1991. In 1992 SOF entered INSROP as a third partner on an equal basis with CNIIMF and FNI.

The complete series of publications may be obtained from the Fridtjof Nansen Institute.

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1. PREFACE

This report is a contribution within the framework of the INSROP Project II.4. Environmental Atlas. 2. Marine Birds. It contains a review of available data on waterbirds concerning their seasonal distribution, numbers, migration, biological peculiarities and vulnerability in relation to different kinds of human impacts related to the navigation along the Northern Sea Route.

Other papers issued within the project II.4.2. (Bakken *et al.*, 1996; Gavrilo *et al.*, 1998) made a considerable contribution to this work. This report is closely connected to the INSROP Project II.5 Environment Impact Assessment (Thomassen *et al.*, 1994).

The data are presented as a series of articles and distribution maps. All the distribution data are implemented into the INSROP GIS system to be used as a basis for the Environmental Impact Assessment.

As the present study covers a vast area of the Russian Arctic, as well as it considers considerable number of waterbird species, quite a large team of experts was involved in the project. It should be emphasised that this co-operation proved very fruitful. All participants are thanked for their valuable contributions to our joint work. Special acknowledgements are given to Alexander Koryakin and Alexander Golovkin for their critical comments to draft versions of eider and seabird articles.

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3. INTRODUCTION

An important part for both the INSROP Sub-Programme II (Environmental Factors) and Sub-Programme I (Natural Conditions and Ice Navigation) is to create a dynamic GIS-database describing the distribution and numbers of biological resources. The database is aimed both at presenting the data in the best way and to be used as basis for the Environmental Impact Assessment (EIA).

INSROP Project II.4. Environmental Atlas. 2. Marine Birds, deals with birds that have been found to be highly vulnerable to human impacts connected to the NSR activity. Species and groups of species to be considered as Valued Ecosystem Components (VEC's) were selected during previous work according to the AEAM process (see Hansson *et al.*, 1994; Bakken *et al.*, 1996). The NSR related impacts (see Thomassen *et al.*, 1994) to be considered in this work are as follows: pollution including waste, disturbance, and social and cultural factors. The assessment of vulnerability of waterbirds inhabiting the NSR area in relation to oil pollution has been conducted (Gavrilo *et al.*, 1998), whilst the possible influence of other potential factors has not been evaluated yet. The latter impact depends on scenarios of the NSR activities, and on development of land-based infrastructure in particular. However, these scenarios are not clear yet.

The NSR area is characterised by a rather uneven state of knowledge in terms of ornithology (Gavrilo & Sirenko, 1995). The data available are of different format, stored at many institutions, some of them being more than 30–40 years old. Quite a large group of experts have been involved in the project, and all have their own approach to the study object. This heterogeneity of the initial material is reflected in the report.

The report consists of three parts devoted to the defined VEC's (see Bakken *et al.*, 1996): **VEC 1** - *Seabirds*; **VEC 2** - *Marine Wildfowl*; and **VEC 3** - *Waders in feeding and resting areas*. Separate species accounts are mostly improved versions of drafts presented in 1995, but information on two new species is also given. Distribution maps for most species/groups of species are given in the Annex.

As a vast area of four Siberian Arctic Seas is considered in the current study, a geographical approach was largely used when describing the VECs represented by groups of vulnerable species, such as marine ducks in moulting and staging areas, waders in feeding and resting areas and seabird colonies. The state of knowledge on different species and areas under consideration, which determines and restricts the ability to assess possible impacts, is emphasised.

4. VEC I. SEABIRDS

4.1 *Black-legged Kittiwake (Rissa tridactyla L.)*

by Liudmila V. Firsova

Status. Breeding, migratory species. Two subspecies are recognised *Rissa tridactyla tridactyla* in the North Atlantic and *R. t. pollicaris* in North Pacific.

General appearance. Medium-sized gull. The average wing length is 318 mm (298–337) in males and 311 mm (297–333) in females (Yudin & Firsova, 1988a). The average weight in Murman is 421 g (305–512) in males and 392 g (305–525) in females (Belopolskiy, 1957). Birds of the eastern subspecies *R. t. pollicaris* are bigger than the western *R. t. tridactyla* (Sluys 1982).

Sexes alike, apart from size. It differs from other gulls by having an undeveloped back toe. It can be distinguished from the Red-legged Kittiwake *Rissa brevirostris* by its black legs and white underwings. Yearlings have a grey zigzag line on grey wing coverts.

Distribution: The breeding range is circumpolar within the Arctic-boreal climatic zone. Its northern border follows 80 N almost everywhere from Greenland via Spitsbergen, Franz Josef Land, Novaya Zemlya and Severnaya Zemlya. In Arctic Canada the northern border is at 74 N. Southern limit of the breeding range lies between 40°N and 50°N in the Atlantic from Bay of Fundy in North America to the north-west coast of Spain. In the Pacific it is found from Southern Sakhalin and the Kuril Islands to the mouth of the Mednaya River in Northern Canada.

Within the Northern Sea Route area the breeding range is from the northernmost islands to the coast of the Eurasian Mainland.

Non-breeding Kittiwakes occur far beyond the breeding range limits, reaching the latitudes of the Central Arctic Basin (Yudin, 1964).

Seasonal migration. The main wintering areas are found between 40°N and 60°N both in the Atlantic and in the Pacific. Single birds may be found much farther south to 15°–20°N (Yudin & Firsova, 1988a). As for the other gulls breeding within the NSR area, it may be suggested that Kittiwakes that nest west of the Taimyr Peninsula migrate westward to Atlantic winter quarters. Those that breed east of Taimyr migrate eastwards to the Pacific Ocean.

Kittiwakes arrive at their breeding grounds as soon as the nearest open water appears close to the colonies. In the north-easternmost Novaya Zemlya they appear in April (Gorbunov, 1929; Antipin, 1938). In polynyas around Severnaya Zemlya they are numerous from mid-May (Ushakov, 1951; Uspenskiy, 1969), while the earliest record for the western archipelago is mid-April (Demme, 1934b). On the Wrangel Island the average arrival dates are in the period from 9 to 20 May, and the birds come 10–11 days earlier on the west coast (Pridatko, 1986).

The Kittiwakes leave the colonies during September and abandon breeding areas in late September to October (Gorbunov, 1929; Antipin, 1938; Laktionov, 1946; Stishov *et al.*, 1991). In warm years, birds may stay as long as up to mid-October, the latest records being 21 October 1950 (west Severnaya Zemlya; Uspenskiy, 1969) and mid-October 1986 (Wrangel Island, Stishov *et al.*, 1991).

Moult. The birds moult gradually in spring and in autumn. They do not lose flight ability and no moulting aggregations are formed.

Population numbers and trends: The total world population is estimated at 6–8,000,000 pairs (Lloyd *et al.*, 1991), with the largest known colonies (nearly 100,000 pairs) in West Greenland, Southwest Bering Sea and in Kamchatka (Salomonsen & Gitz-Johansen, 1944; Sowls *et al.*, 1978; Gerasimov, 1986). The size of the colonies within the NSR area vary from single pairs to tens of thousands. Large colonies (more than 1,000 pairs) are known from Northeast Novaya Zemlya, Severnaya Zemlya, Preobrazheniya Island, the New-Siberian Archipelago, Wrangel Island and several places in Chukotka (Antipin, 1938; Uspenskiy, 1967, 1967; Rutilevskiy, 1963; Kondratiev, 1986a; Stishov *et al.*, 1991; Korte *et al.*, 1995). The largest colonies have been recorded on Belkovskiy and Henrietta Islands, where 20,000 and 18,000 pairs respectively, used to breed several decades ago (Leonov, 1945; Uspenskiy, 1957). In all, 35–85,000 pairs breed on Wrangel Island, and the number fluctuates strongly between years (Stishov *et al.*, 1991). Smaller colonies of less than 1,000 pairs are found in the Kara Sea Islands, Severnaya Zemlya Archipelago and Chukotka (Syroechkovskiy & Lappo, 1994; Kondratiev, 1986a; Bogoslovskaya *et al.*, unpubl.). The minimum number of Black-legged Kittiwakes within the NSR area may be roughly estimated at 100–150,000 pairs, that is ca. 1.5–2.0% of the world population.

A population increase has been noticed in many parts of the range during the last decades: on the North Sea coasts (Harris & Galbraith, 1983; Zonfrillo, 1982), in northern Norway (Brun, 1971), Newfoundland (Maunder & Threlfall, 1972), Novaya Zemlya (Krasnov, 1995) and on a number of Bering Sea Islands (Hunt *et al.*, 1981b). However, population decreases have been noticed in recent years in Britain (Reynolds, 1985), Murman (Krasnov & Barrett, 1995) and stabilisation has been recorded in some parts of Norway (Godø, 1985). Within the NSR area the population trend is poorly known. An increase was recorded only for two small colonies (Kargyn Rock, W. Chaun Bay and Idlidl Island (Kondratiev, 1986a)). The total number of Kittiwakes on the Wrangel and Herald Islands demonstrates annual fluctuations. The number has decreased since the middle of the 1970s until the early 1980s, when it started to increase slightly (Stishov *et al.*, 1991). The reason for the increase was probably, as in other gulls, improved food resources, especially in winter time, including more food remains from human activity.

Habitat. The distribution of suitable nesting habitats determines the location of colonies. The colonies are mainly situated on rocky coastal cliffs and islands. Open waters in early spring, high productivity of adjacent waters and inaccessibility to predators are among the most important factors determining the location of the colonies. Kittiwake colonies are found on rocky cliffs, mainly along the coast, and in fjords, but also in river canyons and even on lake banks up to 50 km from the sea (Belikov & Randla, 1987). There are most often freshwater supplies in the vicinity in which Kittiwake regularly bathe, but this is not an obligatory factor. During the non-breeding season, Kittiwakes prefer more pelagic marine habitats compared to most other gulls (Shuntov, 1972).

Breeding. Monogamous. Become sexually mature after 3–4 years (Belopolskiy, 1957; Coulson & White, 1959). The maximum longevity, registered by means of banding is 21 years (Cramp & Simmons, 1983).

The nesting starts when the rocks are completely free of snow, sometimes more than a month after the birds arrived (22 days on the Wrangel Island (Stishov *et al.*, 1991)). The period of nest building varies from 3 to 10 days in different pairs, and from 25 to 30 days in the population at whole (Belopolskiy, 1957; Modestov, 1967). In unfavourable years, which occur quite regularly near the northern border of the species' range, nest construction may be prolonged for the whole breeding season. It was once observed in mid-August (Uspenskiy, 1963).

Egg laying occurs in June–July in Severnaya Zemlya and on the Wrangel Island (Demme, 1934b; Stishov *et al.*, 1991; Korte *et al.*, 1995). The full clutch contains 1–3 eggs (1.76–2.00 on average) (Yudin & Firsova, 1988a), but on the Wrangel Island it does not exceed 2 eggs (Stishov *et al.*, 1991). Both parents incubate in turn. The incubation period lasts 24–28 days (Modestov, 1967; Firsova, 1978).

Hatching takes place in late July–late August in Severnaya Zemlya (Laktionov, 1946; Uspenskiy, 1963; Stishov *et al.*, 1991). Hatching period on the Wrangel Island can be prolonged for 20–30 days. The young are able to fly at an age of about 40 days. Both parents continue to feed young two weeks after fledging (Firsova, 1978).

Food habits. The main feeding areas are at sea, but coastal shallows and the intertidal zone can be used as well (Belopolskiy, 1957). In the northern part of the range, heads of ice-filled fjords, freshwater flows near the edges of glaciers, small river mouths and edges of drifting ice fields where strong vertical currents occur as the result of temperature and salinity gradients, are among the favourite foraging habitats (Salomonsen & Gitz-Johansen, 1944; Løvenskiold, 1964; Mehlum, 1984). Plankton and fishes are mostly taken right from the sea surface or at depths less than 0.5 m.

The length of foraging flights sometimes reaches 100 km. (Demme, 1934b; Salomonsen & Gitz-Johansen, 1944; Modestov, 1967; Hunt *et al.*, 1981b). Kittiwakes from the Wrangel Island are never recorded further than 20–30 km from the colonies when nesting (Stishov *et al.*, 1991).

Kleptoparasitism on birds, such as guillemots, puffins and terns, is also observed (Krasnov *et al.*, 1982; Løvenskiold, 1964). Kittiwakes are found to follow whales and seals catching fish chased to the sea surface by them (Salomonsen & Gitz-Johansen, 1944; Nelson, 1887). Under high human pressure they can use urban habitats (Coulson & Macdonald, 1962). Like many other gull species, Kittiwakes may follow ships particular while breaking ice and they feed in the open water behind the vessel.

Numerous small species of fish as well as small specimens of larger species are the principal food of Kittiwakes. Among these are Capelin, Sandeel, Pollack, Polar Cod and young of Cod and Herring. Plankton invertebrates, such as crustaceans, molluscs and polychaetes are often used as an additional source of food (Salomonsen & Gitz-Johansen, 1944; Belopolskiy, 1957; Løvenskiold, 1964; Krasnov, 1989a).

Like many other gulls, but to a lesser extent, Kittiwakes may be flexible in their feeding habits, switching from one abundant food source to another. Seasonal and geographical changes in diet are known in well studied areas (Belopolskiy, 1957; Hunt *et al.*, 1981).

Based on the few data on diets of Kittiwakes of the Siberian shelf, Polar Cod seem to prevail (Rutilevskiy, 1963; Uspenskiy, 1963; Stishov *et al.*, 1991).

Fishery remains as well as kitchen waste from ships are of large importance as a food source, especially during the non-breeding period. When lacking their normal food, Kittiwakes may feed on dead marine mammals (Portenko, 1972).

Predators, unfavourable factors. In the Low Arctic, food availability in the vicinity of nesting colonies is of large importance for the breeding success (Krasnov, 1989a). In High Arctic regions, abiotic factors become more important. Death cases from starvation have been observed during heavy storms. In the northern part of the range, heavy ice conditions may affect food availability (Underwood & Stowe, 1984). A case of nest abandonment in a sub-optimal part of the colony after a heavy storm with rain has also been recorded (Golubova, 1990).

Among natural predators of eggs and chicks, larger gulls and skuas are the principal ones. Predation efficiency is inversely proportional to the nesting density (Krasnov *et al.*, 1995). Predation by numerous Glaucous Gulls can sometimes affect breeding success (Kondratiev *et al.*, 1987). Flights away from the colony during disturbances, increase the predation by larger gulls. Kittiwake nests are inaccessible for non-avian predators, but Arctic Foxes can sometimes reach them (Gavrilo, pers. comm.). Arctic Skuas often kleptoparasitise Kittiwakes (Krasnov, 1982).

Economic importance and human impact. Kittiwakes have no economic importance. In Canada, kittiwakes are an attractive component of ecotourism trips to seabird colonies.

Kittiwakes may suffers from food depletion caused by over fishing. This has been well demonstrated for regions with extensive fishery such as the Barents and Bering Seas. On the other hand, as other gull species, Kittiwakes easily switch to food of human origin, feeding on it at sea, in harbours and even in rivers up to 10 miles from sea (Coulson & Macdonald, 1962; Krasnov, 1989a).

Both accidental and chronic water pollution represents a significant danger for Kittiwakes. Cases of mass death from oil spills have been reported (Underwood & Stowe, 1984). As long-lived top predators, Kittiwakes actively accumulate pollutants, but concentrations found in them are 1/3–1/5 of those found in larger gulls (Savinova, 1990).

Disturbance in colonies, both from visiting people and low-flying aircraft can also affect Kittiwakes. They hardly react to the presence of humans, but mass flights from the colony caused by disturbance allow predators easy access to unguarded eggs and young. Increased predation from larger gulls under such circumstances has been demonstrated from Murman (Krasnov *et al.*, 1982b).

And, lastly, Kittiwakes may use urban landscapes as nesting habitat, constructing their nests on building roofs and window sills (Coulson & Thomas, 1985; Golovkin, 1991).

Thus, development of NSR-related activities will expose Kittiwakes to increased risk of oil pollution and, to a lesser extent, to increased disturbance at the nesting colonies. On the other hand, ships moving through closed ice will break the ice cover and turn ice-floes. This may result in increased food availability. But, at the same time, birds attracted to and following ships are more likely to be polluted.

Conservation. The species is included in the Red Data Book of Yakut ASSR. About 30–50% of the breeding Kittiwakes in the NSR area are protected in the 'Wrangel Island' State Reserve. Colonies situated on Belkovskiy and Stolobovoy Islands are included in the buffer zone of 'Lena-delta' State Reserve. A few colonies in Severnaya Zemlya have been protected in the special purposes Federal Reserve 'Severozemelskiy' in 1996. No special conservation measures are suggested for the species.

*4.2 Ivory Gull (*Pagophila eburnea *Phips.).*

by Andrei E. Volkov

Status: Nesting, migratory, partly wintering species.

General appearance, size. Medium-sized gull. Males are larger than females. The average length of a straightened wing is 354.6 mm (345–367) in males; 341.3 mm (328–353) in females; (Tomkovich, 1986). The average mass of males and females varies between years from 530 to 590 g (Bangjord *et al.*, 1994; Volkov & Pridatko, 1994; Volkov, unpubl. data).

It differs from other species of gulls by the pure white colour of the adults. Birds in the first winter plumage have a dark face mask and dark spots on the body and on the tips of wing and tail feathers. The birds in the first summer plumage have a less pronounced dark mask and spots, but these may be absent (Grant, 1986).

Distribution. Nesting is known from the Canadian Archipelago (Thomas & MacDonald, 1987), northern and eastern shores of Greenland (Evans, 1984), Spitsbergen (Løvenskiold, 1964), Victoria Island, Franz Josef Land, Severnaya Zemlya (Yudin & Firsova, 1988), the Kara Sea Islands (Bangjord *et al.*, 1994; Syroyechkovskiy & Lappo, 1994; unpubl. information from the polar stations). One nest has also been found in the northern part of Novaya Zemlya (Antipin, 1938). Thus, the breeding range of the Ivory Gull includes only the Arctic Islands and has a discontinuity from Severnaya Zemlya in the west to the Canadian Archipelago in the east. The wintering grounds are located in the North Atlantic southward to Newfoundland and Iceland, and occasionally south to the Faroe Islands, Britain and the Scandinavian Peninsula (Yudin & Firsova 1988), as well as in the Bering Sea and in the Sea of Okhotsk (Shuntov, 1972; Kosygin, 1985). They are also observed in winter near northern Novaya Zemlya (Butyev, 1959) and off Spitsbergen (Cramp & Simmons, 1983). During the breeding period, first-year birds are distributed at sea while two-year birds come to the breeding grounds. They appear in the nesting colonies but do not breed. Their abundance is higher nearby human settlements (Volkov & de Korte, in press). During migrations the Ivory Gull may fly both to the high-latitudinal Arctic up to 87–88°N and deep inland south to taiga regions (Yudin & Firsova, 1988).

Within the NSR area the Ivory Gull breeds on Severnaya Zemlya and the Kara Sea Islands. On Severnaya Zemlya nesting is confirmed for the Sedov Archipelago (Urvantsev, 1935; Ushakov, 1951; Demme, 1934; de Korte & Volkov, 1993; de Korte *et al.*, 1995), Oktyabrskoy Revolyutsii Island (Gavrilo, 1988a) and Bolshevik Island (Bulavintsev, 1984; Volkov & Pridatko, 1994; de Korte *et al.*, 1995). On of the Kara Sea Islands, nesting is confirmed for the islands Troinoy, Russkiy, Uedineniya, Slozhny, Vize, Ushakov, Voronin, Geiberg, Maly Taimyr, Starokadomskiy, Vilkitskiy (Nordenskiold Archipelago; (Syroyechkovskiy & Lappo, 1994; Bangjord *et al.*, 1994; Syroechkovskiy, pers. comm.; and after data collected from the personnel of polar stations). The report about nesting Ivory Gulls nearby Cape Chelyuskin requires checking.

Seasonal migrations. During spring and autumn migrations the gulls are recorded all over the Arctic Basin and along mainland coasts as well. During summer birds are also found in the entire Arctic Basin, but on the mainland coast they are only recorded at the Taimyr Peninsula.

Dates of arrival at the breeding grounds vary from February to March at Spitsbergen (Løvenskiold, 1964) to May–early June at the Canadian Archipelago (MacDonald, 1976). Within the NSR area the first birds appear from late March (26.03.1939 at the Uedineniya Island), mass arrival is recorded in the second half of April (20.04.1951 at the Domashny Island). Departure from the breeding grounds continues from September to November. The last birds were observed at the Domashny Island on September 24 and at the Uedineniya Island on November 1, 1959 (Uspenskiy, 1969). There are data indicating that autumn migration of adult birds begins 10 days earlier than that of the young ones (after Gorbunov, 1932). Intensive autumn migration is observed along the southern coast of the Wrangel Island during years with low ice concentration. The timing of mass migration varied from early October in 1987 to early November in 1986 (Stishov, 1995).

Moult. The moulting pattern of the Ivory Gull is peculiar. The pre-breeding moult begins in April, sometimes in March (Yudin, 1960). According to Tomkovich (1986), most birds do not have sufficient time to moult before breeding. Many birds stop the moult of flight feathers before completion, while in others the moult slowly continues. Tomkovich (1986) explains the findings that Ivory Gulls continue moulting in early October (Yudin, 1960) by the fact that the birds complete the moult in autumn after a break in summer.

Numbers and population trend. It is difficult to estimate the total breeding population as well as to draw conclusions regarding population trends of this species because the proportion of the population breeding varies from year to year. On the basis of available data during years with favourable ice conditions, we estimate the total breeding population of Ivory Gulls at ca. 14,000 pairs (after Evans, 1984; Uspenskiy & Tomkovich, 1986; Thomas & McDonald, 1987; Mehlum & Bakken, 1994; Vuilleumier, 1995). Within the NSR area the bulk of the Ivory Gulls nest in Severnaya Zemlya and at the Kara Sea Islands. At the Severnaya Zemlya Archipelago the number of breeding Ivory Gulls fluctuates between 1,000 and 2,000 pairs (de Korte *et al.*, 1995). The largest known colony, numbering 1,100 pairs, was discovered at the Domashniy Island (de Korte *et al.*, 1995). At the Kara Sea Islands the number of breeding Ivory Gulls is estimated at several thousand pairs (Syroyechkovskiy & Lappo, 1994; Bangjord *et al.*, 1994; unpubl. data from the polar stations). Thus, not more than 7,000 pairs breed within the NSR area, i.e. about half of the world's breeding population. The total number of Ivory Gulls, including non-breeding birds, is much larger. The Graham-Bell Island (*Franz Josef Land*) alone has been visited by 4–5,000 individuals during the pre-breeding period (Tomkovich, 1986). The highest concentration of Ivory Gulls (35,000 individuals) was recorded in the Davis Strait in March 1978 (Orr & Parsons, 1982).

The small amount of data on population monitoring and changing of nesting places account for the difficulty in estimation of a real population trend both in the Russian Arctic and over the world range. Data on abundance of breeding birds in the region of the Sedov Archipelago (Severnaya Zemlya) have been obtained since the 1930s (Ushakov, 1951; Urvantsev, 1935; Demme, 1934b; de Korte & Volkov, 1993). These data allow a suggestion that there is a general population stability and that the birds regularly change nesting places.

Habitat. The distribution of the Ivory Gull is closely related to the ice-cover conditions at sea. During the non-breeding period the birds are associated with the ice edge zone (Gorbunov, 1929; Shuntov, 1972; Kosygin, 1975, 1985; Cramp & Simmons, 1983). During the breeding period immature birds mainly inhabit ice-filled waters and are rare on nesting grounds. At the Kara Sea Islands and in *Franz Josef Land* nesting has been established on plain tundra (Uspenskiy & Tomkovich, 1986; Syroyechkovskiy & Lappo, 1994). Nests both in cliffs and on plain tundra have been found in Svalbard and Severnaya Zemlya (Løvenskiold, 1964; Gavrilo, 1988; Volkov & Pridatko, 1994; de Korte *et al.*, 1995). At the Canadian Archipelago Islands Ivory Gulls nest on nunataks (Thomas & MacDonald, 1987). Cases of nesting on man-made structures have been observed (Antipin, 1938; Vuilleumier, 1995; Volkov & de Korte, in press).

Breeding. Beginning of egg laying occurs from approximately June 20 to early July (Bulavintsev, 1984; Tomkovich, 1986; de Korte & Volkov, 1993; Volkov & Pridatko, 1994). There are 1–3 eggs in the clutch. The average clutch size seems to depend on ice conditions. It was found to be ca. 2.0 eggs in 1994 on Domashny Island (Volkov & de Korte, in press), while only 1.3 eggs (3 egg-clutches were absent) in 1981 under unfavourable ice conditions (Tomkovich, 1986). Hatching occurs in mid-July – early August. The gulls keep nearby the nesting colonies until mid-August (Volkov & Pridatko, 1994). Nestlings are able to fly 4–5 weeks after hatching (Bulavintsev, 1984).

Food habits. During the nesting period, the diet of the Ivory Gull is based on fish (mainly Polar Cod *Boreogadus saida*) and marine invertebrates (Amphipoda, *Clione*) (Yudin & Firsova, 1988b). Outside the breeding season the Ivory Gulls prey on sea organisms near the pack ice edge (Divoky, 1976). The birds catch fish and marine invertebrates from surface water layers while flying or by means of surface submerging. They also can take food swimming near the ice edge, but this foraging technique is not common (Løvenskiold, 1964; Divoky, 1976; Laybourne, 1978; Yudin & Firsova, 1988b). They are also known to scavenge on dead animals and to take food nearby human dwellings and ships. They do not normally follow ships.

Predators, unfavourable factors. The egg-laying period, number of nesting birds and the breeding success depend largely on ice conditions of the sea area adjacent to the breeding colony in the first half of summer. During years with no open waters or leads, birds either do not breed or the clutches die as a result of food shortage. In some cases breeding success of Ivory Gulls depends on the presence of terrestrial predators. In the Canadian Arctic, predation of clutches by Arctic Foxes has been recorded (MacDonald, 1976). The Arctic Fox is rare in summer in most breeding places of Ivory Gulls in the Russian Arctic.

Economic importance and human impact. The species has no economic importance, but egging is known to occur nearby the polar stations. The development of shipping along the NSR can have a negative influence on the Ivory Gull population in the case of contamination of the Arctic seas by oil products.

At present there are no data on negative influence on breeding success of the Ivory Gull by helicopter traffic nearby colonies or by single visits to colonies by humans. However, if colonies, for instance in the vicinity of polar stations, are regularly disturbed, the birds may abandon the colonies. This was the case at the Sredniy and Golomyany Islands (Sedov Archipelago). At the same time, during the non-breeding period human settlements in the Arctic are one of the most attractive food sources for Ivory Gulls. Also, the breaking of continuous ice cover by ships may make food (fish and marine invertebrates) more accessible for the gulls, and this may affect the population of these birds positively. Note that Ivory Gulls do not feed behind vessels (J. Chardine pers. obs.).

Thus, the most significant factor governing the state of the Ivory Gull populations, is food availability during the breeding period. The largest possible negative effect on the birds as a result of the NSR development can be expected from oil pollution.

Conservation. Included in the Russian Red Data Book as a rare restricted-range species. In the Russian Arctic the breeding colonies of the Ivory Gulls have been protected since 1993 with the establishment of the Great Arctic Reserve including the Kara Sea Islands and the Federal Refuge '*Franz Josef Land*'. Special purposes Federal Reserve 'Severozemelskiy', that includes the largest known Ivory Gull colony, was established on April 1, 1996.

4.3 *Brünnich's Guillemot (*Uria lomvia *L.).*

by Maria Gavrilo

Status. Nesting, migratory species.

The subspecies systematic needs to be specified. After the species revision by L.A. Portenko (1937, 1944) four subspecies are identified within *U. lomvia* including *U. l. lomvia*, *U l. eleonorae*, *U. l. heckeri* and *U. l .arra* (Stepanyan, 1975; Golovkin, 1990), although their biological significance is argued by some authors (Rutilevskiy, 1963; Uspenskiy, 1963; Stishov *et al.*, 1991). If one supports this opinion, then two endemic subspecies *U. I. eleonorae* and *U. l. heckery* inhabit the NSR region, and in addition the nominate race is found within as well as outside the NSR region in the west.

General appearance, size. Medium-sized bird with a spindle-shaped body typical of auks. Mean wing length is 215 mm (192–240), mean body mass is 994 g (730–1,200); males being slightly larger than females (Golovkin, 1990).

Sexes alike. The colouring essentially, black above and white below. The adults in summer have a blackish-brown body, upper parts, head and neck, whereas the underparts and underwings are white. In winter white colouring appears on the throat, neck, and cheeks. It differs from the Common Guillemot by a heavier light stripe along the lower side of the upper mandible, thicker and shorter bill and by having pure white flanks in flight.

Distribution. The breeding range is circumpolar, covering the Arctic and sub-Arctic Seas. It nests in Eurasia along the coast of North Norway, Kola Peninsula, on E. Taimyr, Chukotka and down to the mouth of the Tumnin River (the Sea of Okhotsk) in the south. In North America it breeds in Alaska and in the northeastern and eastern Canadian Archipelago, from the insular Newfoundland in the south to the Grinnel Land in the north. It inhabits Greenland, Iceland and most of the Arctic archipelagos, the islands of the Pacific Ocean basin southward to the Aleutian ridge and Sakhalin.

On Novaya Zemlya the bulk of the population breeds along the western coast. The only known colony on the Kara side is on Gemskerka Island, the north-easternmost tip of the archipelago (Antipin, 1938). Eastwards the next breeding colony is off East Taimyr, at the Preobrazheniya Island (Uspenskiy, 1959) and probably also in the Faddey Bay (Kaftanovskiy, 1951). Further east along the continental coast, guillemots do not nest before the Chukchi Peninsula. On the New-Siberian Islands the colonies are located along the western and northern coasts including Belkovskiy, Stolbovoy, Bennetta and Zhokhov Islands (Rutilevskiy, 1967). On Wrangel Island a number of colonies occupy the western tip (with the largest at the Ptichy Bazar Cape) and on the eastern tip, the Uering Cape. On the Herald Island several colonies are found, mainly on the south-eastern part (Stishov *et al.*, 1991). Along the Arctic coast of Chukotka the Guillemot nests on the Shalaurov and Kolyuchin Islands (Kondratiev, 1986a), Seshan (Golovkin & Flint, 1975), Inchoun and Dezhnev Capes (Tomkovich & Sorokin, 1983), Volnisty and Kekurny Capes and nearby Chegitun River mouth (Konyukhov *et al.*, unpubl.). Thus, within the NSR area the Brünnich's Guillemot has a patchy breeding distribution with a break in the western part.

Brünnich's Guillemots may winter near the ice edge, not far from the breeding grounds. The birds from the North Atlantic migrate to the south of the Davis Strait, shores of Greenland and Newfoundland and at sea in the Greenland and Barents Seas (Tuck, 1960; Salomonsen, 1971). Brünnich's Guillemots from Novaya Zemlya partly winter in waters off Southwest Greenland and they also appear to stay within the Barents Sea near the ice edge (Uspenskiy, 1958; Anker-Nilssen *et al.*, 1988 after Bakken, 1990). There are known cases of wintering of a small number of guillemots in the polynya off the Zhelaniya Cape (Antipin, 1938; Butyev, 1959). Also, wintering in other polynyas of the Siberian Seas is assumed (Kozlova, 1957; Uspenskiy, 1969). Guillemots from the coasts of Siberia and the Pacific Ocean basin winter in the Bering Sea, near the Aleutian and Commodore Islands reaching the latitude of Honsu in the south (Golovkin, 1990).

Seasonal migrations. Seasonal movements in guillemots are not well known. They leave the breeding areas when the sea ice is formed and migrate alone or in small groups. However, in some places large flocks can be observed.

Adults with chicks leave the vicinity of the colonies directly after fledging, and they are able to swim up to 40 km a day (Gaston, 1982). Prospectors leave the colony together in groups before fledging, sometimes carrying along failed breeders. The last records of Brünnich's Guillemots in breeding colonies within the NSR area are as follows: 23.08.1937 on Gemskerk Isle (Antipin, 1938); 05.09.1956 on Stolbovoy Isle (Rutilevskiy, 1963), late August–early September on Bennetta Isle (Uspenskiy, 1963), 19–23.09 on Wrangel Isle (by the observations of 1979–82, Stishov *et al.*, 1991).

Spring migration is more pronounced; numerous flocks flying over areas covered by close ice can be observed. The dates of the appearance near colonies vary by years and regions, depending on ice conditions of the adjacent water areas. The first birds appear in polynyas and leads 1–2 weeks earlier than the conditions permit them to occupy the nesting ledges. As all available observations were made from land, they recorded arrival directly to the nesting colonies. The first birds on the Gemskerk Isle were observed on 05.04.1937 (Antipin, 1938); on the Preobrazheniya Isle on May 6–17 (period of 1936–1952; Uspenskiy, 1969); on Stolbovoy Isle usually on May 25–28, but on June 5 in 1956 (Rutilevskiy, 1963). Guillemots usually arrive to the colonies of Wrangel Isle in mid-May, with the extreme records for 1979–1987 of April 20 and May 17 (Stishov *et al.*, 1991). Thus, Brünnich's Guillemots stay at the breeding colonies from 100 days in the sites located far away from wintering grounds under conditions of heavy ice, up to 180 days in colonies close to wintering grounds in favourable years.

Moult. Adults moult twice a year. The post-breeding moult starts with change of minor contour feathers already on the nesting ledges. Moult of primaries accompanied by the loss of flying ability occurs soon after leaving the breeding colonies. The moult into the breeding plumage usually ends by February (Kaftanovskiy, 1951; Tuck, 1960).

Population numbers and trend. Tuck (1960) considers the Brünnich's Guillemot to be the most abundant seabird and V.P. Shuntov (1993) believes it to be the second in number after the Little Auk. The most recent estimate of the world breeding population is 14,000,000 birds. This figure should be doubled to get an estimate of the total population including non-breeders (CAFF 1996).

Within the NSR area the reliable counts have been conducted only in the east, and there are only rough estimates for the other regions. The largest colonies are located on the Wrangel and Herald Isles totalling 150–200,000 birds; as well as on the Preobrazheniya, Belkovskiy and Kolyuchin Isles (Uspenskiy, 1957, 1959; Kondratiev, 1986; Stishov *et al.*, 1991). According to an evaluation by A.N. Golovkin (1984), which coincides precisely with a frequently cited estimate of S.M. Uspenskiy (1959), the total number of breeding guillemots within the NSR area is ca. 320,000 individuals. We estimate it at not less than 350–400,000 birds.

In spite of an approximate and non-uniform reliability of the available data it can be concluded that only about 3% of the world breeding population of Brünnich's Guillemot inhabit the NSR area. However, following the existing opinion on the subspecies systematic, it should be stressed that two not numerous endemic subspecies nest here.

Current population trends of the Brünnich's Guillemot are not clear and differ between regions. However, in most regions (Northeast Atlantic, Barents and Bering Seas) population declines have been observed during past decades, which are assumed to be a result of overfishing. In other regions (Iceland and Canada) the populations are stable (after Circumpolar Seabird Bull., 1994).

Within the NSR area reliable data on population dynamics are available only for the Wrangel Isle. Here, fluctuation in numbers within the limits of 109,000-143,000 individuals, depending on conditions from year to year, has been found for the last decade (Pridatko, 1986). Fragmentary data on changes in numbers are available for the Chukchi coast. Thus, on the Kolyuchin Isle the number increased 7-fold from 1938 to 1974 and was reduced almost 3-fold during the next 10 years. Simultaneously, the Common Guillemots appeared to have increased in number (Portenko, 1973; Kondratiev, 1986). Thus, at present a general population trend in the population of Brünnich's Guillemot within the study area is hard to evaluate. As the population declines have been recorded in regions with extensive fishing, the Brünnich's Guillemot populations of the Siberian seas could be assumed to be stable.

Habitat. Within the NSR area most of the colonies are located on rocky sea coasts of islands. Guillemots nest on the benches and ledges of different width on the steep rocky cliffs precipitous directly to the sea or separated from it by a narrow beach. The height of nests above sea level varies from several meters to tens of meters. Generally, the breeding colonies are confined to the regions of enhanced biological productivity of the adjacent waters (Belopolskiy, 1957). As a rule, large colonies are found either on small islands or rocky capes protruding into the sea around which the currents contribute to accumulation of food organisms (Golovkin *et al.*, 1972).

Also, at the northern limit ice conditions serve as an additional factor limiting the distribution of the breeding colonies. As Brünnich's Guillemot chicks are unable to fly when they leave the colonies, the distribution of drifting ice in late summer determines the breeding distribution of the species. Thus, the northern boundary of the breeding range is found about at the average multiyear position of the drifting ice edge in late August–early September. Hence absence of Brünnich's Guillemots at Severnaya Zemlya is caused by heavy ice conditions around the archipelago. A relation between the distribution of seabird colonies and the presence of recurring polynyas and leads is shown for the high latitudes (Kupetskiy, 1959; Brown & Nettleship, 1981; Gavrilo *et al.*, 1993). For Brünnich's Guillemots this factor is even more significant than for the other species nesting in the Arctic, such as Kittiwakes, Black Guillemots and Little Auk.

Most of the immatures stay at sea all-year-round, as do adults outside the breeding season. Birds generally occur in continental-shelf waters with floating ice and surface temperature from 0° to 10°C. An increased density of birds at sea is observed in regions of frontal zones of different origin. The occurrence of accumulations of Brünnich's Guillemots in the ice-edge zone is well documented in some areas (see for example, Irving *et al.*, 1970; Bakken, 1990). Quantitative data on the pelagic distribution of Brünnich's Guillemots, as well as of other seabirds within the NSR area, are very limited (Stishov *et al.*, 1991; Bakken & Gavrilo, 1995).

Breeding. Becomes sexually mature after two or three years (Krasovskiy, 1937; Kaftanovskiy, 1951; Uspenskiy, 1956). A colonial species with a strong nesting philopatry.

Within the NSR area it breeds in mixed colonies with Kittiwakes, Black Guillemots and Glaucous Gulls; in the east also with Common Guillemots, Pelagic Cormorants, Horned Puffins and Tufted Puffins. Birds that do not participate in the breeding (prospectors) are also present in the colonies and may make up 15–20% of the birds in the colony (Gaston & Nettleship, 1981).

The single egg is laid directly on bare rock. The egg size varies significantly both within the colony and among geographical populations, being on average 79.5x50.8 mm. The mass of freshly laid eggs varies between 101 an 118 g, being about 11% of the female mass (Krasovskiy, 1937; Golovkin, 1990). If the first egg is lost, about 2/3 of the females are able to lay a second egg in 15–17 days, a very small number of birds can also lay a third egg (Krasovskiy, 1937).

Egg-laying is synchronous (most eggs are laid 5–10 days after the first eggs appear). The timing is relatively stable for a region and depends little on environmental conditions; annual variation does not usually exceed five days (Krasovskiy, 1937; Uspenskiy, 1956; Belopolskiy, 1957; Gaston & Nettleship, 1981). Thus, in Northeastern Novaya Zemlya a mass egg-laying is recorded in mid-June (Antipin, 1938), in late June of 1954 on the Belkovskiy Island (Uspenskiy, 1956), on June 20–23 of 1956 on the Bennetta Island (Uspenskiy, 1957), on June 19–24 of 1979–1984 on the Wrangel Island (Stishov *et al.*, 1991). However, at the northern limits of the range extremely heavy ice conditions can cause breeding delay as known from the Canadian Arctic (Nettleship *et al.*, 1984.). This was probably also observed on the Stolbovoy and Kolyuchin Islands, where the eggs were laid in early July in 1956 and 1985, respectively (Rutilevskiy, 1963; Kondratiev *et al.*, 1987).

Both parents incubate. According to different sources, incubation lasts for 28–35 days, usually 31–35 days (Krasovskiy, 1937; Kaftanovskiy, 1951; Tuck, 1960). After hatching the chicks remain on the nesting ledges from 15 to 30–35 days (Krasovskiy, 1937; Uspenskiy, 1956a; Gaston & Nettleship, 1981). For the New-Siberian Islands a period of 20–28 days is indicated (Rutilevskiy, 1963; Uspenskiy, 1963), and 17–26 days on the Wrangel Island (22 on average) (Stishov *et al.*, 1991). The duration of the chicks' presence on the nesting ledges depends to a great extent on environmental factors. The main factor is the physical condition of the chicks, which is determined by the ability of the parents to provide sufficient food for the chicks. Weather and ice conditions during fledging are also important factors. By the end of the fledging period the chicks leave the colony at younger age (Gaston & Nettleship, 1981). Fledging dates within the NSR area are as follows: Northeast Novaya Zemlya - early August (beginning, Antipin, 1938); Bennetta Island - August 20–23, 1956 (peak, Uspenskiy, 1963), Belkovskiy Island - first 10 days of August 1954 (beginning, Uspenskiy, 1957), Stolbovoy Island - September 2–7, 1956 (Rutilevskiy, 1963), Wrangel Island - August 16 on average, the latest date being August 31 (peak, Stishov *et al.*, 1991). Fledging has a well-pronounced daily rhythm, peaking at 20–24 h local time. The intensity of fledging is observed to be influenced by weather conditions (Daan & Tinbergen, 1979; Gaston & Nettleship, 1981; Gavrilo, 1991b). The chicks are unable to fly when jumping from the nesting ledges and they depart from the breeding grounds by swimming. The adult and the chick stay together for about a month after leaving the colony.

Food habits. Searches for prey by pursuit diving. Normally food is taken in the mid-water column at depth less than 50 m, however the deepest record is 150 m. Mainly ichthyophagous (fish eating). Diet can vary significantly by seasons, years and in different geographical regions. On the whole, the preference is given to the most commonly available pelagic prey. As compared to the Common Guillemot, the diet of the Brünnich's Guillemot is more diverse; the invertebrates, mainly crustaceans, constituting a larger portion (Bradstreet & Brown, 1985). Among the fish in the south of the range, the prevailing species are the young of the benthic fishes Cod and Pollack, and small pelagic species (Capelin, Sandeel and Herring). Among the invertebrates are different crustaceans, as well as squids and polychaets (Bradstreet & Nettleship, 1985). According to the few observations in the Siberian Seas during the nesting period, Brünnich's Guillemots feed mainly on Polar Cod in these areas (Uspenskiy, 1956; Rutilevskiy, 1963; Stishov *et al.*, 1991). The benthic crustaceans *Mesidothea* were recorded to be abundant under extreme conditions of De-Longa Isles (Uspenskiy, 1963). On Chukotka pelagic crustaceans are found to be the principal food (Golovkin & Flint, 1975).

As a numerous species, the Brünnich's Guillemot is an important consumer of the biological production at the higher trophic levels. An increase in the biological productivity in the waters near the seabird colonies and intensification of nutrients cycling are well documented at present (Golovkin, 1991; Golovkin & Pozdnyakova, 1965; Golovkin *et al.*, 1972).

Normally, Brünnich's Guillemots feed quite close to the colonies while breeding. According to observations in the Atlantic and North Pacific the largest accumulation of feeding guillemots is observed at a range of 2–8 km (Bedard, 1976; Tuck & Squires, 1955). In the high Arctic the foraging range is determined in many respects by ice conditions. On one hand, fast ice or closed ice near the colony forces the birds to fly past areas unsuitable for feeding. On the other hand, the Guillemots are able to overcome significant distances (up to 100–175 km) to reach the preferred feeding habitats (for example ice edge zones) (Gaston & Nettleship, 1981). The only observations on foraging distance within the NSR (in East Chukotka) give the foraging range to be not less than 20 km (Golovkin & Flint, 1975). V.I. Pridatko (1986) considers the foraging range at the Wrangel Island to be 24 km on average.

Predators, unfavourable factors. Main predators of eggs and chicks in colonies are larger gulls including Great Black-backed Gull, Herring Gull and Glaucous Gull. The latter is the principal one along the NSR. Although chick loss from predation is not large on average, gulls can significantly affect the breeding success in some regions (Kaftanovskiy, 1951; Kondratiev *et al.*, 1987). In accessible zones of the colony the eggs and chicks can be preyed on by Arctic Foxes. Some offspring die due to unfavourable microclimatic conditions on the ledges, they may also fall down from the ledges, or be hit by rock falls or avalanches. Weather conditions within normal ranges influence little on the survival of juveniles, however, extreme adverse conditions (prolonged storms) result in a decrease in the growth rate due to difficulties of foraging (Gaston & Nettleship, 1981). Death of chicks due to cold is observed (Kaftanovskiy, 1938; Uspenskiy, 1956). The total breeding success up to fledging varies within a wide range from 40 to 93% (Tuck, 1960; Gaston & Nettleship, 1981). A significant number of chicks can be lost when leaving the colony and soon after that. The main causes are predation by gulls, skuas, Arctic Foxes and even Walruses (de Korte, pers. comm.); death from collisions with the rocks and when getting into the surf. Mortality of chicks during fledging can reach 15–24% (Williams, 1975; Gavrilo, 1991b, Pridatko, 1986), reducing the total breeding success by 6–18%. At the northern distribution limit the ice cover close to the colony becomes a significant factor; in some years fast ice or an approach of compact drifting ice result in a complete loss of offspring (Pridatko, 1986). Under such conditions the dates of the start of breeding are of great importance. Thus, Brünnich's Guillemots from the most extreme breeding places have no additional time for successfully rearing chicks from repeated clutches. There are no data on chick mortality after leaving the colony.

Adults can become prey to large falcons. Birds can die when getting into an ice trap; too small fractures or hummocked fast ice.

Economic importance and human impact. Up to the 1950s harvesting of eggs and adults was widely practised in the USSR, resulting in a depletion of the population in some colonies. At present egging is practised by local people on a restricted scale. Along the NSR area the colonies of Brünnich's Guillemots were always only an additional food source for the personnel of polar stations and expeditions. In addition to the direct exploitation, the disturbance when visiting the colonies may considerably increase the predation success by gulls. An increased number of Glaucous Gulls near the settlements also contributes to higher predation pressure in guillemot colonies in such areas.

During the last decades the human impact mainly responsible for the decline in Brünnich's Guillemot populations should be considered to be commercial fishing resulting in food depletion in different regions of the area, drowning in fishing nets and hunting in NW Atlantic (Brown & Nettleship, 1984; Evans, 1984; Lensink, 1984; Ogi, 1984; Elliot 1991; Falk & Durinck, 1992; Krasnov, 1995). However, it should be noted that up to the present the Brünnich's Guillemot suffers from such depletion to a lesser extent than the Common Guillemot or the Puffin (Vader *et al.*, 1989, 1990). For the populations nesting within the NSR area depletion of food resources is only a potential risk at present due to undeveloped commercial fishing in this region. This factor may have an effect on the wintering grounds only; these localities for the birds inhabiting the Siberian Seas have not yet been identified.

Similar to all diving birds, oil pollution presents a significant danger for Brünnich's Guillemots. They are most vulnerable in the period after leaving the colonies (late August–October) when the chicks have not yet become able to fly and the adults change their flight feathers. There are reasons to believe that the routes of the autumn migrations of Brünnich's Guillemots in the Siberian Seas are significantly limited by ice conditions. This fact enhances the vital importance of these routes in the annual cycle of guillemots and the risk of a possible accident in these areas.

In addition to accidental pollution the guillemots, as long-lived organisms at the top of the trophic pyramid, are subject, to a great extent, to a risk of chronic pollution. There are no data on the levels of pollutants in the birds inhabiting the NSR area.

The disturbance caused by low-flying aircraft can result in panic in the colony. This may lead to both direct loss of eggs and chicks being pushed out from the ledges and to increased gull predation.

One of the potentially positive factors connected with the development of shipping along the NSR includes the breakage of compact ice cover by moving ships. This may facilitate food accessibility. However, the importance of this impact is unknown and may not be significant.

Thus, the development of shipping along the NSR represents mainly a threat of oil pollution for the Brünnich's Guillemots.

Conservation. About one half of the breeding population inhabiting the NSR area is protected by the 'Wrangel Island' State Reserve. Colonies on Belkovskiy and Stolbovoy Islands are situated within the buffer zone of the 'Lena-Delta' State Reserve.

4.4 Seabird colonies

by Maria Gavrilo

This section considers the seabird colonies that contain more than 1,000 individuals, according to available data, and are mainly inhabited by obligate-colonial species. The biology of the most abundant and widespread species that were also found to be most vulnerable in relation to oil pollution are described in separate articles (see above).

Distribution, species composition and population numbers of the colonial seabird settlements within the NSR area, like the entire group on the whole, are extremely non-uniformly studied. The eastern region, where most of the colonies are located, is characterised by the best information coverage. The only place where permanent studies are carried out, is the State Reserve 'Wrangel Island'. Series of multi-year observations obtained here, provide an understanding of the annual population dynamics and the variability of the course of seasonal phenomena in the seabird colonies. There are no data at all about the eastern coast of Novaya Zemlya (except for the north-easternmost region). The data from the New-Siberian Islands, collected several decades ago, are too old to assess modern status. Most colonies of Severnaya Zemlya were examined only incidentally during short visits that did not allow carrying out reliable counts of hidden nesting species. The only exception is recently established monitoring of the Ivory Gull colonies at Sdov Archipelago. The colonies at the Chukotka coast have been examined at least once, but only single special studies have been conducted here (Golovkin & Flint, 1975; Kondratiev *et al.*, 1987). An analysis of the history of bird studies of the region under consideration suggests that seabirds, except for the Wrangel Island, have actually never been an object of special research. By the present time the location and the species composition of colonies are known for most of the regions. Current data on the number, phenology and demography are available only for the Wrangel Island. Data on the pelagic distribution of seabirds are practically absent (Bakken & Gavrilo, 1995; Decker *et al.*, 1998 in press). There are also no data on wintering areas and migration routes.

The nesting fauna of colonial seabirds within the NSR area is represented by 12 species, including 11 of the order Charadriiformes and one of the order Pelicaniiformes (Table 4.1).

Depending on species composition, the colonies can be subdivided into several types (Uspenskiy, 1959). Under the severe climatic conditions of the Siberian shelf seas the colonies of the Arctic and high-Arctic types with few species represented are most common. The colonies of Severnaya Zemlya located farther north, as compared to the other colonies, differ, primarily in the absence of the Brünnich's Guillemot and the dominance of the Atlantic element – the Little Auk. The colonial settlements of another high-Arctic species of Atlantic origin, the Ivory Gull, are also widespread in the archipelago and over the Kara Sea islands. On the whole, the fauna of the seabird colonies is represented by four species including Little Auk, Kittiwake, Black Guillemot and Glaucous Gull. The Ivory Gulls normally settle separately forming monospecies flat colonies (see *The Ivory Gull*). Thus the nesting colonies of the islands in the Northeast Kara Sea and the Northwest Laptev Sea belong to the high-Arctic type.

Table 4.1. Breeding colonial seabirds within the NSR area.

	Sea			
Species	Kara	Laptev	East-Siberian	Chukchi
Phalacrocorax pelagicus	–	–	**B**	**B**
Larus hyperboreus	**B**	**B**	**B**	**B**
Larus argentatus	**(B)**	**(B)**	**B**	**B**
Rissa tridactyla	**B**	**B**	**B**	**B**
Pagophila eburnea	**B**	**B**	–	–
Alle alle	**B**	**B**	–	–
Uria lomvia	**B**	**B**	**B**	**B**
Uria aalge	–	–	–	**B**
Fratercula corniculata	–	–	–	**B**
Fratercula cirrhata	–	–	–	**B**
Cepphus grylle	**B**	**B**	**B**	**B**
Cepphus columba	–	–	–	**B**

B - breeding; **(B)** - breeding, but in separate colonies not considered in this study.

The fauna of many of the remaining colonies is dominated by Kittiwake and Brünnich's Guillemot, hence they can be attributed to the Arctic type. The nesting colonies of the extreme Northeast Novaya Zemlya, East Taimyr and the New-Siberian Islands differ by having only four species represented with a circumpolar distribution including Brünnich's Guillemot, Kittiwake, Black Guillemot and Glaucous Gull.

When moving eastwards, although the leading role of the Brünnich's Guillemot and the Kittiwake remains, the seabird fauna is enriched by the Pacific boreal species including Pelagic Cormorant, Horned Puffin, Tufted Puffin. The Black Guillemot is replaced in the easternmost region by the Pigeon Guillemot, and also the Common Guillemot appears. A high relative abundance of Black Guillemots is a peculiar feature of the colonies of Herald Island, as well as those of the De-Long archipelago. Thus the colonies of Wrangel and Herald Islands, as well as many of those situated along the Arctic coast of Chukotka, also belong to the Arctic type enriched by penetration of boreal elements from the Pacific Ocean. Only the colonies of the easternmost region of the Chukchi Peninsula, where the maximum species diversity is observed (up to eight species) and the boreal species become dominant instead of the Brünnich's Guillemot, can be considered as belonging to the northern boreal-Pacific type.

The distribution of seabird nesting colonies is governed by the combination of favourable biotopic, protection and feeding conditions; the latter being of greatest importance. At present it is well known that the seabird colonies are on the whole confined to regions of increased biological productivity and their specific position depends on the local hydrological features. Increased vertical water circulation in the Arctic Seas mainly occurs in the area of the polar front which within the Russian Arctic is most developed in the Barents, Bering and Chukchi Seas. Among these, only the western Chukchi Sea belongs to the NSR area. The number of seabirds nesting along the coasts in this area is higher than in the other seas of the Siberian shelf. The ice cover is an important oceanographic factor affecting the life of the Arctic marine organisms. The presence of solid ice cover restricts the access of seabirds to food and also poses a problem for guillemot chicks during their swimming migration from the breeding colonies. On the other hand, it is shown that the ecosystems of recurring polynyas and the ice edge are characterised by enhanced biological productivity. Another zone of increased water circulation and hence of enhanced productivity is the regions of the shelf break. Seabird colonies in the high Arctic are confined to recurring polynyas (Kupetskiy, 1959; Brown & Nettleship, 1981; Gavrilo *et al.*, 1995 and others). The only large colony of the Kara Sea is attached to the northern tip of the Novozemelskaya polynya; the colonies of Severnaya Zemlya are tied up with the Eastern Severozemelskaya polynya which is located along the boundary of the continental slope; the colonies of Preobrazheniya Island and the New-Siberian Islands correspond to the system of the Laptev polynyas which is known as the Great Siberian polynya. The ZaWrangelevskaya polynya adjoins Wrangel Island.

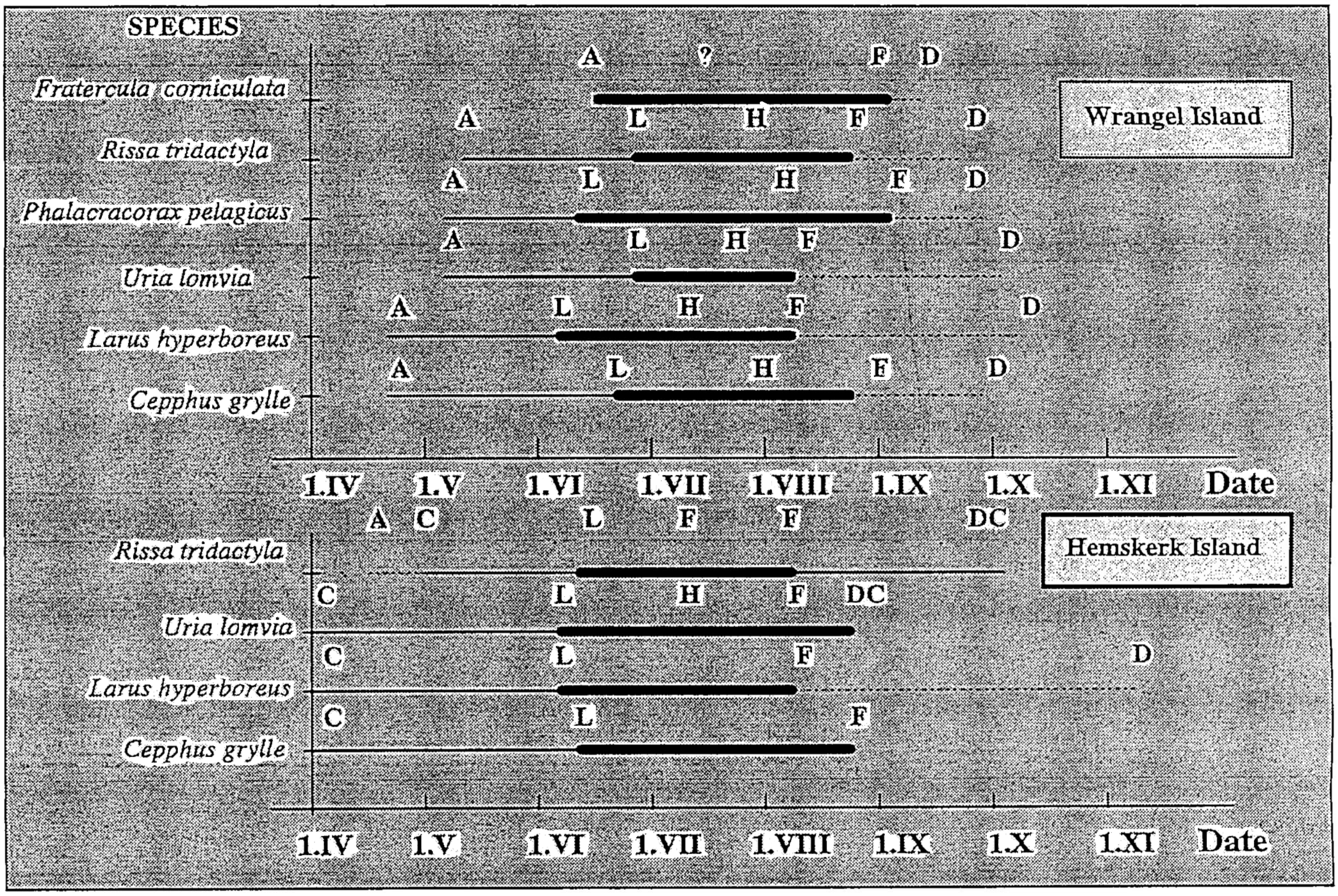
Structure of the shores, although it is not a decisive factor for the existence of colonies, can restrict their distribution to a certain extent. The overwhelming majority of seabirds of the study region nest on precipitous rocky sea coast which is related to protection from terrestrial predators and a limited flying ability in some species. The suitable shores within the NSR area are quite limited and are mainly confined to the arctic islands. At the mainland, rocky shores with suitable cliffs are only found in East Chukotka.

On the whole, regarding quantity, the seabird colonies of the Siberian shelf seas are not rich. Among the 46 colonies considered in this study, there is only one of a very large size (over 100,000 individuals), 4 large colonies (50,000–100,000 individuals) and 11 colonies of average size (10,000–50,000 individuals). The Kara Sea is the area least populated by seabirds. Here, there are no large colonies, the largest known, numbering up to 20,000–25,000 individuals, is at the extreme Northeastern Novaya Zemlya, i.e. under conditions of the direct influence of the Barents Sea waters. The Laptev and the East-Siberian Seas occupy an intermediate position. The large colonies are found in connection with the Great Siberian polynya, but abundant nesting colonies are also situated in W. Wrangel Island and at the eastern coast of Severnaya Zemlya. The colonies of the Chukchi Sea are characterised not only by the highest species diversity, but also by the greatest abundance of nesting seabirds. The largest colonies known for the NSR area, are located at Uering Cape and Kolyuchin Island (up to 200,000 and 60,000 individuals, respectively). According to available data, the total number of seabirds in the colonies within the NSR area are estimated at 600,000–700,000 breeding pairs (not counting terns and Glaucous, Ivory and Herring Gulls nesting in separate colonies). Accounting, for non-breeders and young birds, these figure can be doubled.

Seabirds inhabiting the Siberian shelf seas are migratory birds. Few winter sites are recorded in the polynyas off Zhelaniya Cape and in Matochkin Shar Strait (Antipin, 1938; Dubrovskiy, 1944; Butyev, 1959). Wintering in the other polynyas is only assumed (Uspenskiy, 1969).

The dynamics of colony attendance in different species at Wrangel Island and Hemskerk Island (NE. Novaya Zemlya) is shown in Fig. 4.1 as an example.

Arrival at the nesting grounds depends on the ice conditions of the adjacent areas. The birds move towards the nesting colonies along the system of polynyas and hence the spring migration frequently occurs from the North – from the recurring polynyas (Antipin, 1938; Uspenskiy, 1957). First, birds appear in the colonies that are at the shortest distance to the ice edge. Thus, the activity in the colony on Hemskerk Island starts in the beginning of April. By the end of April, the colonies of Wrangel Island are revived. The first to arrive are the Arctic species wintering near the drifting ice edge; Black Guillemots as well as Brünnich's Guillemots and Glaucous Gulls. Later Kittiwakes and Pelagic Cormorants appear. The species penetrating the Arctic from temperate latitudes, including Horned and Tufted Puffins are the last to arrive. Thus, both the species and the colonies, on the whole, differ in duration of pre-breeding period. The longest pre-breeding period is found in Black Guillemots, winter relatively close to the breeding grounds and demonstrate high flexibility in relation to food habits and ice conditions. They arrive at Hemskerk Island in the first days of April and begin almost immediately to occupy the snow-free parts of the cliffs, but breeding begins more than two months later. Brünnich's Guillemots and Glaucous Gulls come to the island simultaneously with Black Guillemots, but their pre-breeding period is slightly shorter (about two months). The Kittiwakes, that come a month later, have about 40 days between arrival and laying. Chicks fledge during August and leave the nearby area by October. Only Glaucous Gulls can be observed as late as November. Thus, the active period in this colony lasts for about 7 months (210 days), being the longest known for the area under consideration.



Symbol	Wrangel Island	Hemskerk Island
A	Arrival to the island	Arrival to the area
C	-	First colony attendance
L	First egg laying	First egg laying
H	First hatching	First hatching
F	First fledging	First fledging
D	Departure from the island	Departure from the island
DC	-	Departure from the colony

Figure 4.1. Colony attendance at Wrangel (Pridatko, 1986b) and Hemskerk Islands (Antipin, 1938).

First inhabitants to come at the Wrangel Island cliffs are also Black Guillemots and Glaucous Gulls, whilst the majority of the inhabitants, including Brünnich's Guillemots and Kittiwakes, appear two weeks later, by mid-May. Thus, the pre-breeding period lasts here for 60 days in Black Guillemot, for 40 days in Brünnich's Guillemot and only for 20 days in Kittiwake. Young begin fledging in the second half of August, and the birds have left the island chiefly by the end of September. Thus, the duration of the active period in Wrangel Island colonies lasts for about 170 days, including 140 days for the main body.

The minimum active period is known for the colony located under the extreme conditions of the De-Long archipelago, Henrietta Island. In spite of the Great Siberian polynya being close, severe climatic conditions prevent birds attending the colony due to snow and ice remaining on the cliffs. Thus, 40 and 30 days pass between the arrival and first colony attendance in Black Guillemots and Kittiwakes respectively. The active period in the colony (taking into account time from the first colony attendance at the beginning of May) was recorded to be only 100 days, and the cliffs became deserted by September 20 (Leonov, 1946).

As described elsewhere (Bakken *et al.*, 1996; Gavrilo *et al.*, in press), the main hazard to seabird colonies posed by increased shipping activity along the NSR will be the risk of oil pollution. The period of highest vulnerability coincides with the active period in the colonies, i.e. early April (in colonies situated under favourable conditions) to early May, until September. One should take into account, however, that in spring–early summer seabird distribution patterns strongly depend on ice conditions. The chief foraging areas can be situated tens of kilometres from the colonies (E. Severnaya Zemlya colonies and polynya off Cape Arkticheskiy for example). Under favourable ice conditions when at peak of the breeding season, foraging range is chiefly restricted to 30 km from the colonies according to scanty data available from the study area (Golovkin & Flint, 1975; Pridatko, 1986a).

Finally, it should be stressed, that new data on phenology, number and population dynamics, as well as distribution patterns, are essential for the execution of reliable sensitive modelling and an Environmental Impact Assessment.

5. VEC 2. MARINE WILDFOWL

5.1 The state of knowledge on marine ducks and waders

by Maria Gavrilo

Since the present study aims primarily at nature protection, including Environmental Impact Assessment, the "territorial" principle is largely used in the analysis of composite VEC's, i.e. those which consider the group of species (duck concentrations and waders in feeding and resting areas). Also, a geographical principle is governed by a traditional approach to investigating a vast territory of the Russian Arctic, where various regions are the responsibility zones of different research institutions. In view of the specific regional features both with regard to ecology of separate groups of birds and the landscapes inhabited by them we were interested in the participation of specialists with experience of work in the regions under consideration. Since special research works are beyond the scope of the present project, only the data that have been obtained before were used. The varying approaches of the authors to the study objectives is also reflected in the final review resulting sometimes in a non-uniform character of the data presented. Thus in some cases the emphasis was laid on the biology of the species, in other cases on the characteristics of fauna and population. In any case, however, we tried to use the available material to a maximum. By generalising data on numbers and distribution of the study groups, the key sites along the coast most important for ducks and waders during the summer–autumn migrations and moulting, were delineated.

The data presented are also non-uniform due to a varying extent of knowledge on the vast area along the coasts of the four Siberian Seas. Long-term studies for more than two decades were carried out at different points of the Yugor Peninsula, where aerial surveys covered the entire coast. The last of them was, however, conducted 10 years ago (Estafyev, 1991; Mineev, 1994). On the Yamal Peninsula a network of stationary observation sites began operating in 1969, but all points of permanent observations are found in inland and southern parts of the peninsula (Danilov *et al.*, 1984). The coastal regions, including the extreme north of the peninsula have been examined only in the last decade in the course of land based surveys (Distribution and numbers..., 1985). Stationary studies in Taimyr, initiated several decades ago (Krechmar, 1966; Vinokurov, 1970 and others), focused on the western region of the peninsula. The area of study was expanded to include a number of points at the Taimyr coast and the islands of the Kara Sea about a decade ago with the commencement of work of the Arctic Expedition of the Institute of Ecology and Evolution, RAS (The Arctic tundra of Taimyr..., 1994). Long-term ornithological studies on the extensive coast of Yakutia were performed only in the deltas of several large rivers (Indigirka and Kolyma) more than a decade ago (Kistchinski, 1988; Kistchinski & Flint, 1972, 1977, 1979; Krechmar *et al.*, 1991 and others). In the Lena-Delta, permanent observations were started when the State Reserve was established here. East of the Kolyma-Delta, the region of the Chaun Lowland has been much better investigated than any other region of the Arctic coast of north-eastern Russia. This as a result of the studies of the productivity of the ecosystems by the Institute of Biological Problems of the North of the Far Eastern Branch of the RAS (for example, Kondratiev, 1982; 1979; 1984; 1985; 1988; 1988; 1993; Krechmar *et al.*, 1991). The region of the Kolyuchin Bay was an arena of intensive ground and airborne visual quantitative counts in the 1970s (Krechmar *et al.*, 1978). In recent years only airborne visual counts have been performed here.

Wrangel Island is the only place where comprehensive ornithological studies have taken place among the Arctic islands; this as a result of the establishment of the State Reserve (see Stishov *et al.*, 1991). Severnaya Zemlya, where up to recently no biological studies have been conducted, was quite well investigated during the last decade (Belikov & Randla, 1986; Gavrilo, 1988a,b; de Korte *et al.*, 1995), but stationary ornithological studies have been very restricted. Several decades ago AARI conducted ornithological studies for a number of years at the New-Siberian Islands (see New-Siberian Islands..., 1967). The eastern coast of Novaya Zemlya remains up to now one of the least studied areas not only among the islands of the Arctic, but of the entire Russian Arctic. Since 1925 when the expedition on board the "Elding" (Gorbunov *et al.*, 1929) sailed along the Kara coast, there have been actually no investigations here. Current expeditions visited only the eastern shores of the northern- and southernmost tips of the archipelago (Boyarskiy, 1993). The least studied territories in terms of ornithology on the arctic coast of Siberia are the Gydan Peninsula, the deltas of Olenek and Yana Rivers, as well as vast areas of Yakutia eastward up to the Rauchua-Delta.

A large contribution to studies of bird fauna of the Arctic coast was made by the Russian-Swedish expedition "Ecology of Tundra -94" onboard the R/V "Akademik Fedorov" in 1994 (see Grönlund & Melander, 1995) and by aerial bird survey along the coast of Chukotka and Yakutia westward to the Lena Delta in 1993–1994 by American and Russian experts (Poyarkov, 1995; Eldridge *et al.*, 1993; Hodges & Eldridge, 1994, 1995).

Since the regions of current permanent studies are sporadically distributed and cover far from all the highly productive regions of the coast, the past studies, even the materials of the pioneer explorers are still of importance to-date. It should be stressed that while the species composition of birds and their geographic distribution have been relatively fully cleared up for many regions of the coast, the quantitative data on habitat distribution and population dynamics, as well as productivity of the populations, are available only for a few regions of multi-year stationary studies. However, this kind of information is extremely useful for planning and organisation of any resource management or nature protection projects and measures.

Another feature of the state of knowledge on waterbirds is that the studies focus on the species' nesting biology. Knowledge on non-breeding biology, habitat use and numbers are quite poor even for the regions of permanent studies. However under conditions of the North extensive movements of the non-breeding segment of the populations and spatial separation between their habitats and habitats of breeding birds are peculiar for members of the orders Anseriformes and Charadriiformes. Summer northward migrations known for tundra ducks, geese, waders and gulls can be considered as their adaptation to using rich food resources of the northernmost territories and water areas (Kistchinski, 1982).

5.2 Barnacle Goose (Branta leucopsis *Bechst.*).

by Irina V. Pokrovskaya, Grigori M. Tertitski, and Maria Gavrilo

Status. Nesting, migratory species. Northern Atlantic monotypical species with three spatially separate populations in Eastern Greenland, Spitsbergen and Northwest Russia.

General appearance, size. A medium-sized goose with relatively long neck and short bill. Body length is 58–70 cm, wing span is 132–145 cm, body mass is 1,100–2,250 g. Sexes alike. White or creamy cheeks and forehead distinguishes this species from other species of the genus *Branta*. The smaller Brent Goose (*B. bernicla*) has a white collar on the upper part of the neck and lacks stripes on the front of the back. The bigger Canada Goose (*B. canadensis*) has only a white throat patch, which reaches the cheeks behind the eyes. Yearlings have a black stripe from bill to eye coming further to the black nape, the upper parts of cheeks are speckled with grey stains. The rest of the plumage is paler than in adults and brown colours prevail over black. Brown bars on body sides are less visible.

Distribution. Breeds in Greenland, Spitsbergen, Novaya Zemlya and along the shores and islands of the south-eastern Barents Sea. Since late 1980s new breeding sites in the Baltic region have been establishing (Larsson *et al.*, 1988; Leito *et al.*, 1990).

Wintering grounds are Scotland, Ireland and the Netherlands (Leito, 1990; Madsen, 1994) and possibly the south-west of England (Cramp, 1977).

Recently both the Russian population and the species as a whole, have increased in numbers and expanded their breeding range. Only the Southern Island of Novaya Zemlya and Vaigach Island used to be principal breeding areas for this population several decades before. Since the 1970s a set of new breeding locations has been establishing along the migration route including Yugor Peninsula, Kanin Peninsula, Malozemelskaya and Bolshezemelskaya tundra and Kolguev Island (Kalyakin, 1986; Leito *et al.*, 1990; Gavrilo, 1991a; Ponomareva, 1991; Filchagov & Leonovich, 1992; Mineev, 1994; Syroechkovskiy-jr, 1995; Volkov & Chupin, 1995). Along the western coast of Novaya Zemlya the Barnacle Goose has been recorded northward to Severnaya Sulmenevaya Bay (Pokrovskaya & Tertikski, 1993).

The recent expansion of the Barnacle Goose in Russian areas is considered to be a recovery of the former natural breeding range (Kalyakin, 1986).

Barnacle Geese only penetrate the westernmost part of the NSR area including Yugor Peninsula, Vaigach Island and Southern Island of Novaya Zemlya. Barnacle Geese have also been recorded in summer on the Yamal and Gydan Peninsulas (Linkov, 1983; Kalyakin, 1993; Zhukov, 1995).

Seasonal migrations. During migration Barnacle Geese travel ca. 4,000 km and according to Bertold's classification belong to short-distance migrants (Leito, 1990). The flyway of the Eastern European population goes along south-eastern coast of the Barents 'Sea and then comes across the White sea, Finnish bay, northern Estonia, Gotland, southern Sweden, Northern Germany and southern Denmark. Usually geese leave their breeding area in late August–early September. The length of autumn migration is about 3 months (September–November), with an average moving rate 44 km a day (Leito, 1990). Spring migration comes with an average moving rate about 32 km a day and consists of a series of jumps *with* increasing rate toward the end of migration (Leito, 1989). The second and last staging area on the way north is Gotland Island and western Estonia, where about a half of the population concentrate at a time reaching maximum numbers in the first half of May (Leito, 1984). Within the NSR area pronounced spring migration occurs along the west coast of Yugor Peninsula and Yugor Shar Strait peaking at early June, while autumn migration goes inconspicuously (Kalyakin, 1984; Mineev, 1994).

Moult. The moulting period lasts 3–4 weeks, from mid-July to mid-August. The non-breeding part of the population starts and finishes their moulting earlier than breeders (Cramp, 1977). Brood-rearing birds join non-breeding birds during moult and spend all their time until fledging within the coastal biotopes rich in lakes and soft vegetation or in coastal sheltered waters. Flightless birds escape from danger by moving to the sea or lakes.

Numbers and population trend. All three populations have increased their numbers during the last decades. Recently the total world population of the Barnacle Goose in winter was estimated at from 110,000 to 175,000 birds according to different authors (Owen, 1984; Kalyakin, 1993 and unpubl.; Madsen, 1994). The Russian population has increased from about 50,000 individuals in the 1970s to 120,000–130,000 in the early 1990s (Ebbinge, 1982 and unpubl., cited in Madsen, 1994; Rose & Scott, 1994).

The number of Barnacle Geese inhabiting the NSR area may only be roughly estimated. Vaigach Island is one of the key areas for the Barnacle Goose and the population here is estimated at 10,000–25,000 individuals (Kalyakin, 1984, 1993; Ponomareva, 1994). The Yugor population is estimated at 550–800 birds (Kalyakin, 1993; Morozov, 1995). Possible breeding areas at the eastern coast of Novaya Zemlya have not been surveyed and total estimates available for the archipelago may be too low. During the 1992 Novaya Zemlya survey the highest density of Barnacle Geese was recorded at Menshikova Cape area (34 and 14 ind./km^2 at sea and on tundra, respectively) (Pokrovskaya & Tertikski, 1993). Thus at the present state of knowledge the NSR population can be suggested to make up 5–10% of the world population and 8–20% of the Russian population at a minimum, not taking into account birds in eastern Novaya Zemlya.

Habitat. Barnacle Geese are found in coastal habitats during the entire annual cycle. Within the coastal habitats they are flexible in choosing nesting biotopes, but inaccessibility for terrestrial predators is an obligatory factor. Rocky coastal precipices, ridges and river canyons, small off-shore islets as well as specific transitional coastal flat landscapes generally called "laidas" are the chief nesting habitats. Often Barnacle Geese nest in mixed colonies with Eiders, Glaucous Gulls, or close to raptors to get protection. Sometimes they occupy tops of seabird cliffs. Empty nests of Rough-legged Buzzard (*Buteo lagopus*) are readily occupied. (Uspenskiy, 1951; Kalyakin, 1986; Ponomareva, 1992; Morozov, 1995; Syroechkovskiy-jr., 1995; Volkov & Chupin, 1995). Within the NSR area different nesting habitats are used except for those of the flat type. Tundra lake islets are sometimes also used (Romanov, 1989; Mineev, 1994).

In summer non-breeders inhabit the narrow coastal strip close to the breeding places and often roost at sea. In the wintering grounds the geese make extensive use of the coastal zone and agricultural areas.

Breeding. Becomes mature after third year of life. Breeds in colonies of different size and density, as well as in single pairs. The largest and densest colonies are known from flat habitats. On the Yugor Peninsula and Vaigach Island Barnacle Geese nest in single pairs and small colonies of up to 20–30 pairs (Kalyakin, 1986; Morozov, 1995).

The ratio between the breeding and non-breeding parts of the population varies widely and depends on weather, time of snow-melting, density of small rodents as well as on the age-sex population structure. In 1984 on Vaigach and Yugor Peninsula this ratio was about 1:2 (Kalyakin, 1986), but in 1987 on Vaigach Island it had changed to 3:1 (Romanov, 1989), but Morozov (1995) found a very low non-breeding fraction on the Yugor Peninsula (0–25%). It should be taken into account that non-breeders seem to be highly underestimated because they mainly stay at sea.

The first geese arrive to Vaigach and Yugor Peninsula in early May (in 1983), peaking in early June (Kalyakin, 1986). The nesting begins in the second half of June (Mineev, 1994).

A nest consists of a low bolster of vegetation and is often built up with dried droppings. Down is used as lining and cover. Full clutch contains 3–6 (1–8) eggs. Intra-specific nest parasitism is well known for the Barnacle Geese. The average clutch size varies from place to place and between seasons. For Vaigach it is found to be 3.9–4.4 eggs (Kalyakin, 1986; Syroechkovskiy E.V. *et al.*, 1995) of 79.5 x 49.4 mm in size (Kalyakin, 1986; Ponomareva, 1992). Incubation lasts 24–25 days. The hatching season varies from site to site within the NSR area as well as from year to year; hatching may take place from the beginning till 20 July. The earliest hatching registered for Yugor Peninsula was on 14 July in 1983 (Kalyakin, 1986), and hatching peak on Vaigach was on 19–21 July in 1987 (Romanov, 1989). It takes about 40–45 days from hatching until the goslings are able to fly.

The mean brood size has been determined as 2.4 goslings in Yugor Peninsula and Vaigach by Kalyakin (1986). Due to strong family bonds through the first nine months, broods size in winter can also be determined. It varies from 1.4 to 3.1 young for all three populations (Boyd, 1968, cited from Cramp, 1977).

Food habits. Vegetation in all parts is the bulk of the diet. Molluscs and crustaceans are sometimes consumed (Isakov & Ptushenko, 1952). Summer feeding of the Russian population has not been studied, but different species of dwarf willows, horsetails and saxifragas are their main diet in Spitsbergen (Prop *et al.*, 1984).

Predators and negative factors. The main predators in the NSR area are Arctic Foxes (*Alopex lagopus*), and Glaucous (*Larus hyperboreus*) and Herring Gulls (*Larus argentatus*). Low lemming (*Lemmus lemmus*) densities can account for the total breeding failure in Barnacle Geese nesting in accessible places. Normally Barnacle Geese are able to protect their nests from avian predators, but larger gulls may be dangerous in cases of food deficit and high gull numbers (Kalyakin, 1986).

Economic importance and human impact. The economic significance is small. According to Kalyakin (1986), Barnacle Geese constitute about 6% of all geese in spring hunting bag in the area of Yugor Peninsula and Vaigach Island. In some places local people harvest eggs from nests in the colonies next to settlements, thereby decreasing the clutch size (Ponomareva, 1992; Filchagov & Leonovich, 1992). The geese may cause damage to agriculture in winter. There are still no ways to avoid such conflicts (Madsen, 1994), though some measures have been developed on local levels to prevent damage and minimise crop loss (Leito, 1989).

Although the populations are in a positive development, the Barnacle Goose still remains vulnerable to human impact. This as a consequence of the spatial structure of the population during the entire life cycle, including breeding.

Development of shipping along the NSR may have a major negative effect on the Barnacle Goose population status if the coastline is contaminated by oil products. This because moulting and brood-rearing flocks are tied up with the narrow coastal strip and often move to sea to escape danger or when roosting. Geese that nest on small off-shore islets have to overcome straits with flightless goslings by swimming to reach brood-rearing grounds. This factor becomes most important in years of low lemming densities, when only goslings from such habitats have chances to survive. Hence, the most vulnerable time is mid-July–late August.

Other impacts such as direct disturbance and noise or an increase in edible waste from humans may in some cases significantly decrease nesting success of the geese by increasing the abundance of predators and their hunting success.

Conservation. Barnacle Goose is a species which has recovered and is still increasing in numbers and expanding (or having expanded) its range. Therefore it has been excluded from the last version of the Red Data Book of Russia (in press). A significant part of the Russian population is protected in Vaigachskiy Federal Refuge. Nevertheless, a complete survey of all important breeding and moulting sites is necessary. Strict limitation of human activity in these areas is needed including oil spill emergency plans.

5.3 *Brent Goose (*Branta bernicla *L.).*

by Eugeniy E. Syroechkovskiy-jr

Status. Nesting, migratory species. Polytypical species whose systematic are not completely developed yet. This paper considers the Brent Goose (*Branta bernicla*) to be a species with three subspecies as follows *B. b. hrota, B. b. bernicla* and *B. b. nigricans*, while *B. b. orientalis* is a population within the latter one (see Syroechkovskiy-jr., 1995c).

General appearance, size. Small-sized, very dark goose. The wing length is 300–350 mm and weight 1.5–2.2 kg. Sexes alike. Breast, neck, head, back, wing and tail feathers are of dark-grey and black colour. Belly, body sides and undertail coverts are white. There is a white collar on the neck. The subspecies differ in details of colouring: the breast (from white in *B. b. hrota* to almost black in *B .b .nigricans*), closed collar (most developed and closed on the back in *B .b. bernicla*). Young birds up to 6–10 months do not have a white collar and are easily distinguished by white tips of the wing coverts and scapulars.

Distribution. Breeds across high-Arctic tundra. All three subspecies of the Brent Goose inhabit the territory of Russia. The Atlantic Brent Goose (*B. b. hrota*) nests at Franz Josef Land. The information on this subspecies nesting at the Severny Island of Novaya Zemlya (Kalyakin, 1993) requires confirmation. Hence, only the nominate and Pacific races occur within the NSR area. Dark-bellied Brent Goose *B. b. bernicla*) breeds on the arctic coast of Taimyr, Gydan and Yamal, in Severnaya Zemlya archipelago and the Kara Sea Islands. During the last decades new nesting populations began to appear on the migration route from Western Europe. They are known on the Kanin Peninsula, Timanskiy shore of Malozemelskaya tundra and may also possibly occur in some regions of the Barents Sea coast (Filchagov & Leonovich, 1992; Syroechkovskiy-jr., 1995a). The Black Brant breeds in isolated populations from the lower reaches of the Olenek River eastward up to the Anadyr River mouth (Ptushenko, 1952; Cramp, 1977). According to the location of the winter quarters, the birds of this subspecies probably comprise two populations; an Asian and an American (Syroechkovskiy-jr., 1995d). The Asian population nests from the lower reaches of the Olenek River to the lower reaches of the Yana River. The American population nests and moults east of the lower reaches of the Yana River.

Seasonal migrations. Dark-bellied Brent Geese fly in spring from Western Europe along the White Sea-Baltic Flyway, and cross the Kanin Peninsula in early June. The geese probably make the distance to Taimyr in several steps without long staging. For the last 20 years the mean date of the first recording on Taimyr is June 10. The departure from Taimyr occurs during August, on the Yugor Peninsula coasts the birds are recorded up to early October (Mineev, 1994). Pacific Brent Geese appear on the breeding grounds in very late May–early June (Degtyarev *et al.*, 1995). Departure takes place in late August–September. The seasonal migrations of the American population go mainly in the latitudinal direction, along the Arctic coast, connecting Yakutian breeding grounds and American winter grounds (Kistchinski & Vronskiy, 1979). Winter quarters of the Asian population are located in Japan, Korea and China. In spring the geese migrate along Lena and Yana River valleys, while in autumn they round the mainland along the coast, but migration patterns are not yet clear (Syroechkovskiy-jr., 1995d).

Moult. The moult occurs in late July–early August, adults with broods moult 1–2 weeks later. The flightless period lasts for 2–3 weeks. The moulting biotopes vary within the area. The bulk of the geese that breed on the mainland are segregated for moult over extensive deltas and at maritime lacustrine plains along the seashore. The flightless birds stay near water all the time to escape from danger. As a rule abundant food is available nearby and the geese can make extensive use of quite a small area within a radius of a hundred metres from the water body during moulting. The birds inhabiting remote islands of the Kara Sea have rather different habits. There are often no water bodies at the islands and the coast is usually ice bound in July. Poor vegetation cover forces the moulting geese to overcome many kilometres in order to get enough food. Under such conditions, moulting Brent Geese use terrestrial habitats. When in danger, moulting geese form dense flocks. Such way of moult is only possible in the absence of Arctic Foxes.

Numbers and population trend. The overall world number of the Brent Goose is estimated at 575,700 birds (Rose & Scott, 1994). Taking into account the increasing trend of the nominate race we assume it reached 650,000 individuals in the winter of 1994/95. Not less than 300–370,000 Brent Geese inhabit the northern coasts of Russia in summer, i.e. 60–70% of the world population. The number of Dark-bellied Brent Goose (which is a breeding endemic of Russia) have been steadily increasing for the last 30 years, while the Black Brant demonstrates the opposite trend. Particularly noticeable decline has been observed in the Asian population, whose abundance recently has been estimated at several thousand birds only (Syroechkovskiy-jr., 1995d). This population is in a more threatened state as compared to the more abundant American population.

Habitat. The Brent Goose is, together with the Emperor Goose, one of the most "marine" species of geese. Much of the life cycle is spent near water. This is particularly evident in the winter grounds in Western Europe and America. There the Brent Goose inhabits mainly the tidal zone, sometimes appearing on adjacent agricultural grounds. While breeding, the Brent Goose inhabits small and large islands, as well as maritime tundra, penetrating inland not more than several tens of kilometres. The geese nest mainly on tundra, both at watersheds and in river valleys and other relief depressions. Minor islands near the mainland are extensively used. Thus, breeding density on remote islands of the Kara Sea reaches 10 pairs/km^2. During the nesting period, until fledging, the Dark-bellied Brent Geese are not so much attached to the sea. As the sea is ice covered up to July–August over much of the their range, the coastal strip is used to escape from danger during the brood rearing period in certain suitable places only. During migrating, however, the Brents make more extensive use of the sea surface as compared to other geese. They often land on water and can feed on marine vegetation in the tidal zone at the coast of the Barents and especially the White Sea. They are known to form significant aggregations at sea near the Taimyr coasts before migration. In Yakutia and at Chukotka the Black Brants occur within the coastal strip inhabiting deltas, estuaries and lagoon areas both during breeding and moulting. They often breed in mixed colonies with gulls, including Herring, Glaucous and Ivory Gulls, as well as other waterbirds (Demme, 1934b; Degtyarev *et al.*, 1995; Pozdnyakov *et al.*, 1995; Syroechkovskiy-jr., 1995 in press). Nesting under protection of several other species of birds have been recorded, including Snowy Owl, Rough-legged Buzzard, Pomarine Skua and Peregrine Falcon (Portenko, 1972; Litvin *et al.*, 1985).

Breeding. The Brent Goose usually starts breeding when 3–4 years old, but some birds can breed being as young as two years. A maximum longevity recorded in captivity is about 20 years. Annually, not more than 25% of birds in the population start to breed. Breeding occurs both in single pairs dispersed on the tundra and in colonies of up to hundreds of nests. The Brent Goose starts nesting immediately after arrival, i.e. in late May–early June. The clutch consists of 3–5 eggs of 60–75 x 40–52 mm in size. The incubation lasts for 23–26 days and goslings hatch in early July. Pairs with young aggregate in flocks; single pairs are rare on the maritime tundra or along river and lake banks. The goslings are able to fly 30–35 days after hatching and soon after depart from the breeding range.

Food habits. Grazes on tundra preferring wet areas with rich herbaceous vegetation, particularly when moulting. Grass and sedge are the principal food, but all vascular plants can be consumed during food shortage, especially in the north of the barren-grounds tundra. While staging in the White Sea area, feeding is similar to that in wintering grounds. This includes Zostera, green algae and salt-marsh vegetation. The Dark-bellied Brent Goose is one of the largest nesting birds on the northern barren-grounds tundra of Taimyr and at the Kara Sea islands. In favourable years it is also the most abundant terrestrial bird species. It can even exceed the nesting density of the Purple Sandpiper and the Snow Bunting. In such years the Brent Goose makes up to 70% of the total biomass at the central islands of the Kara Sea. It is also the main phytophage when the density of lemmings is low. Thus, we observed Brent Geese to graze up to 80% of the grass vegetation over the entire area of the Russkiy and Troinoy Islands. Hence, the Brent Goose is one of the main components of the organic turnover in the ecosystems of the northern Arctic tundra at the Kara Sea islands. The consumption by Brent Geese on the continental arctic tundra of Taimyr is also significant. In other regions of the Russian Arctic the Brent Goose is less abundant and does not play such an important role in the ecosystem.

Predators and unfavourable factors. The principal predators accounting for loss of eggs and young are Arctic Fox, skuas (especially Arctic Skua), and Herring, Glaucous and Ivory Gulls. Which species is the most important varies between regions, but the greatest impact occurs when the number of Arctic Foxes is high and the density of lemmings low, which can cause complete breeding failure for the geese. Even nesting under the protection of gulls and birds of prey does not help much (Syroechkovskiy-jr., 1995 in press.). In the years of such conditions, when nomadic Arctic Foxes remain in summer at the remote islands of the Kara Sea, the Brent Geese can not even moult there. Nests may also be destroyed by Polar Bears. Adult geese can be preyed on by Snowy Owls when at nest. During seasons with a particularly prolonged spring, cold summer and intensive predation by Arctic Foxes, the number of Brent Geese that start breeding is significantly lower as compared to more favourable years. Mortality of females on nests due to returned spring frosts is known.

Economic importance and human impact. The Black Brant is not important as a game bird as it is included in the Red Data Book of Russia. The hunting of the nominate race is also prohibited almost everywhere. The Brent Goose is the most trusting one with regard to humans among arctic geese and that is why it suffers most due to illegal hunting. Brent Geese are easy to catch and shoot during moult and sometimes they are victims of mass hunting. According to our estimates, the illegal harvest in Russia does not exceed 5–7,000 birds annually. Disturbance appears to make smaller impact on both nesting and moulting Brent Geese as compared with other geese. During low helicopter flights over solitary breeding pairs the male leaves the nest, as a rule, while the female often remains. Flights over the colony make rather much disturbance. Moulting birds are more afraid of aircraft. Moulting flocks interrupt feeding and enter water. According to our observations, 15–45 minutes passes from the helicopter left until the entire flock resumes feeding. Frequent flights of aircraft low over water can significantly affect the time and energy budget of moulting Brent Geese.

The development of land–based infrastructure and an increase in the number of people on the nesting and moulting grounds can obviously impact on the geese. Birds that inhabit the islands surrounded by sea ice are at higher risk as they have no possibility to reach water when in danger. Indirect effect of disturbance is high in breeding Brent Goose, as adults leave the nest without covering it by down and the nest becomes an easy prey for gulls and skuas. As the Brent Goose is closely connected with the marine habitats, it is more vulnerable to oil pollution at sea than many other geese (except for Barnacles and Emperors). While breeding the geese are at higher risk from oil spills in the western part of the area (Yamal and Gydan coasts), partly in the Yenisey and Khatanga Bays, and also those breeding in deltas of N. Yakutia. Chronic pollution in the coastal zone can have a negative effect on populations inhabiting the western segments of the range including W. Yamal and N. Gydan, and also the coasts of north-east Asia, as the geese here make extensive use of littoral vegetation, especially while fattening before migration. Thus, increased shipping along the NSR and development of land-based infrastructure will expose the Brent Geese to the risk of oil pollution both chronic and accidental, illegal hunting and to lesser extent disturbance.

Conservation. The Pacific Brent Goose is included in the Red Data Book of the Russian Federation (Krechmar, 1983). The most threatened Asian population is protected in the Lena-Delta Reserve. The key areas for the Dark-bellied Brent Geese are protected in The Great Arctic Reserve.

5.4 *White-fronted Goose (*Anser albifrons *Scopoli)*

by Eugeny A. Krechmar, IBPN RAS

Status: Nesting migratory species. A polytypic species with a circumpolar breeding range. At present up to five subspecies are identified (Johnsgard, 1978; Madge & Burn, 1988); *Anser albifrons albifrons, A. a. flavirostris, A. a. gambelli, A .a. elgasi* and *A .a. frontalis*. Portenko (1972) and Kolbe (1981) identify 4 subspecies; *A. albifrons albifrons, A. a. flavirostris, A. a. gambelli* and *A. a. frontalis,* combining *A. a. elgasi* and *A. a. frontalis* in the latter. In view of different standpoints regarding the geographical distribution of subspecies, this paper uses the subspecies taxonomy proposed by these authors.

General appearance, size. A large "grey" goose. Sexes alike, but the female is slightly smaller. The geese from the East-Asian populations of *A. a. albifrons* are slightly larger than the European ones. The body length is 700–860 mm, the wing-span is 1,500–1,800 mm (Stepanyan, 1975). The weight of the mature birds in the spring period varies within 2,100–3,000 g in males and 2,000–2,700 g in females. In adults the feathering near the base of the maxilla and the forehead (not reaching the eye) is white. The breast has black patches of irregular form and varying highly in size and number. This combination makes the White-fronts easy to distinguish. The belly and tops of tail feathers are white. The beak is rosy-yellowish, the feet are yellow. Immatures do not have a white patch on the forehead or dark patches on the breast and are difficult to distinguish from Lesser White-fronted Geese (*Anser erythropus*). During migration, large groups of geese form a wedge-shaped flock. The flight is accompanied by long-drawn cries. The so-called "flight call" sounds like "klou-iu-u". Sometimes, especially in a disturbed group of several birds this cry passes to guttural "uliu-liu-liu". The voice of the Lesser White-fronted Goose is higher which can serve as a good distinguishing field indication under conditions of insufficient visibility.

Distribution. Breeds in the zone of tundra and forest tundra of Eurasia and North America. In North America the White-fronted Goose inhabits vast areas in the north-west from the Cook Gulf in the west to the central Canadian Arctic islands (90° W) in the east. It also breeds at the western coast of Greenland (between 64°00'N and 72°30'N). The subspecies *A. a. albifrons,* being the Russian endemic subspecies, inhabits the continental tundra and forest tundra of Eurasia from the western coast of Kanin Peninsula in the west to the Anadyr River mouth and Kolyuch Bay and the mouth of the Khatyrka River in the east. Recently the presence of small isolated populations north of 59°N at the coast of the Sea of Okhotsk has been proved (Krechmar, 1996). Along the NSR area, distribution of breeding grounds is non-uniform being related, to a great extent, to the presence of vast wetland. In the north it reaches a number of the Arctic islands including Vaigach Island, the Southern Island of Novaya Zemlya and the New-Siberian Islands (Syroechkovskiy-jr. *et al.*, 1995; Rutilevskiy, 1967).

Seasonal migration. White-fronted Geese nesting in northern Eurasia, are typical long-distant migrants whose wintering grounds are located within the same continent. The geese from the European part of the breeding range, as well as from Yamal and partly from western Taimyr (Borzhonov, 1975), winter in western Europe (Netherlands, England, Germany, Hungary, the former Yugoslavia and Greece). Their flyways pass along the southern shore of the Baltic Sea and some cross the western Carpathians. Geese from West Siberia also winter in Turkey, Iran and Iraq, in the coastal regions of the Black Sea, the Sea of Azov and the Caspian Sea. White-fronts inhabiting the area east of the Lena-Delta, winter in south-eastern China, on the Korean Peninsula and on Japanese Islands. Their flyways pass both across the continental zone of eastern Asia and along the Pacific coast. White-fronted Geese arrive at the breeding grounds later than Bean Geese; in the second half of May–early June. The variance in the arrival dates depends, to a great extent, on annual differences in the spring processes on the nesting grounds. On the Yugor Peninsula the first White-fronted Geese appear on May 5–9 (Mineev, 1994), mass arrival occurs from May 26 to June 11 (Estafyev *et al.*, 1995). On Novaya Zemlya the geese come during May 15–25 (Gorbunov, 1929). In western and north-western Taimyr geese appear during the first ten days of June (Kolyushev, 1933; Krechmar, 1966; Tomkovich & Vronskiy, 1994). At N. Taimyr White-fronted Geese come from the first ten days of June to early July (Tomkovich *et al.*, 1994), and at E. Taimyr in late May–first half of June (Chupin, 1987). In the Khroma-Indigirka tundra the White-fronts appear during the last ten days of May–early June (Perfilyev, 1975). In the lower reaches of Kolyma, the first geese appear from May 10 till very early June. The first records in the Chaun lowland were on May 10 (1975–1984), while migration can last up to June 12 (Krechmar *et al.*, 1991). In late June–first half of July there are local movements of non-breeding geese to the moulting grounds. Such migrations are observed during late June–early July in W. Taimyr and on the Yugor Peninsula (Krechmar, 1966; Mineev, 1994), and during the first two weeks of July in NW and E. Taimyr (Tomkovich & Vronskiy, 1994; Tomkovich *et al.*, 1994). Over much of the area within the NSR the autumn migration of White-fronted Geese occurs from late August to early October. Thus departure from Vaigach takes place from late August to the first ten days of September (Uspenskiy & Chernov, 1969). On Yugor Peninsula, migration goes in waves from the first half of September to October 11 (Yestafyev *et al.*, 1995). In the Chaun Bay, autumn migration is observed in mid-September (Krechmar *et al.*, 1991).

Moult. Moults once a year. Non-breeders begin moult of flight feather in the third week of July, i.e. slightly later as compared to the Bean Geese (Krechmar, 1966). Flocks of moulting geese number from several tens up to hundred birds (Krechmar, 1966; Mineev, 1994; Degtyarev, 1995a). Adults rearing broods start moulting in late July–early August. Moult is completed by the time the young are able to fly. Most of the White-fronts becomes able to fly by late August.

Numbers and population trend. On the Yugor Peninsula the breeding density varies between 2.1 and 3.9 ind./km^2, while in areas with non-breeding aggregations it can reach as much as 7 ind./km^2 (Kara Bay coast; Mineev, unpubl. data). The population is increasing (Mineev, 1995). At Vaigach Island the population is small, but the concentration of moulting geese can reach 9.0–9.7 ind./km^2. The number of White-fronted Geese on the tundra of the European north-eastern region (including Yugor Peninsula) is estimated at 100–180,000 individuals (Mineev, 1995). Recently, a decrease in the numbers of moulting birds has been found in N. Yamal (Ryabitsev, 1995). This is assumed to be caused by intensive industrial exploration in this region. The increased local eastward migration activities indicate shifting of the mass moulting sites to other regions (presumably, to the NE. Gydan and W. Taimyr). The population density of White-fronts in the central zone of the NE. Gydan varies within 2–6 ind./km^2 (Linkov, 1983). Aircraft surveys of waterfowl in the late 1960s (Uspenskiy & Kistchinski, 1972) resulted in a density of 6.0–6.5 nesting birds/km^2 in NE. Gydan (for moulting birds 5.0–5.5 ind./km^2). The total number of White-fronted Geese in the west of NE. Gydan was estimated at 20–25,000 individuals. The last summarised data (Chernichko *et al.*, 1994) gives the total numbers of White-fronts and Bean Geese on NE. Gydan and Oleniy Island to be ca. 50–70,000 birds. Taking into account that the White-fronts undoubtedly constitute the majority of the geese here, a slightly increasing trend in the region should be noted. Taimyr is characterised by an irregular patchy distribution of breeding sites (Krechmar, 1966). Annual fluctuations in nesting density also makes it difficult to estimate population size and the ratio breeding/non-breeding birds in the region (Rogacheva, 1988). Martynov (1983) estimated the total number of the geese at 430,000 individuals in the late 1970s–early 1980s. A tendency for some decrease in the number has been noted (Rogacheva, 1988). At the same time the number of White-fronts has been estimated at ca. 90,000 breeding pairs with pre-hunting number at ca. 900,000 individuals, for the "middle region" of Russia including Yamal, Gydan and Taimyr Peninsulas (Krivenko, 1984). Taking into account the ratio between breeding/non-breeding birds this appears to be a little overestimated. It has been shown that for the western and eastern zones of the "middle region" the population trend can be of ambiguous character. Aerial goose survey on the tundra between the Anabar and the Yana Rivers (Labutin *et al.*, 1986) gave total estimates in August of 6,300 individuals (Anabar to Olenek); 22,700 individuals (Lena-Delta) and 18,800 individuals (Yana to Omoloy). Abundance of White-fronted Geese can be approximately estimated taking into account that it was the dominant species together with the Bean Goose, and constituted 58–83% of the geese in the Lena-Delta. The numbers of all goose species have decreased to 1/3 as compared to the early 1960s. Recently, important moulting sites have been discovered nearby Bustakh Lake, in the Lena-Delta and on the Indigirka-Alazeya tundra (Degtyarev, 1995a). Thus in the Lena-Delta the total number of moulting geese was ca. 30,000 individuals, that means not less than 17,000 White-fronts (16,000; Solovieva, pers. comm.). Relative stabilisation in numbers in this region can be attributed to the establishment of the Lena-Delta State Reserve. The overall number of the White-fronted Goose in NE. Yakutia (Lena to Kolyma) is currently estimated at 62–92,000 individuals (Andreyev, in press). The decline that is observed in the area east of Anabar (Labutin *et al.*, 1986), can be connected with overhunting of waterfowl at wintering grounds in SE China (Degtyarev, 1995b). In the 1970s the total abundance of White-fronts on the East Siberian tundra was determined at 300,000 individuals, with density of 0.5–0.8 pairs/km^2 in Vakaarem Lowland (Kistchinski, 1972, 1988). Recent population density east of Chaun Bay is low; 0.4–0.7 birds, both breeding and non-breeding, per sq. km (Kondratiev, 1988; Eldridge *et al.*, 1993), this means a population decline for the last 20–30 years.

The population trend of the White-fronted Goose is thus different depending on regions within the NSR area. Whereas the numbers are stable in the west, sometimes slowly increasing (Rogacheva, 1988; Chernichko *et al.*, 1994; Mineev, 1995), they continue to decrease slowly east of the Taimyr Peninsula (Labutin *et al.*, 1986; Kistchinski, 1988; Eldridge *et al.*, 1993). Probably, this situation can be related to the differing winter quarters used by birds from the two areas. Based on the data available (Andreyev, in press; Kistchinski, 1988; Krivenko, 1984, 1991; Martynov, 1983; Labutin *et al.*, 1986; Mineev, 1995), the total abundance of White-fronts over the territory directly adjacent to the NSR can be estimated at 500–1,000,000 individuals. Taking into account the imperfect censusing methods, distribution patterns, high annual fluctuations in numbers and the decline in the eastern regions, we consider the lower estimate to be most correct. Thus the total abundance of the White-fronted Goose within the study area, constitutes about 20–40% of the world population (North-American population is estimated currently at 1 million geese; after Ely & Dzubin, 1994).

Habitat. In spring, geese attach to thaw patches that are formed in the well-exposed hummocked zones. Dry, slightly elevated, places are preferred for nesting. Usually nests are attached to the water bodies, although in some regions it is not obligatory (Krechmar, 1986a). No biotope preference is found on tundra (Krechmar, 1966; Kondratiev, 1993). Hillocky moss-sedge tundra, hummocked-willow shrub tundra, moss-lichen dwarf shrub tundra or polygonal bogs can be used. In the coastal tundra the White-fronted Goose prefers small thermokarst lakes using features of the rugged coastline. Broods and brood groups gather on the shores of the water bodies. They make local movements along the river channels using the flood-plain beds for grazing. These areas are rich in horsetail and young shoots of sedge. Non-breeding birds usually gather for moult at isolated lakes with a sufficient food base on the open shores. Some geese use coastal areas during moulting (Vronskiy, 1987; Eldridge *et al.*, 1993).

Breeding. Becomes mature after the third year. Nests usually in solitary pairs, but loose colonies are known from the west of the range (Mineev, 1995). Birds start breeding 5–15 days after arrival, depending on the disappearance of snow in the places suitable for nesting. In different zones of the range these dates can vary significantly. The White-fronted Geese nesting in W. Taimyr begin laying already when intensive migration is still going on; in the second half of June (Krechmar, 1966). In NW. Taimyr laying continues up to late June (Tomkovich & Vronskiy, 1994); in the westernmost regions of the NSR, on the Yugor Peninsula, it occurs in mid-June. Incubation takes 24–25 days (it is known to be prolonged up to 28 days; Mineev 1995). In different zones of the range, regardless of strong differences in climatic conditions, there is a significant stability of incubation duration that is achieved by continuous brooding (Krechmar, 1986b). The nest is covered by mixing vegetation remains with down or small contour feathers. In the regions with unfavourable weather conditions geese cover their nests more carefully with down which can slightly increase thermal isolation (Krechmar, 1986b).

The clutches contain 4–5 eggs on average (2–9 in different zones of the range; Krechmar, 1986b; Mineev, 1995). They have been found to be slightly greater in the southern part of the range, reaching 7–9 eggs (Krechmar, 1986a; Kondratiev, 1993; Mineev, 1955). The egg size varies from 78.9x50.8 mm on average in the west of the range (Mineev, 1955), up to 79.7x53.4 mm in the east (Kondratiev, 1993). Hatching occurs over much of the NSR area from the second ten-day period to late July, shifting to the first ten-days in S. Yamal (Krechmar, 1966; Danilov *et al.*, 1984; Tomkovich & Vronskiy, 1994; Mineev, 1995). After leaving the nest, the broods move to the feeding biotopes where they move around keeping to the shores of the water bodies. Sometimes the broods join into small aggregations including up to 10 and more families (Krechmar *et al.*, 1991). Goslings are able to fly 6–7 weeks after hatching; i.e. in late August–early September.

Food habits. After arrival, up to the onset of active plant growth, the diet of the White-fronted Goose mainly consists of the near-root starch-containing parts of different sedges, as well as berries left from the previous year. Thus in the western NSR area the principal food in this period is near-root thickenings of *Carex aquatilis* and *C. stans*, shoots from the previous year of *Arctophila fulva*, as well as berries of *Arctostaphylos uva-ursi* and *Empetrum nigrum*. In June–July the fraction of berries from *E. nigrum, A. uva-ursi, Vaccinium myrtillus* and *V. uliginosum* increases in the diet (Estafyev *et al.*, 1995).

Predators and unfavourable factors. Spring conditions and such factors as low mean daily temperature, precipitation and the degree of snow cover disappearance on the nesting sites in particular, are the significant abiotic factors that can account for delayed breeding of White-fronted Geese in high-latitudes which are characterised by a restricted vegetation period (Krechmar, 1966, 1986b). Predators can have significant effects on the breeding success, especially during periods of shortage in their main food. During low lemming cycle the Arctic Fox and Arctic Skua can exercise strong pressure upon the nesting birds. In especially unfavourable years 55% (Kondratiev, 1993) to 90% (Mineev, 1995) of goose clutches can be lost due to predation.

Economic importance and human impact. The White-fronted Goose is the most popular game species in the NSR area. In some regions (the east of the NSR) it can play an important role in the life of the indigenous people. The mean annual harvest of geese (both White-fronted and Bean Geese) in the Lena-Delta is about 2,500 individuals, i.e. not less than 1,200 White-fronted Geese are shot pr. year, based on the assumption of equal proportions of these two species in the hunting (Blokhin, 1988). In W. Taimyr, the White-fronted Goose used to amount up to half of the spring hunting bag (Krechmar, 1966).

Even at a relatively low hunting pressure, there is a large number of problems that cannot be evaluated but directly affect breeding population stability in geese. Thus, for example, the geese from established pairs are shot first of all. Much wounded game appears which is not considered. Disturbance during the spring hunting results in delayed nesting and sometimes even in birds not breeding at all. Eastern populations of geese are under an especially strong pressure at wintering grounds in the countries of south-eastern Asia. In periods of food shortage the population still practises a barbarian mass hunting of geese in these areas. An important role of the "human presence" effect on the nesting grounds in summertime should be noted separately. The strategy of nature management formed at the present time, has resulted in the fact that in summer local people protect Arctic and Red Foxes as valuable fur animals in the winter. The synanthropic life strategy of these animals combined with decreased human impact on them results in higher predation pressure on nesting geese that are under double pressure, both from predators and man (Krechmar & Syroechkovskiy, 1978). Thus the effect of human presence can have a significant impact upon the balance of the ecosystem. The negative influence of industrial exploration of the territories has already been mentioned. Due to a rapid development of economic activities affecting nearly all territories adjacent to the NSR, there is at present a much greater need for restricting the access to the northern tundra zone than earlier. The development of infrastructure and use of light aircraft, vehicles and shallow-draft boats will allow humans to freely penetrate the remote regions that up to now served as a reliable refuge both for breeding and non-breeding moulting birds. The use of helicopters during the period of moult and brood rearing (the second half of July–early August) should be especially restricted. Contamination of the coastal zone by oil products can affect moulting birds and broods attached to shores in late July–early August. The fraction of White-fronts using these biotopes is, however, small. Thus, the NSR-related activities that can represent a hazard for the normal existence of White-fronted Goose populations are as follows: disturbance, increased hunting pressure, and to a lesser extent, pollution of coastal biotopes.

Conservation. Along the NSR area White-fronted Geese are protected by the Vaigachskiy, Purinskiy and Chaigurino State Refuges, and The Great Arctic, Taimyrskiy and Lena-Delta State Reserves. Purinskiy State Refuge and the Great Arctic and Lena-Delta State Reserves are of the greatest importance as they protect the unique moulting concentrations of non-breeding birds.

*5.5 Bean Goose (*Anser fabalis *Latham).*

by Alexander V. Kondratiev and Grigori M. Tertikski

Status. Nesting, migratory species.

Polytypical species whose subspecies systematic are not completely developed yet. Five or four subspecies are recognised by different authors (Stepanyan, 1975; Cramp, 1977). This paper is based on the point of view of the latter author and considers mostly two northern Russian tundra subspecies *A .f. rossicus* and *A .f. serrirostris*.

General appearance, size. A large, long-necked, dark-headed "grey" goose with orange legs and yellow-orange and black bill. Sexes alike. Length is 66–84 cm. Size and colour patterns of the bill and body size vary highly between subspecies, being the characters used to distinguish them from each other. *A. f. middendorfii* is the largest subspecies, *A. f. serrirostris* is medium-sized, while *A .f. rossicus* is the smallest one with an average weight of 2,700 g (2,000–3,400) in males and 2,400 g (2,000–2,800) in females. The two-coloured beak distinguishes the Bean Goose from the Greylag Goose *Anser anser*. Some Bean Geese have a very narrow whitish line around the base of the bill, but never enough to be confused with the White-fronted Goose. Confusion most likely with Pink-footed Goose, especially small *A. f. rossicus*, but the former is smaller with greyer upperparts, and has deep fleshy-pink legs and a band on the bill.

Distribution: Breeds in Eurasia from Norway in west to Chaun Bay and N. Kamchatka in east. The northern border of the breeding range goes along the arctic coast; on Yamal to 75°30'N and on Taimyr to 76°N. The Southern border is at approximately 65°N in Norway from 61–62°N in Finland and Sweden, 60°N in European Russia and 61°N in W. Siberia.

Further east the distribution limit is south to Altay, NW Mongolia, S. Baikal area and along Amur River. The north-eastern distribution border stretches from the Chaun Lowland to the Anadyr River basin. Then further south along the Bering Sea coast to N. Kamchatka and comes west to Okhotsk along the N. Okhotsk Sea. The species breeds also on sub-Arctic islands (Isakov & Ptushenko, 1952; Portenko, 1972; Rogacheva, 1988; Stepanyan, 1990; Andreev in press.). Two tundra subspecies breed within the NSR area: *A. f. rossicus* in western parts and *A. f. serrirostris* in eastern parts. The border between the tundra subspecies is not clearly expressed and lies between Lena and Khatanga Rivers. Breeding confirmed for Southern Island of Novaya Zemlya, Kotelny and Bolshoy Lyakhovskiy Islands, while non-breeding birds are distributed over the whole of the mentioned archipelagos. Non-breeding *A. f. fabalis* and *A. f. middendorfii* penetrate north to Arctic coasts (Novaya Zemlya, Lena-Delta) while moulting.

Seasonal migrations. The main wintering grounds of *A. f. rossicus* lie in Central and Western Europe. The flyway goes across the European part of Russia and along its north coast. *A. f. serrirostris* winters in Korea, China and in smaller numbers in Japan. The flyway goes across E. Siberia following lager river valleys and covers as much as 5,400–6,200 km, probably being the longest flyway known for Arctic geese (Andreev, in press).

Among the long-distant migrants, Bean Geese are among the first to arrive in spring. Phenology of arrival is quite similar for the entire NSR area: the first birds appear in mid-May (10–20), mass arrival is recorded in late May (Kolyma and Indigirka Deltas) to the very beginning of June (Yugor and Gydan Peninsulas, Central Yamal, Lena-Delta, New-Siberian Islands), but the specific dates may be shifted several days depending on weather conditions (Naumov, 1931; Mikhel, 1935; Tugarinov, 1941; Isakov & Ptushenko, 1952; Rutilevskiy, 1963; Danilov *et al.*, 1984; Krechmar *et al.*, 1991; Mineev, 1994). Summer migration is well pronounced in Bean Geese. Most Beans fly northward to the Arctic coast and further north to the islands. Movements of non-breeding and failed breeding birds begin after 20 June peaking in early July (Blokhin, 1988; Krechmar *et al.*, 1991; Mineev, 1994). Departure to the wintering grounds stretches from the second half of August to October. The autumn migration can start as early as in mid-August (Yugor Peninsula), when the local breeders still have not completed their moult (Mineev, 1994). The second wave of migration occurs in late August–early September. At the same time the geese start leaving Novaya Zemlya and Lena-Delta (Tugarinov, 1941; Blokhin, 1988). The Bean Geese leave Yamal, Gydan, Lower Kolyma during second–third ten days of September (Naumov, 1931; Tugarinov, 1941; Danilov *et al.*, 1984; Krechmar *et al.*, 1991). The latest flocks can be observed as late as 10 October (Yugor Peninsula, Novaya Zemlya; Tugarinov, 1941; Mineev, 1994).

Moult. Moults once a year. Minor contour feathers are moulted gradually during summer and also during autumn migration (Mineev, 1994). Non-breeders begin moult of flight feathers in mid-July, whereas brood-rearing birds start moulting one–two weeks later (Gorbunov, 1929; Blokhin, 1988). Flocks of moulting geese may number from several tens up to thousand birds (Krechmar *et al.*, 1991; Mineev, 1994; Degtyarev, 1995). Most Bean Geese are able to fly again by mid-August.

Numbers and population trend. On the Yugor Peninsula the average breeding density decreases from 4.2 to 0.5 ind./km^2 from west to east, reaching maximum numbers of 5.2 and 1.1 ind./km^2 in areas between Lymbadayakha-Vasyakha rivers and Kara-Tabyu-Sopchayu rivers, respectively. The average non-breeding density varies annually between 1.1 and 5.4 ind./km^2 (Mineev, unpubl. data). Overall population estimates for Vaigach are extremely different in different sources (Kalyakin, 1985, 1993; Romanov, 1988). The minimum figure calculated from Romanov (1988) gives almost 4,000 breeding birds, meaning an average density of 1.2 ind./km^2. The highest breeding density, 6–10 ind./km^2, is found in N. Vaigach (Ponomareva, 1994; Syroechkovskiy *et al.*, 1995). Maximum density of non-breeding Beans (up 114 ind./km^2) is found in Central Vaigach (Romanov, 1988). Both populations have increased in numbers during the last decades (Karpovich & Kokhanov, 1967; Romanov, 1988; Mineev, 1994). The total number of Bean Geese in Novaya Zemlya is unknown, and the eastern coast is almost not surveyed at all. The only data available from the eastern parts (Cape Menshikova area) give non-breeding density of 24 ind./km^2 (Pokrovskaya & Tertikski, 1993). The population trend is unknown, but is assumed to be the same as in the rest of the NE European population. No recent data on breeding density are available for Yamal, Gydan or Bely Island. The Beans breed mainly in central Yamal being rare in south and disappear north of Kharasavey (Danilov *et al.*, 1984; Molochaev & Borshchevskiy, 1984). Nevertheless, the Bean used to be a regular breeder (in low numbers) on Bely Island in the 1930s (Tyulin, 1938). The only figures for breeding abundance are available from SE Yamal (Kamenny Cape area; Ryabitsev, 1995) and gives densities fluctuating annually between 0.09 and 0.18 ind./km^2. Yamal and Gydan used to be important moulting grounds for "grey" geese, with the Beans being the most numerous waterfowl species, a few decades ago (Pugachuk, 1965; Uspenskiy & Kistchinski, 1972). Since then, both breeding and non-breeding numbers have declined sharply on Yamal; even in 1970–80 no big moulting accumulations have been observed (Danilov *et al.*, 1984). Nowadays only small flocks of less than ten geese are recorded (Bakhmutov *et al.*, 1985; Sosin *et al.*, 1985). As it is an extensive human activity on Yamal that is responsible for goose population degradation, a shift of moulting sites to Gydan has been suggested (Molochaev, pers. comm.). The sub-arctic tundra between the Pyasina and Khatanga Rivers used to be the optimum of the breeding range of Bean Geese in Taimyr in late 1950s–early 1960s with breeding densities of 3.5–10 birds/km^2. During the next 15–20 years the abundance of breeding Bean Geese declined significantly (Krechmar, 1966; Kokorev 1983, 1985 cited after Rogacheva, 1988). The Bean Goose penetrated the Arctic coast of Taimyr along the Nizhnyaya Taimyra and Pyasina Valleys, but the former record has not been confirmed recently (Sdobnikov, 1959a; Borzhonov & Vinokurov, 1984; Tomkovich *et al.*, 1994). Totally, ca. 20,400 Bean Geese were recorded within the Arctic tundra zone in 1978–1981 (Martynov, 1983, cited from Rogacheva, 1988). The main moulting site of non-breeding Beans in Taimyr is known to be the Pyasina-Delta, where 20–25% of the entire Taimyr population moult (Borzhonov & Vinokurov, 1984). Nowadays the Bean Goose is not a numerous visitor in most arctic coastal areas of Taimyr (Tomkovich & Vronskiy, 1988a, 1994; Tomkovich *et al.*, 1994). Earlier this century, the Bean Goose used to breed across the entire N. Yakutia eastward to the Amguema River (Portenko, 1972). Nowadays fairly stable breeding populations remain in some remote refuges only. These are the Uele River basin (breeding density ca. 0.1–0.3 birds/km^2), the arctic tundra between the Anabar and Olenek Rivers (0.1–0.2 birds/km^2), Yana-Delta (0.2–0.4 birds/km^2; our calculations after Labutin *et al.*, 1986; Degtyarev, 1991); Olenekskaya-Arynskaya arms interfluvial (0.08–0.2 birds/km^2; our calculation after Blokhin, 1988; Pozdnyakov & Sofronov, 1995), Konkovaya-Chukochya interfluvial (0.7–1.3 birds/km^2; Krechmar *et al.*, 1991), and Indigirka Lowland, Kuropatochya and Ruchua Rivers low reaches as well (Andreev, in press). The overall number of Bean Geese counted in late summer shows a general decreasing tendency from west to east N. Yakutia. Totally, the number of Bean Geese in August on the tundra from Anabar to Indigirka is estimated at 30–60,000 individuals in 1980–85 with highest densities in Uele basin and Yana-Delta (our calculation after Labutin *et al.*, 1988; Degtyarev, 1991; considering Beans making up 20–40% and 10–50% of overall goose numbers, respectively). East of the Alazeya river the number is only the half and in Kolyma area one tenth of that in the above mentioned regions (Krechmar *et al.*, 1991). Only some 8,000 Bean Geese were counted between Kolyma and Alazeya in 1993 including moulting concentration in the Kuropatochya River area (Andreev, unpubl. and in press). The Bean Goose is absent nowadays in the Kolyma-Delta both as a breeding and moulting species. Evident decline has been recorded in Chaun Lowland and Ayon Island during recent decades. No clear spring migration is seen nowadays (by 1984 spring numbers had decreased to 1/30 of the numbers in 1976). The Bean Goose used to be an abundant breeder in coastal tundra from Chaun Bay eastward to the Amguema River, but have deserted this area by now (Portenko, 1972; Krechmar *et al.*, 1991; Hodges & Eldridge, 1994).

It is difficult to give an estimate of the total population of Bean Geese. It should be noted, that figures given for most of N Yakutia (Labutin *et al.*, 1986; Degtyarev, 1988, 1991; Blokhin, 1988) must be considered carefully because these data were obtained during aerial surveys when the overall stock of *Anser* species was counted, and the fraction of breeding Bean Geese was calculated taking into account results of selective ground counts. Besides this, all the data are from surveys covering less than 10% of the total area and extrapolating from that. This kind of method produces uncertain results, especially if it is used during moulting, when geese are patchily distributed. It should be stressed, however, that the entire population of the eastern Siberian tundra Bean Goose (*A. f. serrirostris*) breeds within the NSR area .

However, the population trend is quite clear almost all over the range. In most parts of the NSR area the number of Bean Geese decreased dramatically during the last decades except for Vaigach Island and Yugor Peninsula (and probably Novaya Zemlya). All across the Asian tundra a significant population decline of both breeding and moulting geese and a break-up of the range has been going on continuously since the middle of this century.

Habitats. The first thawed patches of tundra covered by cottongrass are of great importance for Bean Geese just after arrival and their presence influence on the breeding success (Sdobnikov, 1959a; Krechmar *et al.*, 1991). For nesting the geese prefer slopes, bluffs, elevated banks of lakes and rivers that become free of snow first, with various types of grass and bush tundra, mostly nearby water bodies. Stony slopes and flat hill tops have been found to be preferred in Novaya Zemlya (Syroechkovskiy *et al.*, 1995). Some birds nest in the vicinity of the nests of larger falcons and Rough-legged Buzzards, and they may even occupy the empty nests of these species (Krechmar *et al.*, 1991; Mineev, 1994). Broods are reared close to lakes or river channels and they graze on adjacent meadows.

Nesting and moulting biotopes are separated to avoid potential food competition during these crucial periods of the annual cycle (Andreev, 1993). Moulting concentrations (up to several hundred birds) aggregate on lakes and rivers. Certain big lakes are used for moulting every year. On southern tundra areas most of the Bean Geese moult on lakes, but further north, where the ice cover on the lakes melts later leading to delay in vegetation growth, they moult mostly along rivers and in deltas. Along the Arctic coast Bean Geese often moult at sea (Rutilevskiy, 1967; Uspenskiy & Kistchinski, 1972; Kalyakin, pers. comm.).

Breeding. Becomes mature after third year. Nests in isolated pairs. The breeding part of the population fluctuates highly from year to year. For example, 2 and 66% of the Bean Geese were breeding at Yamal in 1968 and 1969, respectively (Uspenskiy & Kistchinski, 1972). In N. Yakutia the breeding fraction is found to be about 20% on average (Labutin *et al.*, 1986; Pozdnyakov & Sofronov, 1995).

Breeding starts soon after arrival at the breeding areas, sometimes almost under winter conditions. Under average weather conditions the first eggs appear during the first two weeks of June, but the period of laying can be extended for a month with the earliest clutches started in late May (Danilov *et al.*, 1984; Krechmar, 1966; Krechmar *et al.*, 1991; Andreev, 1993; Mineev, 1994; Pozdnyakov & Sofronov, 1995).

Clutch size varies significantly between regions and years. Within the NSR area the average size may vary from 2.6 to 5.8 eggs (Krechmar, 1966; Pozdnyakov & Sofronov, 1995). Decrease in clutch size is found with moving north (Krechmar *et al.*, 1991; Syroechkovskiy *et al.*, 1995). The average egg size is 81.9 x 56.2 mm, average weight is 125.4 g. No replacement clutch is recorded.

Incubation lasts about 27 days (25–30) and goslings appear in very late June–beginning of July in the Kolyma area and Chaun Lowland (Krechmar *et al.*, 1991; Andreev, 1993), or during mid-July over the rest of continental segment of the NSR area (Krechmar, 1966; Danilov *et al.*, 1984; Blokhin, 1988; Mineev, 1994). Brood size is also highly variable, reaching 4.2–5.0 chicks in favourable seasons (N. Yakutia), being on average 3.4–3.7 goslings (Danilov *et al.*, 1984; Blokhin, 1988; Mineev, 1994; Pozdnyakov & Sofronov, 1995). Families often join when the rearing period progresses, forming aggregations of several tens of birds. Young become adult-sized being 6–7 weeks old and take on wings after mid-August. Family bonds are strong until next spring and break when parents start nesting again.

Food habits. Tundra species of *Graminea* and *Cyperacea* are the principal food in all subspecies of Bean Geese. The favourite food in spring is blooming heads and underground stems of cottongrasses *Eriophorum* spp., green shoots of *Arctophila fulva* and water sedge *Carex aquatilis* (Isakov, 1952; Krechmar *et al.*, 1991). In summer time the geese feed intensively on different species of grasses, sedges, cottongrasses and horsetails, preferring different species depending on the habitat. During moulting not only these species, but all vegetation around safe lakes (it is safety that is most important for the selection of moulting sites) is grazed out, including mosses and dicotyledons. An important feature of moulting sites, not only for the Beans but for all other geese as well, is the unique set of chemical elements in vegetation on permanent moulting sites. This supply of necessary chemical elements (sulphur in particular) is based on constant recycling of elements with droppings (Derksen *et al.*, 1982). If the geese move to a new moulting site because of repeated disturbance on a traditional place, this will inevitably cause shortage of elements necessary for feather growth in the next several years.

Predators and negative factors. The timing of snow melt in a certain area is the main abiotic factor affecting population productivity in Bean Geese. Cold and late springs cause significant decrease in the relative number of breeders (down to 1/8 of the proportion in normal years in Taimyr) and average clutch size (down to 50%), and to a lesser extent some delay in timing of breeding (Krechmar, 1966; Borzhonov, 1974; Syroechkovskiy *et al.*, 1995).

Predators, especially Arctic Foxes and larger gulls can reduce the breeding success, especially in years of low lemming abundance. Bad weather conditions together with low lemming cycle accounted for the almost complete breeding failure in 1968 on Yamal (Uspenskiy & Kistchinski, 1972).

Economic importance and human impact. The Bean Goose is one of the favourite game species actually overall its range in different seasons. It is the mass hunting on wintering grounds in China that is responsible for the dramatic decline in the goose populations on the eastern tundra (see Andreev, in press.). On breeding grounds direct harvest seems to remove quite a small fraction of the population, while the indirect impact during the shooting period is higher (Blokhin, 1988; Degtyarev, 1991). Egging and reindeer herding impact on nesting geese in some regions. Disturbance is very important both during the nesting period and in the pre-moulting period. People, low aircraft flights and ground vehicles may cause direct influence, by birds abandoning the disturbed area and skip breeding, as well as indirect influence when most nests are predated by gulls and foxes after parents being chased off by disturbance. Disturbance during pre-breeding and pre-moulting time may cause abandonment of favourite moulting places, the geese being displaced to poorer areas. The disappearance of moulting sites on Yamal and the present distribution pattern in N. Yakutia reflect the tendency of Bean Geese to avoid human neighbourhood (Blokhin, 1988; Krechmar *et al.*, 1991; Ryabitsev & Alekseeva, 1995). (See also the *White-fronted Goose*).

As mentioned above, Bean Geese are weakly connected with sea coast over most of their range. Only in the northernmost parts of the range (Novaya Zemlya, New-Siberian Islands) the geese may moult at sea. Such birds, and the geese using delta channels as moulting and rearing habitats, are at risk of oil pollution.

Thus, the development of shipping along the NSR will expose the Bean Geese inhabiting the northernmost zones of their range to the risk of oil pollution and airborne disturbance, while increased hunting and disturbance caused by vehicles and water vessels due to development of land-based infrastructure will be the main impact in the rest of the range.

Conservation. The species is protected in The Great Arctic and Lena-Delta State Reserves, and in Vaigachskiy and Purinskiy Federal Refuges.

5.6 *Emperor Goose (*Philacte canagica *Sevastianov).*

by Alexander V. Kondratiev

Status: Nesting migratory species.

General appearance, size. Medium sized goose with relatively short legs and short thick neck. The body length is 650–700 mm, mean weight is 2.25–2.5 kg. The wing length is on average 375 mm in females and 405 mm in males. Sexes alike. The plumage is grey-coloured with a scaly pattern due to white and black banded feathers. Tail feathers are pure white, the foreneck is darkish to black, the head and hindneck white; in nature with a shade of a rusty colour. The flight is heavier with more frequent wingbeats, as compared to other geese, and it often flies low over water. On water it is characterised by a low seat, elongated body and a relatively short neck.

Distribution. Nests in the coastal tundra of the Chukchi Peninsula from the Amguema River mouth eastward up to Dezhnev Cape and further south along the coast of the Bering Sea to the Navarin Cape. At Alaska the Emperors nest mainly in the Yukon-Kuskokvim Delta and in the north of the Seward Peninsula (Eisenhauer & Kirkpatrick, 1977; Petersen et al, 1994). A significant part of the population move to St. Lawrence Island to moult.

Within the NSR area the Emperor Goose inhabits the area from the Amguema River mouth eastward to the Dezhnev Cape (Kistchinski, 1988). Vankarem Lowland and coastal tundra along the Kolyuchin Bay are the densest populated breeding grounds. These are also the main moulting grounds for non-breeding birds (Kistchinski, 1972; Kistchinski, 1988; Krechmar *et al.* 1978). Emperor Geese observed in the Kolyma-Delta should be considered as vagrant (Spangenberg, 1960).

Seasonal migrations. Spring staging in the lagoons of the Alaska Peninsula is of great importance in the life cycle of the Emperors. Here the geese arrive in mid-April. Spring arrival to the breeding grounds occurs in late May–early June (data from Kolyuchin Bay: Krechmar *et al.*, 1978; and from Uusenveem River: Tomkovich & Sorokin, 1983) depending on weather conditions. Autumn migration starts as early as in mid-August. The first flocks flying eastward along the northern coast of Chukotka have been observed on August 15, 1980 (Tomkovich & Sorokin, 1983) and August 20 (Krechmar *et al.*, 1978).

Moult. Non-breeders stay in the nesting biotopes up to late June, then they gather in flocks of from 15 to 50 birds for moulting at sea coast and in lagoons. The Ukouge lagoon used to be the principal moulting site where the majority of such flocks, numbering 2,000 birds, were observed earlier (Kistchinski, 1972). When disturbed, Emperor Geese run to the water and escape danger at sea. Non-breeding geese are able to fly by mid-August after moulting, while brood-rearing parents regain this ability a little later.

Population numbers and trend. The total abundance of the world population has been assessed regularly by the USFWS since 1981. This became possible because of the concentration of almost the whole world population on the Alaska Peninsula during autumn and spring migration. In 1964 total spring numbers were estimated at 140,000 individuals, then there was a gradual decrease to 42,000 in 1986. After this the numbers have recovered to 60,000 by 1992 (King & Dau, 1992; Petersen *et al.*, 1994). Aerial surveys of Emperor Geese in the nesting period over the coastal zone of the Yukon-Kuskokvim Delta have been conducted since 1985. This allowed to record annual changes in the population and separate the trends in the American and the Asian populations, which are inevitably counted together during the autumn and spring counts (Butler, 1993). According to these data the American population of Emperors have remained stable since 1985, as compared to increasing numbers of White-fronted and Canada Geese (Petersen *et al.*, 1994).

The data on Emperor abundance within the NSR are more fragmentary, but a general declining tendency has been recorded also here. The maximum population on the Chukchi Peninsula is estimated at 12,000 individuals (Kistchinski, 1976, 1988). Up to 4,000 non-breeders moult on the coast of the Kolyuchin Bay (Krechmar & Kondratiev, 1982). The present numbers of the Emperors at the Arctic Ocean coast can be estimated on the basis of recent aerial surveys at a minimum of 2,000 individuals (Eldridge *et al.* 1993) to a maximum of 5,500 individuals (Hodges & Eldridge, 1995).

Breeding density varies significantly between regions. In the Y-K Delta it reaches 19 nests per 1 km^2 (Eisenhauer & Kirkpatrick, 1977), and 5 pairs per 10 km^2 on the coast of the Anadyr Bay (Kondratiev, 1993). Only 3 pairs per 10 km^2 was recorded on the Kolyuchin Bay coast (Krechmar & Kondratiev, 1982) and 2.2 pairs/10 km^2 on average over the northern coast of the Chukchi Peninsula (Kistchinski, 1976).

Habitat. The Emperor Goose is the most marine species among the geese. The distribution during the nesting period is closely related to the near sea landscapes, primarily with flooded coastal sedge (*Carex subspathacea*) and grass (*Puccinellia phryganodes*) meadows (Eisenhauer & Kirckpatrick, 1977; Petersen *et al.*, 1994; Laing & Raveling, 1993). These habitats are important feeding grounds during the entire summer. Emperor Geese can also breed in the tundra zones more remote from the coast, sometimes as far as more than 60 km (Portenko, 1972; Kistchinski, 1988). However, the narrow coastal strip adjacent to the sea meadows is the preferred nesting biotope (Petersen, 1990; Krechmar & Kondratiev, 1982; Krechmar *et al.*, 1991; Kondratiev, 1993). On autumn and spring staging grounds on the Alaska Peninsula the Emperors are connected with tidal flats where they feed on eelgrass (*Zostera* sp.), green algae and invertebrates (Headley, 1967; Petersen, 1983; Petersen *et al.*, 1994).

Breeding. Becomes mature after third year. The maximum known age is nine years. The breeding part of the population probably does not exceed 20% of the total number of birds that arrive at the nesting grounds (Kistchinski, 1988). The non-breeders include both 1–2 year old immatures and adult experienced pairs missing breeding. According to the estimates of Petersen (1992) 30–60% of the breeding females do not attempt to breed the following year.

The pre-breeding period in the north-west of the area (the Chukchi Sea coast) is 10–15 days (Krechmar & Kondratiev, 1982). Usually nesting starts in late June, but in cold summers it can be delayed for 15–20 days, as was recorded in 1975 on the Uusenveem River low reaches (Tomkovich & Sorokin, 1983). There are 2–7 (4 on average) eggs in a full clutch (Krechmar *et al.*, 1978; Krechmar & Kondratiev, 1982). The species is characterised by a high degree of intraspecific nest parasitism (Petersen, 1992; Kondratiev, 1993). In the Yukon-Delta up to 15% of the goslings hatch from parasitic eggs (Petersen, 1991). The incubation takes 23–26 days (24 on average). Hatching occurs on 12–19 July on the Chukchi Sea coast (Krechmar & Kondratiev, 1982; Kistchinski, 1988).

The female incubates and the male guards the nest during the first half of the incubation only. Incubating females practically do not feed and spend 98% of the time on the nest (Laing & Raveling, 1993). Males stay away storing fat resources for the brood-rearing period, during which the main occupation of the males is to protect the goslings in the very open habitats. During the rearing period, broods can join in aggregations numbering up to 45 birds (Tomkovich & Sorokin, 1983). Goslings take on wing at 50–60 days, i.e. in the second half to the end of August. Parents with young regain flight ability at the same time.

Food habits: The main food is benthic intertidal invertebrates and vegetation in marine and estuarine habitats, and vegetation in terrestrial habitats. Little is known about foraging habitats in winter, other than their preference for intertidal areas (G.V. Byrd, pers. comm., cited from Petersen *et al.*, 1994). At spring and autumn staging areas the geese feed on blue mussels and *Balthica macoma* clams by dipping their head at waters as deep as 30 cm (Petersen, 1983). Vegetation, such as *Zostera marina*, *Ulva* sp. (*Algae*) and some beach plants (*Lathyrus maritimus, Honckenia peploides*), have also been recorded in autumn (Petersen *et al.*, 1994). In spring, during the pre-breeding period, the geese feed mostly on thawed patches of graminoid meadows by grazing and grubbing roots of *Triglochin maritimus* and *Elymus* spp. (Laing, 1991). During brood-rearing, the geese feed primarily in intertidal salt marshes dominated by *Carex ramenskii*, *C. subspathacea*, *Elymus* sp. and *Puccinellia phryganodes* (Laing & Raveling, 1993). The same feeding habits and plants (*C. subspathacea* and *P. phryganodes*) have also been recorded for moulting birds (Kistchinski, 1972).

Predators and unfavourable factors. Breeding success varies highly between years and regions. In favourable years it is 60–90% (Petersen, 1992). The main reason for low breeding success is predation from Arctic Foxes; sometimes almost all nests are preyed upon in some regions. The high vulnerability of Emperor Geese to predation from Arctic Foxes is due to the absence of the male goose from the nest during the second half of the incubation period.

Two factors have a main influence on the spring numbers of Emperor Goose: breeding success in the previous year (53% variation), and winter mortality, which is relatively high as compared to other goose species (Petersen *et al.*, 1994).

Economic importance and human impact. In spite of being protected in the area, the Emperor Geese are shot, and hunting (mainly in spring) plays a definite role in the habits of local people of Alaska, partly also of Chukotka.

During brood-rearing and moulting the geese are extremely sensitive to disturbance and avoid staying close to human settlements. Increased disturbance and visits in feeding biotopes by humans in the second half of summer may result in the disappearance of Emperor Geese.

Development of shipping along the NSR may have a negative effect on the status of the Emperor Goose population if the coastline is contaminated by oil products. This because the main feeding grounds of this species are within the periodically flooded marine meadows. It is contamination of coastal ecosystems at the Aleutian Islands that is assumed to be responsible for a high mortality of the Emperors on wintering grounds (Petersen *et al.*, 1994).

Conservation. Listed in the Red Data Book of the Russian Federation as a rare restricted-area species decreasing in number. In Russia the only breeding grounds of the Emperors on the coast of the Anadyr Bay have been protected since 1973. Only a difficult access to the breeding grounds at the Arctic coast of Chukotka serves as a guarantee for successful reproduction of the species, which is extremely sensitive to disturbance.

*5.7 Long-tailed Duck (*Clangula hyemalis *L.)*

by Irina V. Pokrovskaya, Grigori M. Tertikski and Maria V. Gavrilo

Status. Nesting, migratory species.

General appearance, size. Small, short-necked seaduck with a short bill, steep forehead, small head and narrow all-dark wings. Length 40–47 cm, in addition males have central tail feathers extending up to 13 cm. Weight varies highly during summer, decreasing in males on average from 860 g (775–920 g) in May to 780 g (665–800 g) in July; and in breeding females from 685 g (610–780 g) in June to 550–600 g in August. Non-breeding females weight 700–800 g in late summer (Isakov & Ptushenko, 1952.).

Sexually dimorphic. Seasonally variable plumage. Moult sequences complicated, making sexing and ageing of other than adult males difficult. Adult males have elongated central tail feathers in all plumages, except during active moult. In summer they are mainly brown with a whitish patch on the sides of the head and white sides, belly and undertail coverts. In winter males are mostly whitish with dark-brown breast, side of head, centre of upperparts and tail. Females in summer have a less bright plumage, as compared with males. The colouring is characterised by significant individual, seasonal and age differences. And still the Long-tailed Duck is quite different from the other ducks; an adult male cannot be confused with any other species. Females and the young can sometimes be taken for females and young of the Harlequin Duck.

Distribution. The breeding range is circumpolar within the arctic-boreal climatic zone. In N. America it is distributed from Alaska eastward to Labrador. It inhabits the Canadian archipelago and Greenland, but breeds only sporadically north of 74–75 latitude. In Eurasia the breeding range goes south to the zone of southern forest tundra; reaching 60°N along the coast of Bering Sea. It is found far north, and breeds regularly in Svalbard and on the Southern Island of Novaya Zemlya, Vaigach and Kolguev isles (Rutilevskiy, 1973).

The Long-tailed Duck is common and widespread all over the NSR area. The breeding range covers the entire mainland coast except for N. Taimyr, including areas of fairly stable and high breeding density as follows: E. Yugor Peninsula, Vaigach Island, central and S. Yamal, Anabar tundra, Lena, Yana, Indigirka and Kolyma deltas, Chaun and Vankarem Lowlands, and Ayon Island (Kistchinski, 1973; Danilov et al, 1984; Mineev, 1994). It is absent as a breeding species at the Severnaya Zemlya archipelago and the Kara Sea Isles. On the Northern Island of Novaya Zemlya, New-Siberian Islands and Wrangel Island it breeds only sporadically, but occurs in great numbers here during moulting (Rutilevskiy, 1973; Stishov *et al.*, 1991; de Korte *et al.*, 1995).

Four main winter quarters are known for the Long-tailed Ducks, including two in N. Atlantic and two in N. Pacific. Birds breeding east of Taimyr winter in the Bering Strait and Bering Sea penetrating south to Japanese and Korean waters. Ducks breeding in Europe, W. Siberia and Taimyr winter along shores of Western Europe and Kola Peninsula. A small number winter near SW. Novaya Zemlya. It occurs regularly on lakes of central Europe, and the northern coasts of the Black and Caspian Seas (Isakov & Ptushenko, 1952; Rutilevskiy, 1973; Kistchinski, 1988; Rogacheva, 1988; Madge & Burn, 1988). The main part of this population (somewhat more than 90%) is centred in the Baltic Sea (Andell *et al.*, 1994).

Seasonal migrations. The migration routes pass over the sea and cross the mainland along the river valleys as well (Kistchinski, 1982, 1988; Bianki, 1989b). In the westernmost part of the NSR area Long-tailed Ducks migrate mainly over the sea in spring, while in Taimyr, N. Yakutia and Chukotka they use a continental route (Krechmar, 1966; Kistchinskiy, 1982; Estafyev *et al.*, 1995). The Long-tailed Duck comes to the nesting grounds quite early compared to other diving ducks; as soon as open water appears. Within the NSR area this is during the last ten-days of May–first ten-days of June (Kistchinski, 1988; Krechmar *et al.*, 1991; Mineev, 1994). In years with normal spring conditions Long-tailed Ducks arrive at the S. Yamal in late May and at the N. Yamal in early June (Danilov *et al.*, 1984). Breeding ducks appear on the Wrangel Island in early June, while non-breeding flocks can be recorded as early as late April, but usually in early May, depending on ice conditions at sea (Stishov *et al.*, 1991). Unusually early arrival is recorded in the Chaun Bay at places artificially heated by industrial discharges (Krechmar *et al.*, 1991).

Migration for moult is well pronounced in males of Long-tailed Ducks, but some non-breeding females also join them. Females are more abundant in such flocks in years of low lemming densities (Danilov *et al.*, 1984). Summer migration starts after egg laying is completed, i.e. in late June, and continues until mid-July in accordance with the egg-laying period (Portenko, 1972; Rutilevskiy, 1973; Danilov *et al.*, 1984; Kistchinski, 1988). Ducks generally move northward from their breeding grounds to the Arctic coast and isles. Mass migration towards North over polynyas close to the shores of Yamal used to be common in the 1970s (Danilov *et al.*, 1984).

Males having completed moult, start autumn migration in late August. However, Long-tailed Ducks occur everywhere at sea up to late September–early October, that is, up to freezing of the area (Naumov, 1931; Tyulin, 1938; Isakov & Ptushenko, 1952). The ducks leave the Novaya Zemlya archipelago by the end of October, and stay in the vicinity of Vaigach till early November (Estafyev *et al.*, 1995). Before departure, the males gather in large flocks at sea and lagoons. Well-pronounced migration is recorded along the coast of N. Chukotka and at the New-Siberian Isles. Adult males fly mostly along the sea coast while successful females with young cross the mainland keeping to river valleys and lake systems (Portenko, 1972; Rutilevskiy, 1973; Tomkovich & Sorokin, 1988).

Moult. Both sexes have four adult plumages (resulting from three moults) annually; winter, breeding and summer. Full moult occurs in the second half of summer. Some populations undertake extensive moult migrations, whereas others moult nearby the breeding grounds. Males, that have finished breeding, non-breeding birds and failed breeding females moult in large flocks mainly at sea along the Arctic coast. Females and some males stay moulting on tundra lakes. Female flocks usually do not exceed several dozens of individuals, while males sometimes gather in flocks of hundred birds. Moulting of flight feathers in these groups occurs during mid-July–late August (Gorbunov, 1929; Rutilevskiy, 1973; Krechmar *et al.*, 1991). Successful females seem to moult on the breeding grounds, either after leaving grown ducklings or when staying with broods (Krechmar, 1966; Rutilevskiy, 1973; Krechmar & Artyukhov, 1979). Moult in this group takes place in mid-August–early September.

Recently moulting accumulations of Long-tailed Ducks have been recorded in the Vaigach area, in river mouths of the Yugor Peninsula and N. Yamal, Yenisey Bay, deltas of Lena and Indigirka, around Ayon Island and Kyttyk Peninsula, in the area of Svyatoy Nos Cape and Lopatka Peninsula, at sea next to the Rauchua-Delta, in Kolyuchin Bay (Kondratiev A.Ya., unpubl. data; Lappo, unpubl. data; Mineev, unpubl. data; Morozov, 1984; Labutin *et al.*, 1986; Kistchinski, 1988; Romanov, 1989; Krechmar *et al.*, 1991). The Long-tailed Duck used to be an abundant moulting duck along Novaya Zemlya and N. Yamal coasts, in the coastal waters of the New-Siberian archipelago and Wrangel Island, but only the latter record has recently been confirmed, while noticeable decline is observed in Yamal and no recent data exist for the archipelagos (Gorbunov, 1929; Portenko, 1972; Rutilevskiy, 1972; Danilov *et al.*, 1984; Stishov *et al.*, 1991).

Population numbers and trend. Being a characteristic tundra duck all over the breeding range, the Long-tailed Duck becomes a background species within the sub-zone of typical tundra. However, patchy distribution patterns and considerable annual population fluctuations within the range are typical for this duck (Kistchinskiy, 1983; Vronskiy, 1986; Mineev, 1994). Counting in winter is often difficult because large rafts keep far offshore. Hence, available data on overall abundance are approximate and rather conflicting. The world population is estimated at 10,000,000 individuals in some reports (del Hoyo *et al.*, 1992), while the total population of the former USSR alone has been estimated at the same figure (Krivenko, 1991).

Within the NSR area the Long-tailed Duck is recorded as a common and abundant breeding species on the E. Yugor Peninsula (breeding density up to 3 ind/km^2; Mineev, unpubl. data); central and S. Yamal (up to 7.5 ind/km^2 at Kamenny Cape; Ryabitsev, 1995); Chaun Lowland (up to 30 ind/km^2; Krechmar *et al.*, 1991); Vankarem Lowland and the coast by Kolyuchin Bay (up to 1.8 and 4.5 ind/km^2 respectively; Kondratiev A.Ya., unpubl. data), and for the Lena, Yana, Kolyma and Indigirka deltas, Ayon Isle and Kyttyk Peninsula as well (Kistchinski & Flint, 1972; Kistchinski, 1988; Krechmar *et al.*, 1991).

The Long-tailed Duck is, however, more abundant as a non-breeding and moulting bird within the study area, and most estimates, obtained during aerial surveys, concern overall numbers including all groups. Thus, on Vaigach Isle the total number of the Long-tailed Duck in 1987 was estimated at 20–25,000, twice as many as in 1960 (Karpovich & Kokhanov, 1963; Romanov, 1989). The Long-tailed Duck was a very abundant species on Yamal and Gydan Peninsulas with populations being estimated at ca. 400,000 breeding pairs (Isakov, 1970) or at 610,000 individuals for the overall stock in the 1960s (Uspenskiy & Kistchinski, 1972). Huge rafts used to moult close to N. Yamal, stretching for several km alongside its shores, but only flocks of hundreds of birds, rarely as many as 2,000, have been observed recently (Danilov *et al.*, 1984; Sosin *et al.*, 1985). Nevertheless, the Long-tailed Duck is still considered to be the most numerous duck in Yamal (Danilov *et al.*, 1984), with overall density reaching 45.7 ind/km^2 in favourable habitats on flood-plains by the Kharasavey River (Morozov, 1984).

On Taimyr the Long-tailed Duck is most numerous in the subzone of typical tundra with an overall stock estimated at 1,600,000 of individuals in the late 1970s, but only a small fraction (less than 0.5%) reaches the Arctic shores (Martynov, 1983).

As all duck species were counted together during the aerial surveys in W. Yakutia in the early 1980s, only numbers for Long-tailed Ducks in Lena-Delta are available. It is estimated at 40–60,000 individuals (density 1.0–1.5 ind./km^2) in August (Labutin *et al.*, 1986). The highest duck concentrations were found in Yana-Delta; this is in good concordance with the previous results of Kistchinski (1973), who recorded 1.5 ind/km^2 in 1972. Further east, in the early 1970s, the abundance of Long-tailed Ducks was estimated at 40–60,000 individuals (a density of 0.1–2 ind./km^2) between Khroma and Sundrun Rivers, and at 200,000 individuals (density 6.5 ind./km^2) in N. Chuckchi Peninsula (Kistchinski, 1973). Land-based counts in E. Chukotka recorded total densities of Long-tailed Ducks to be 1.2–29 ind/km^2 in different habitats, and to vary by 3–4 times between years (Tomkovich & Sorokin, 1988).

On the Wrangel Island there are numerous non-breeding Long-tailed Ducks, but it is a rare breeding species. The density during the nesting period is 15–30 ind/km^2 on plain tundra with lakes (Stishov *et al.*, 1991), and the overall population for the island is estimated at 20,000 ducks (Stishov, 1984).

Summarising all data mentioned above, the estimate of the Long-tailed Duck population at 500,000 individuals for the Russian North Pacific Rim (east of Lena-Delta) seems to be acceptable (Goudie *et al.*, 1994).

To our mind it is difficult to give a realistic estimate for the population inhabiting the NSR area using reliable data available, as few counts have been conducted recently and there are no data for moulting accumulations at sea, which are likely to account for the largest fraction of the population. It is also difficult to determine the recent population trend in different areas, taking into account the mentioned dynamical patterns, but the population is considered to have been generally stable for entire Russia over the last decade (Krivenko, 1991; Goudie *et al.*, 1994).

Habitat. As a typical seaduck, it spends much of the year at sea. Winters chiefly at sea, generally offshore, along ice edges, but also inland in large, deep lakes or brackish lagoons. During spring migration the ducks occur either at sea in polynyas or inland in rivers. When moulting, males stay mostly in shallow areas at sea, sheltered bays, lagoons and estuaries; big lakes are also used. Females stay on tundra in remote densely fringed lakes, rivers and river branches (Gorbunov, 1929; Isakov & Ptushenko, 1952; Portenko, 1972; Rutilevskiy, 1973; Kistchinski, 1988; Stishov *et al.*, 1991).

Inhabits a wide spectrum of tundra biotopes when breeding. Nests relatively open on tundra by small water bodies, on bogs and coastal sites including deltas, estuaries and spits. On small isles inaccessible for predators, colonies can be formed, often shared with other waterbirds (Danilov *et al.*, 1984; Krechmar *et al.*, 1991; Stishov *et al.*, 1991; Mineev, 1994). Broods are reared on small shallow lakes and ponds with developed vegetation along the coasts. On Wrangel Island the broods are also observed in the lagoon area (Stishov *et al.*, 1991).

Breeding. Becomes mature first summer. The maximum longevity recorded by banding is 13 years (Bianki, 1989b). Breeds mainly solitary, but colonies are formed under good protective conditions.

The Long-tailed Ducks begin breeding relatively late, usually after the second ten-days of June on the mainland coast, and even in late June on the Wrangel Island (Portenko, 1972; Danilov *et al.*, 1984; Krechmar *et al.*, 1991; Stishov *et al.*, 1991; Mineev, 1994). Significant variation in the dates when the first clutches appear are found in the Chaun Lowland. This can be explained by feeding specialisation on water invertebrates, whose abundance strongly depends on climatic conditions (Krechmar *et al.*, 1991). Prolonged laying period, sometimes as long as for 3 weeks, that is related to relaying after the first clutch is lost, is typical for this species.

The mean clutch size varies within the study area from 5.1 (Chaun Lowland) to 6.7 eggs (Low Kolyma and Yamal) (Krechmar *et al.*, 1978, 1991; Danilov *et al.*, 1984; Mineev, 1994). Mean egg size is 54x38 mm (Stoneware, 1967 after Cramp, 1977) and weight 39 g (Isakov & Ptushenko, 1952). Incubation begins with the laying of the last egg and lasts for 26 (24–29) days (Krechmar & Artyukhov, 1979; Cramp, 1977). The hatching dates are also extended similar to egg laying, mainly falling on the second half of July. Several broods can form a group, but this habit is not as pronounced as in eiders. Most of the young takes on wings in late August–early September.

Food habits. At sea the species preys by diving after different benthic invertebrates. The marine diet includes molluscs, chiefly bivalves, crustaceans, and other invertebrates; and fish is also consumed (Isakov & Ptushenko, 1952). The ducks moulting in the SW Kara Sea were found to prey mainly on Gastropods (Mikhel, 1937). Being a very active and proficient diver, the Long-tailed Ducks are reported to dive to depths of 50 m. When on tundra, the diet is based on insect larvae, but other fresh-water invertebrates, fishes and plants are included as well (Krechmar *et al.*, 1991; Mineev, 1994). In unfavourable years the Long-tailed Duck can switch to non-typical food; water plants and detritus (Danilov *et al.*, 1984; Mineev, 1984). Crustaceans (75%) are the principal food of ducklings, and the rest is plants (Kottam, 1938, after Cramp, 1977).

Predators and unfavourable factors. The main predators on tundra are Arctic Fox, Glaucous and Herring Gulls, and Arctic and Pomarine Skuas. They make significant impact on the breeding success in years of low lemming densities. Females may not attempt breeding under high predator pressure (Krechmar *et al.*, 1978). To gain protection the ducks nest close to gulls or terns, and even close to human settlements. Breeding density in the latter case can be ten times higher compared to natural habitats (Krechmar, 1966; Krechmar *et al.*, 1991).

Data obtained in Low Kolyma suggest that fluctuations in the breeding success depend on the availability of Chironomid larvae (Krechmar *et al.*, 1991).

Economic importance and human impact. The Long-tailed Duck is everywhere one of the important game birds.

Close relations to the sea, behavioural patterns and habit of concentrating in large numbers, particularly during the flightless moulting period, expose the Long-tailed Ducks at high risk from direct oil pollution. Mass death caused by oil spills is well documented. Feeding on benthic invertebrates when at sea make them vulnerable to chronic pollution as well. Development of land-based activity and disturbance will hardly affect the Long-tailed Ducks when nesting. But their habits of gaining protection nearby human settlements make them vulnerable to illegal hunting and predation by stray and unleashed dogs.

Thus, development of shipping along the NSR will hazard the Long-tailed Duck mainly by the risk of oil pollution.

Conservation. Available data suggest that the Long-tailed Duck is still a numerous and widespread species with apparently stable abundance and does not need special conservation and management measures. Nevertheless, regular mass moulting sites should be protected against oil pollution.

5.8 *Common Eider (*Somateria mollissima *L.)*

by Grigori M. Tertikski and Maria V. Gavrilo

Status. Nesting migratory species. Six subspecies are usually recognised (Stepanyan, 1975; Simmons, 1977), two of those are known to inhabit the NSR area: *S. m. mollissima* and *S. m. v-nigrum*.

General appearance, size. A large, heavily-built true seaduck. The largest not only of eiders but also among other ducks of the northern hemisphere. Length 50–71 cm. Body weight undergoes significant seasonal variations, being 2,250–2,600 g (males) and 2,360–2,900 g (females) in the breeding period in the nominate race. Males lose about 300 g when moulting, whereas females lose ca. 37% of their starting weight when incubating, weighing 1,550–1,600 g by hatching (Bianki & Boiko, 1979).

Sexually dimorphic. Seasonally variable plumage. Males in breeding plumage have a colouring typical for eiders: black underparts contrasting with white breast and upperparts, and black crown; a combination not shared by other eiders. Male *S. m. mollissima* has olive-grey bill, while *S. m. v-nigrum* has orange bill. The latter also has a large black 'V' on the upper throat and chin. Females are generally dark brown with cross ochre pattern in plumage. Common Eiders are well distinguished from other eiders by 'roman-nosed' profile and feathering extends into a point along the sides of the bill.

Distribution. Circumpolar species. Widespread throughout coastal regions of Arctic and sub-Arctic, although apparently absent from central arctic coastline of Siberia and N. Canadian islands. The range goes south as far as Maine State and Cook Bay in USA, and British Isles, Netherlands and Poland in Europe. It is also found in isolated colonies in N. France and on the N. Black Sea. In the Pacific the breeding range goes south to Commodore Isles in Bering Sea and Penzhin Bay in Sea of Okhotsk (Cramp, 1977).

The nominate subspecies is found in the westernmost part of the NSR area. It breeds along the coasts of Novaya Zemlya, Vaigach Island and N. Yugor Peninsula (Gorbunov, 1929; Demme, 1946b; Estafyev *et al.*, 1995). Isolated breeding sites are found on the Kara Sea Islands (known since the 1960s) and were recently recorded in Severnaya Zemlya (Syroechkovskiy & Lappo, 1994; Volkov & de Korte, pers.comm.). The eastern parts of the NSR area are inhabited by the Pacific eiders. Their westernmost breeding grounds are the Anjou Isles. On the mainland coast Common Eiders appear as nesting on W. Chaun Bay. They also breed on Wrangel Island (Rutilevskiy, 1957; Portenko, 1972). Non-breeding Eiders penetrate west as far as SE. Taimyr, and can be met at sea from Khatanga Bay to the Bering Strait.

Eastern-European Common Eiders winter in ice free waters of the Barents Sea, and partly in the White Sea. In the Pacific the chief wintering sites are located along the ice edge in the central Bering Sea and in the Bering Strait as well (Isakov & Ptushenko, 1952; Shklyarevich, 1979). The distribution in winter quarters in Barents and White Seas is found to depend on ice conditions (Shklyarevich, 1979).

Seasonal migrations. Migration goes at sea and, hence, it is poorly studied. Barents Sea Common Eiders start migrating in the second half of March (Bianki, 1989). In the Kara Sea migration is not pronounced, because the Common Eiders of the nominate race are at the easternmost limit of their range here. Common Eiders are assumed to occur at sea in the vicinity of the breeding grounds as soon as leads and polynyas appear. Mass arrival to Zhelaniya Cape is recorded in mid-April, to Vaigach and Yugor Peninsula area in early May (Antipin, 1938; Uspenskiy, 1967). Along the Arctic coast of Chukotka Common Eiders migrate during May, appearing in Uelen in late April–early May (Portenko, 1972; Tomkovich & Sorokin, 1988). Flying to the Wrangel Island, Eiders first go along N. Chukchi Peninsula then turn North, and reach shore of the island during May, but in springs with favourable ice conditions the first birds may appear as early as late April (Portenko, 1972; Stishov *et al.*, 1991). Along the coasts of the New-Siberian Islands and Kolyuchin Bay the first eiders appear in late May–early June; mass arrival occurs few days later (Rutilevskiy, 1957; Krechmar *et al.*, 1977). Only breeding birds come to the Arctic Islands, while non-breeding birds visit the mainland zone of the breeding range forming a second migration wave (Portenko, 1972; Rutilevskiy, 1957). The Common Eiders come ashore and disperse on tundra as the spring progresses, this happens during June.

As egg laying is finished, males begin migrating for moult, non-breeding birds and failed breeding females follow them. Extensive migration of these groups occurs along the Arctic coast of E. Chukotka during late June–July. Females constitute the majority in migrating flocks by early August, and males become rare in the second half of the month. Females with broods are the last to leave breeding grounds. Some broods depart from the New-Siberian Islands by swimming, yet before ducklings take on wings, by 10 August (Rutilevskiy, 1957). Successful breeding eiders leave the tundra by late August, and waters near the breeding grounds during September, but a few birds delay till November. The only mass pre-migration aggregations are known to form off the south coast of Wrangel Island (Stishov *et al.*, 1991). Autumn migration in E. Chukchi Peninsula is recorded during September–October peaking at the border of these months, while scarce flocks pass Uelen till late October, and some birds occur as late as December (Portenko, 1972). Autumn migration in the Kara Sea occurs from mid-September along the eastern coast of Novaya Zemlya, in Matochkin Shar and Kara Gate Straits (Demme, 1946b).

Moult. Common Eiders moult their feathers from July till January–February. Full moult, including flight feathers, starts after the breeding season has been completed. Adult males lose flight ability in a period from July through August. Breeding females moult later. (Cramp, 1977).

Moult occurs at sea and, hence, it is as yet poorly studied . Migration patterns and some direct observations within the NSR area suggest that the eiders leave the breeding grounds before moulting the flight feathers. The bulk of the males and non-breeders move to wintering quarters to moult, but partly moult along sheltered coasts next to the breeding places (Kara Gate and Yugor Shar Strait) or in open sea over the shoals (New-Siberian Islands and waters off the N. Chukotka). Successful females moult after leaving the breeding areas (Rutilevskiy, 1957; Portenko, 1972; Kistchinski, 1988; Mineev, unpubl. data).

Numbers and population trend. There has been a generally increasing trend in the population size of the nominate race since the 1940s, recently reaching ca. 3,000,000 individuals mostly belonging to the Baltic population (Rose & Scott, 1994). However, the trend can vary between different populations; the White Sea and Murman populations are fluctuating (Bianki, 1984; Koryakin, 1984). Overall abundance of Pacific eiders is guestimated at 150,000 (Rose & Scott, 1994) with a declining trend in Russia and apparently also in Alaska (Goudie *et al.*, 1994).

There are very few recent data on Common Eider numbers from the western NSR area. In Novaya Zemlya the bulk of the eiders used to breed along the western coast in the 1940s, and the overall breeding population of the archipelago was estimated at 25,000 pairs (Demme, 1946b). The only recent guestimate (Kalyakin, 1993) gives 95–100,000 individuals as the total population of both King and Common Eider for W. Novaya Zemlya, and cannot be compared with the earlier estimate. In the Vaigach area the number of Common Eiders is guestimated at 2,000–2,500 pairs (Ponomareva, 1994) and has doubled since the 1950s (Karpovich & Kokhanov, 1967). Data for the Yugor Peninsula are contradictory. V. N. Kalyakin (1984) estimated the number of Common Eider nesting pairs at 1,000 and about the same number of non-breeding individuals for the 1980s. Yu. N. Mineev (1994) considered the Common Eider to be a rare species (breeding density 0.01–0.7 ind/km^2 on the N. Yugor Peninsula mainland coast; Mineev, unpubl. data) with a decreasing trend, but he did not work in the area preferred by Common Eiders. Data available for the Kara Sea isles and Severnaya Zemlya give 15–20 pairs only (Syroechkovskiy & Lappo, 1994; Volkov & de Korte, pers.comm.). Hence, in spite of unreliable recent data on Common Eider abundance for the western NSR, the population here hardly exceeds 1% of the population of the nominate race.

The Common Eider used to be a common breeder along the coasts of the Anjou Isles four decades ago. It nested with highest density along the southern coast of Zemlya Bunge, it was less abundant along the northern and north-western coasts of Kotelny Isle and on Faddeevskiy Isle, while only few nests were found on Novaya Sibir Isle. (Rutilevskiy, 1957). No recent data are available from this area. On the Wrangel Island the overall Common Eider abundance is estimated at 20,000 individuals (Stishov, 1984). The highest breeding densities are found along the northern coast and in the downstream of big rivers on the southern coast (from 3–5 to 10–12 nests per 1 km route). The density of foraging eiders reaches 15–30 ind./km^2 and 30–40 ind./km^2 on lagoons and in river mouths respectively. Eider density on tundra lakes does not exceed 20 ind./km^2 (Stishov *et al.*, 1991). The population is supposed to be stable at present.

In the early 1970s overall abundance of Common Eiders along the N. Chukotka coast was estimated at 55,000–60,000 breeding females and up to some 100,000 males and non-breeders according to aerial and land-based survey (Kistchinski & Flint, 1977). Breeding density varied highly with habitats. It was found to be 0.17 ind./km^2 on maritime tundra in Vankarem Lowland, 1.5 ind./km^2 in area of Ukouge and Nutauge lagoons, and reached maximum at 200 ind./km^2 in Belyaka Spit area (Kistchinski, 1976; Krechmar *et al.*, 1978). In the

E. Chukchi Peninsula overall density of Common Eiders was found to vary from 0.1 to 16 ind./km^2 in different tundra habitats in the mid-1970s (Tomkovich & Sorokin, 1988). Recently the overall Common Eider number on the tundra from Chaun to Kolyuchin Bay in June was estimated at 22,000 birds including only ca. 2,500 birds in pairs according to aerial survey (Hodges & Eldridge, 1994). In spite of discussible method used, this means a sharp decline during the past decades. Goudie with co-authors (1994) assumed the current population of Pacific Common Eiders to have decreased 3–4 fold since the 1970s, but the decrease seems to be greater. Currently, Pacific Common Eiders inhabiting the NSR area can be assumed to comprise about 40% of total abundance of the *v-nigrum* race.

Habitat. Common Eider, among all marine ducks, and nominate subspecies most of all, is closely connected with marine habitats, although prevailing biotope attachment differs noticeably among subspecies while breeding. *S. m. mollissima* is strongly tied up with sea coast. The overwhelming majority nests on small inshore islands inaccessible for predators. On the mainland and big islands almost all nests are located within 500 m from the sea, rarely as far as 1.5 km, but on the lake bank. The eiders avoid precipices and steep slopes for nest building. Choose coastal habitats and prefer rocky patches faced to straits and closed bays with rich littoral fauna, avoid sandy and loam shores open to surf (Isakov & Ptushenko, 1952). The brood is taken to the sea one–two days after hatching.

Pacific Common Eiders, unlike birds of the nominate race, nest on maritime tundra along banks of small tundra water bodies. After hatching females can stay along with the brood on the lakes. Eiders of this subspecies can nest as far as 50–100 km from the coast on Chukotka (Kistchinski, 1976; Stishov, pers. comm.). However, on Anjou Isles Pacific Common Eiders, like birds of the nominate race, prefer coastal biotopes including sandy beaches, spits and low inshore isles, and do not penetrate inland more than 2–7 km (Zemlya Bunge; Rutilevskiy, 1957). Often breeds in mixed colonies with Barnacle Geese, Black Brants, Glaucous and Herring Gulls, Arctic Terns; can also nest under protection from nest predators near Snowy Owls, Peregrine Falcons and human settlements (Demme, 1946b; Portenko, 1972; Krechmar *et al.*, 1978; Stishov *et al.*, 1991). It is the coastal accumulative habitats and places offering protection from predators that are inhabited by the highest densities of Pacific Common Eiders all over the eastern part of the NSR area.

Non-breeding birds keep at sea, occurring within inshore coastal waters, lagoons and downstream of the plain rivers. During winter both subspecies stay in open sea using unfrozen patches of water such as polynyas, leads and ice edge.

Breeding. Become mature after third year. Eiders of nominate race breed mostly in colonies of various densities. Some birds nest in single pairs. Pacific Common Eiders usually nest solitary, but can also form colonies in optimal habitats (Rutilevskiy, 1957; Krechmar *et al.*, 1978; Stishov *et al.*, 1991).

Breeding starts in June soon after the eiders appear ashore. Mass laying occurs during first ten-days in W. Novaya Zemlya, second ten-days in Yugor-Vaigach area and on Wrangel Island, and in late June in Kolyuchin Bay. Most females complete clutches by early July on Anjou

Isles. Laying period can be prolonged for 3–4 weeks. If the first clutch is lost during the first half of incubation, laying is repeated. About 60% of the birds that lost their first clutch replaced it on Vaigach Island in 1960 (Karpovich & Kokhanov, 1963). Females with late broods were recorded as late as October 18 on Yugor Peninsula (Mineev, 1994). Nest parasitism is recorded in dense or mixed colonies with other Anserines (Stishov *et al.*, 1991).

Full clutches contain 2–7 eggs, on average varying from 3.4 to 5.4 in different regions, and are found to be bigger on islands (Novaya Zemlya, Anjou, Wrangel) than on the mainland coast (Yugor Peninsula, Chukotka) (Rutilevskiy, 1957; Karpovich & Kokhanov, 1967; Krechmar *et al.*, 1978; Kalyakin, 1984; Stishov *et al.*, 1991). Significant annual variations were noted on the Wrangel Island (Stishov *et al.*, 1991). Extensive incubation begins before next to last egg is laid. The incubation period is 24–27 days and ducklings appear during mid-July–early August. In 1–2 days after hatching the female leads the brood to the water. Common Eiders usually form mixed or joint broods (Koryakin, 1983; Stishov et al, 1991). In two months after hatching young reach the size of adults, and broods fall apart.

Food habits. Preys by diving on different benthic invertebrates when at sea. The littoral zone at depths of less than 10 m is the chief summer feeding habitat. During the first two weeks nestlings prey on surface at low water. Ducklings learn underwater feeding on sublittoral. In areas of high disturbance chicks shift to underwater feeding earlier (Karpovich, 1984; Koryakin, 1989).

The diet includes mostly molluscs, but echinoderms and crustaceans are also consumed. Species composition of the diet depends on characters of the benthos ecosystem in the foraging area (Tatarinkova *et al.*, 1979; Shklyarevich & Shklyarevich, 1982). Most of the energy needed for reproduction is stored when feeding at sea, and both sexes lose significant mass while breeding. Hence, later nutrition requirements naturally increase. The birds forage in the sublittoral, and the role of gastropods, echinoderms, ascidia and polychaetes, that are more nutrient-rich organisms compared to mussels, increases in their diet (Bianki *et al.*, 1979). The eiders readily prey on fish in winter time.

Predators and negative factors. Main predators on the tundra are the following: larger gulls, Snowy Owls, Arctic and Pomarine Skuas and Arctic Foxes; the latter become more significant for the Pacific Common Eiders. Predators can significantly affect breeding success in periods of low lemming densities. For instance, only 35 nestlings and several hundred females with no broods were recorded on Novaya Zemlya in 1992 (low lemming cycle) (Pokrovskaya & Tertikski, unpubl.). Rodent abundance also influences breeding distribution in the nominate race. In Novaya Zemlya Common Eiders nest on tundra only during seasons of high lemming densities (Demme, 1946b).

In the case of very high breeding density, epizootia can lead to population decline; nestlings are affected first (Bianki, 1984). Eiders wintering in the White Sea suffer in severe winters with unfavourable ice conditions, when benthic molluscs are affected by ice (Karpovich, 1979).

Economic importance and human impact. In Europe the Common Eider is a game bird, but has also been subject to egg and down gathering for several hundreds of years. Eiderdown used to be an important resource being exploited in Novaya Zemlya 50 years ago. Nowadays Common Eiders are under hunting and egging pressure only in the vicinities of human settlements. In the East the Pacific Common Eider is a game bird as well, in spite of the fact that all eiders are protected from hunting in Russia, but egging and down gathering are not as popular as in the West, because of lower nesting density.

Among the factors lowering survival of Common Eider clutches, disturbance is potentially the most important (Koryakin, 1986). The probability of clutch destruction after disturbance depends on date of incubation and female caution. Eider resistance to disturbance is highest in areas were contacts with humans are frequent and neutral. That is also confirmed by the fact that Pacific Common Eiders keep to human settlements to get protection against predators (Portenko, 1972; Stishov *et al.*, 1991). Human disturbance decreases the proportion of broods in the population and increases duckling mortality due to successful gull attacks. The intensive time and energy budget of ducklings determines their high vulnerability for disturbance (Koryakin, 1982, 1983, 1986). Hence, local development of land-based infrastructure can affect Common Eider populations by increasing disturbance. This will be more important for the Common Eiders because of their higher coloniality as compared to other eider species. The increased human population will also lead to increased hunting pressure, and will to some extent lead to growth in the populations of gulls and skuas.

However, the main factor responsible for population stability of Common Eiders, like in other seaducks, is survival of adults (Goudie *et al.*, 1994). As diving ducks spend much time at sea, the eiders are strongly exposed to the risk of contamination, primarily by oil spills occurring at sea and especially in the coastal zone. Mass mortality can be caused not only by major oil spills, but also from minor spills of oil and oil-products in the areas of bird concentration (Joensen, 1972, after Kumari, 1979). In general, birds of the nominate race, being more closely connected with sea, are at greater risk in relation to oil pollution.

Thus, development of shipping along the NSR will hazard the Common Eider to the higher risk of oil pollution and, to a lesser extent, to increased illegal hunting and egging, and disturbance in the breeding colonies due to development of land-based infrastructure.

Conservation. It is included in the Red Data Book of Yakut ASSR. Eiders of the nominate subspecies now get real protection only in Kandalaksha State Reserve, and Pacific Common Eiders in Wrangel Island State Reserve.

5.9 King Eider (Somateria spectabilis L.)

by Diana V. Solovieva

Status. Nesting, migratory species.

General appearance, size. Large seaduck with a compact constitution. Males slightly exceed females in size, although females weigh more when arriving at the breeding areas. Average body length of males is 571 mm (513–589) and of females 545 mm (513–575). Average mass of males arriving at the breeding grounds is 1,864 g (1,340–2,160) and of females 1,916 g (1,350–2,200). The birds lose weight during breeding and can reach the lower limits of 1,300 g in males and 960 g in females.

Sexually dimorphic. The male in a definitive plumage differs from the males of other eider species. It is decorated with a bright-orange fatty crest on the upper mandible. Females have dark-brown motley plumage, and it is distinguished from other eider females by bill feathering patterns.

Distribution: The range is almost circumpolar. It is absent at the east of the Chukchi Peninsula, in Europe westward of Kolguev Island and Kanin Peninsula (except Svalbard) and on a number of islands of the Canadian Archipelago. Over the rest of the territory it nests on tundra as far to the south as the subzone of southern subarctic tundra. Inhabits most of the Arctic archipelagos.

Within the NSR area it breeds along almost all of the coast both on the mainland and on the islands, excluding the territory eastward of Vankarem Lowland.

Three main winter grounds are known. Eiders nesting in W. Siberia and Europe, winter in the White and Barents Seas. Birds nesting in East Siberia (eastward of the Taimyr Lake), in Alaska and in W. Canada, winter in the Bering Sea. The rest of the eiders winter in the North Atlantic.

Seasonal migrations. The King Eider is a typical long-distant migrant. The prevailing migration direction is latitudinal, because flyways connect the arctic breeding grounds with the subarctic and boreal winter grounds.

Pacific King Eiders begin spring migration in early April (Portenko, 1972), and by mid-April they appear on the polynya near the New Siberian Islands. The Atlantic (European) population appears on polynyas near Novaya Zemlya already in March (Demme, 1946a). A part of the population is supposed to winter there (Gorbunov, 1929). There is observation on spring staging on Yamal polynya in April (R. Borisov, pers. comm.). Migration passes over the sea, but some birds of the Pacific population shorten the distance and cross the Chukchi Peninsula. Flight from the sea to tundra starts in late May, almost simultaneously along the whole breeding range. The breeding segment of the population comes first; their flight finishes by 10–15 June. Non-breeding birds appear two weeks later.

Summer migration of males starts in early July. The departure of non-breeding females extends from July to early August. Females with broods leave the breeding grounds in September. The last King Eiders were recorded on the New Siberian Islands as late as October 15 (Rutilevskiy, 1957). Autumn migration goes both along the Arctic coast of the Chukchi Peninsula, passing by lagoons (Tomkovich & Sorokin, 1983) and across the mainland (Konyukhov, unpubl.).

The Atlantic population moves from the breeding grounds much later than the Pacific one. South-westward migration over the sea between Kolguev and Vaigach Islands was observed in the first half of November (Demme, 1946a). Timing and certain route of seasonal migrations in King Eiders strongly depend on the ice conditions that influence food availability and accessibility.

Moult. King Eiders moult twice a year. Flight feather moult takes place after the breeding season. Breeding males and females moult at different times. For the males it is known to occur during July–early August on average, while for the females the timing is not fully known.

Moulting aggregations of males in the NSR area are known in: Baidartskaya and Torasovey Bays (Mineev, 1994), Matochkin Shar Strait (Gorbunov, 1929), waters adjacent to the Stolbovoy Island (Rutilevskiy, 1963) and Kolyuchin Bay (Portenko, 1972). These sites are not used annually, presumably, because of the hydrological conditions.

Failed-breeding females stayed on the breeding places, and started moult of contour plumage on the tundra lakes, gathering in small flocks. The flight feather moult occurs at sea. Successful females moult on the winter quarters.

Population numbers and trend. We estimate the spring abundance of the King Eider within the NSR area at 840,000 individuals including 600,000 of breeding adults and 240,000 of non-breeding females. The most dense nesting populations are known from Novaya Zemlya (the overall number is guestimated at 50,000; Kalyakin, 1993), NE. Taimyr (local density up 138.7 ind./km^2; Yakushin, 1983) and Yamal (local density up 60 pairs/km^2; Pugachuk, 1965).

The recent King Eider population trend seems to be stable (Goudie *et al.*, 1994), but a slight decrease is supposed for the westernmost part of the breeding range, including the Novaya Zemlya Archipelago, Vaigach Islands and Yugor Peninsula (Kalyakin, 1993; Mineev, unpubl. data).

Habitat. Stays at sea during most of the year: males for 11 months a year and breeding females for about 9 months; immature eiders come ashore from time to time. At sea King Eiders occur in open water and on polynyas and leads as well. Before migration King Eiders concentrate in the estuaries and marine shallows. It prefers deeper waters compared to other eider species except for the Spectacled Eider.

While breeding, King Eiders move to freshwater bodies. Various biotopes are used, but lakes are obligatory for nesting habitats. River deltas and terraces are preferred habitats; on watershed nesting density decreases, and it never breeds in mounting tundra.

Breeding. Become mature after third year.

King Eiders spend not more than 100 days at the breeding places, including a 80 days breeding cycle, from beginning of egg laying to fledging.

The groups that arrive to the breeding places in the Lena-Delta are as follows: pairs ready to breed, adult males that already bred eastwards, adult males not attempting to breed, and failed-breeding and immature females (Fig. 5.1). Pairs are formed on the winter grounds or during spring migration. Courtship and copulation take place when at sea, but sometimes on tundra fresh water bodies.

Usually the King Eider nests solitary, but it tends to concentrate under protection of colonies of larger gulls, Sabine's Gull, Brent Goose and Steller's Eider. The only place known to have King Eider loose colony is the Bikada River mouth (Taimyr) (Rogacheva, 1988).

King Eiders start nesting within 10–15 days after arrival. The full clutch consists of 5–6 eggs (3–8). The eggs are of a medium size among other eiders (66.2 x 44.6 mm and 72.9 g on average). During laying, the male guards by the nest, and departs to the sea after the permanent incubation begins. Hence, repeated clutches can be laid if the first was lost before the males left the breeding area. Incubation lasts for 26–28 days. During this period the female practically does not feed.

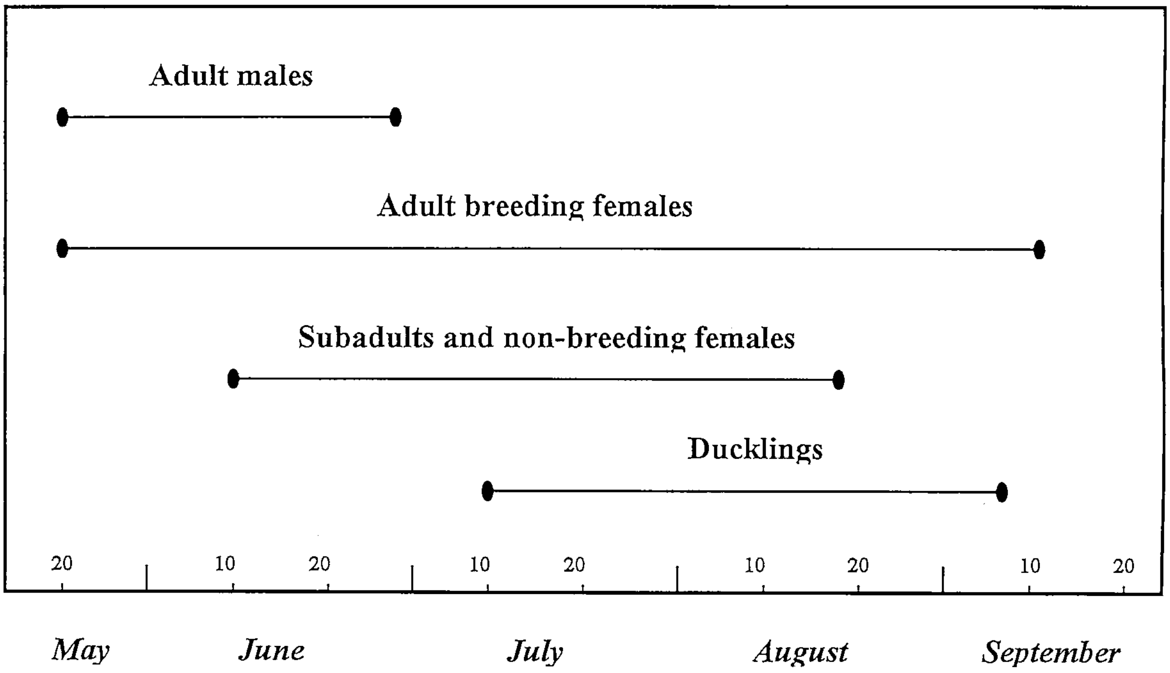


Figure 5.1. Sex-age population structure of the King Eider and its dynamics at the breeding grounds in the Lena Delta

Hatching in early clutches occurs by early July, and a month later in replaced clutches. In one case hatching was recorded as late as in early September (Gorbunov, 1929). Firstly, ducklings are reared on freshwater water bodies. Then, in mid-August they move downstreams to the sea. The King Eider often forms joint and mixed broods. In estuaries such groups enlarge and number as much as 200 birds. Departure goes by small flocks or by separate broods (Rutilevskiy, 1957).

Food habits. Feeds by diving on different benthic invertebrates when at sea. It feeds at the depths of 12–15 m on average, but can be found as deep as 54 m. The diet is more diverse than that of Common Eiders and varies within the range: molluscs prevail in the Bering Sea, while echinoderms dominate in Atlantic waters. Most of the energy needed for reproduction is stored when feeding at sea.

Movement from the sea to the tundra is timed to coincide with the development of open water patches on rivers and streams; in some areas it is determined by snow melting and water appearance on the moss tundra. Here, in spring, King Eiders feed mostly on seeds of the water plants and chironomid larvae. Hatching is timed to coincide with the summer peak of hydrobios production, mostly crustaceans.

Predators and unfavourable factors. It is assumed that most adult King Eider females start to breed annually. Females with broods do not make up more than 22% of the overall number of females in the hatching period, even in successful years. Their relative abundance can be as small as 1.5% in years of low lemming density. Since, like most other seaducks, the King Eider is adapted to high egg and nestling mortality and the main population reserve is adult birds, their numbers should be constant to keep stable species abundance (Goudie *et al.*, 1994).

The main predators on the tundra are Arctic Foxes, Glaucous and Herring Gulls, and Arctic and Pomarine Skuas. Predation by one of these sometimes becomes a factor limiting breeding success, depending on the relative abundance of the listed species in the local area. Thus, in the Lena-Delta most clutches are preyed on by larger gulls, while on Wrangel Island Arctic Fox is most important. Downy ducklings are taken by skuas.

Economic importance and human impact. In spite of the fact that all eiders are protected from hunting, King Eiders are shot actively during spring migration along all migration routes. Autumn hunting takes place on the Chukchi Peninsula only. It is impossible to estimate the overall hunting bag. In the Lena-Delta annual spring harvest is 6.3% of the population abundance, that is corresponding to the critical level of adult removal from seaduck population (Goudie *et al.*, 1995).

As marine diving ducks spend much time at sea, the King Eider is strongly subjected to a risk of contamination, primarily of oil spills occurring at sea and especially in the estuaries and polynyas. The spring staging and moulting period, when flightless birds accumulate in large flocks, is the most vulnerable periods for the species.

While staging on polynyas during spring, King Eiders can be directly disturbed by moving vessels especially in narrow polynyas. This has been recorded in Yamal polynya in April (R. Borisov, pers. comm.).

Local development of land-based infrastructure can lead to degradation of nesting habitats and increasing disturbance. But this will hardly affect the species' abundance, as it is distributed evenly within the range. The increased human population will lead to a higher hunting pressure, and will to some extent also lead to increased populations of gulls and skuas.

Thus, development of shipping along the NSR will hazard the King Eider to an increased risk of oil pollution and, to a lesser extent, to increased illegal hunting and disturbance at the nesting places due to development of land-based infrastructure.

Conservation. The King Eider is protected in the Great Arctic Reserve, Taimyrskiy Reserve, Lena-Delta Reserve, Wrangel Island Reserve, and Vaigachskiy and Chaigurino Federal Refuges. Taking into account the current status of the species, it is not in need of special conservation and management measures. Places of regular moulting accumulations and spring staging should be protected against pollution and disturbance.

5.10 *Spectacled Eider (*Somateria fischeri *(Brandt)).*

by Alexander V. Kondratiev

Status: Nesting migratory species.

General appearance, size: Large-sized seaduck with stout body. Body length 405–450 mm. Average wing length 263 mm in females and 272 mm in males. Average weight 1.4–1.7 kg (seasonal changes see below).

Sexually dimorphic. Males in breeding plumage have white back, similar to Common Eider males. Belly and breast are both black; the black breast distinguishes this species from Common and King Eiders. Females are dark brown with black stripes on feathers composing vertical bars on flanks, resembling females of Common Eiders. In all plumages species-specific eye-patches about 3 cm in diameter are clearly distinct. The patches are white in males and sandy-coloured in females, composed by radially oriented small feathers, bordered with black (males) or dark-brown (females) "spectacles". These eye-patches are clearly seen even in downy ducklings. Bill feather patterns are also species-specific; side and upper "Capes" are joined together and extend far forward beyond nostrils.

Males in breeding plumage in flight show white back, green head, black belly and breast. Females can be distinguished from the greater Common Eider by shorter, more proportional head and lack of long prominent bill. Pale underwings separate this species from the King Eider, which is similar in size and has bright white underwings.

Distribution: The species is distributed along the Siberian Arctic coast from the Lena-Delta eastward to the Bering Strait, along the coasts of Alaska from the Alaska Peninsula northward to Barrow Cape, and inhabits waters of the East-Siberian, Chukchi and Bering Seas. Breeds in coastal tundra of East Siberia and Alaska. In Siberia the breeding range goes from the Lena-Delta eastward to the mouth of the Amguema river. In Alaska Spectacled Eiders breed along the coast between the Kuskokwim River mouth northward to the Collwill River (Dau & Kistchinski, 1977). The main part of the population moves to the Bering Strait area to moult, though many birds remain in the Arctic sea waters nearby breeding grounds. Winter quarters have remained practically unknown until recently, but it was supposed that the main part of the population spends winter on polynyas of the Bering Sea, far from the coasts (Dau & Kistchinski, 1977; M. Petersen, pers. comm.). In all the few cases where wintering birds were recorded this occurred in the Bering Sea area off the Alaska Peninsula, along the Aleutian Chain and the nearby Pribiloff Islands (Dau & Kistchinski, 1977). This has recently been confirmed by observations of wintering flocks of Spectacled Eiders in polynyas of the Bering Sea between St. Lawrence and St. Mathews Island. The total numbers reached 150,000 individuals (Balogh, 1996).

Within the NSR area Spectacled Eiders can be met along the coast and in seas eastward of the Lena-Delta to the Bering Strait. Breeds from the Lena-Delta to the Amguema River. It breeds irregularly at the Lena-Delta, New Siberian Islands, Yana-Delta and east of Pevek. The species is most abundant at the Indigirka-Delta, in the Kolyma-Alazeya area and at the mouth of the Chaun River (Dau & Kistchinski, 1977). Moult partly occurs there. There are numerous moulting aggregations of this species in the easternmost zones of the NSR area, in the Bering Strait waters afar from shores

Seasonal migrations: Mass spring concentrations occur in May in the Northern Bering Strait and in polynyas of the Chukchi Sea. This causes their spring arrival to Y-K Delta breeding grounds to be not from the south, where wintering has taken place, but from the north, where their staging areas are located. On the Siberian nesting grounds Spectacled Eiders appear in late May–early June, depending on the year and latitude. Thus, they arrived at the Indigirka-Delta during the second week of June in 1971 (Kistchinski & Flint, 1979). Eiders arrive along the coast from the east in small flocks, consisting of distinguishable pairs (Dau & Kistchinski, 1977). Migration from the sea is also observed (Beme *et al.*, 1966).

Adult males start leaving their nesting grounds by late June. Pronounced migration going south-east has been observed after July 10 on the East Chukutka (Tomkovich & Sorokin, 1983). Non-breeding females remain on the breeding grounds, moving closer to sea. Breeding females with ducklings leave the area by late August–early September, depending on the place and the phenology of that year.

Moult: Non-breeding females moult mostly nearby the breeding grounds. Moulting areas of breeding females are still unknown. Routes of moulting migrations of males are supposed to pass over the Eastern Siberian and Chukchi Seas afar from coast (Dau & Kistchinski, 1977). Males from the Yukon-Delta migrate for moulting to the Chukchi Peninsula, crossing the Bering Strait in late June (Pearce, pers. comm.). Only a few single birds occurred there in August. Non-breeding females start moulting their contour feather in late June. Wing feathers are moulted in mid-July, at the same time as adult males, but no exact records are known from the literature (Dau & Kistchinski, 1977).

Numbers and population trends: The total world population was estimated at 200,000 birds 20 years ago (Madge & Burn, 1988). The greatest local nesting concentrations were noticed at Y-K Delta (Gabrielson & Lincoln, 1959; Dau & Kistchinski, 1977), and on the North Slope, especially between Whenright and Barrow (Learned & Ballow, 1994). Approximately 50,000 pairs of Spectacled Eiders used to nest at Y-K Delta in the past (Dau & Kistchinski, 1977), but only 1,700 pairs (i.e. 3,400 individuals) were surveyed here in 1992, and studies carried out in 1986–1992 found a constant drop in the population numbers of about 14% a year (Stehn *et al.*, 1993). The size of the North Slope population has recently been estimated at 9,300 birds (Larned, 1994). The most recent data has been obtained at wintering grounds. Near 150,000 individuals have been surveyed on polynyas of the Bering Sea in area between St.-Lawrence and St.-Mathews Islands (Balogh 1996).

Within the NSR area, in the most productive areas of North Siberia, the overall numbers fluctuate between the years. In 1959 Beme *et al.* (1965) estimated the overall size of the Russian population at 17,000 individuals. In 1971 at the Indigirka-Delta the spring number was estimated at 17–18,000 pairs (i.e. 34,000–36,000 birds) by Kistchinski and Flint (1979). The highest density (3.3–6 pairs/km^2) was recorded in coastal areas. In 1993 the overall number of Spectacled Eiders at the Indigirka-Delta was estimated at 19,000 birds with a maximum density of 3 pairs/km^2 (Pearce *et al.* unpubl.), whereas the estimate in 1994 was 46,000 birds with maximum density of 8 pairs/km^2 (Hodges & Eldridge, 1995).

In the Kolyma-Alazeya area Spectacled Eiders are still fairly numerous along the coastline. The maximum numbers are observed at Kolyma-Delta and north-west of it, within a 40 km wide coastal zone between the Chukochya and Alazeya Rivers. The number here have been guestimated at 10–15,000 individuals with an overall density of ca. 2 pairs/km^2 (Andreev, unpubl.) and at 25,000 individuals (Hodges & Eldridge, 1995). At the Chaun Lowland Spectacled Eiders are not as abundant. Their number could be estimated at 1,000 birds (Krechmar *et al.*, 1991; Kondratiev, 1990), and later at 2,000 birds (Hodges & Eldridge, 1995).

According to the data obtained by aerial surveys carried out during the breeding season on the East Siberian tundra covering the whole breeding range of the species, the total abundance is extrapolated to be ca. 120,000 birds (Hodges & Eldridge, 1995 with changes). Adults were most abundant among these birds. Immature females, that are known to visit breeding grounds along with the breeding segment of the population, were counted as well. Besides this, an unknown number of one-year old males remain at sea, and their numbers may be roughly estimated at 15,000 birds according to a 50% survival rate for yearlings of sea-ducks (Goudie *et al.*, 1994) and 20% recruitment rate. Thus, the bulk of the world population inhabits the NSR area.

Habitat: Much of the year is spent at sea. Adult males are connected with terrestrial habitats only one month a year, whereas this is three months a year for breeding females. Sub-adult males are extremely rare on the breeding grounds and remain at sea all year round. The breeding distribution of Spectacled Eiders is more closely connected with coastal parts of big rivers than that of the other eiders. A small proportion breeds at plateaux and watersheds. In big deltas the highest numbers are observed in the coastal zones. The typical habitats are vast lowlands covered by *Arctophila fulva* and various sedges with scattered small islets. In the pre-nesting period Spectacled Eiders are most numerous on lakes with big areas of shallow waters, or flooded with spring-melted water moss turf (Kistchinski & Flint, 1979; Kondratiev & Zadorina, 1992). Nesting habitats include various types of open tundra and very often big and small islands on tundra lakes. After hatching broods start to migrate on small tundra ponds and lakes, where they prey on plankton crustaceans (Kondratiev & Zadorina, 1992). During the moulting period the birds inhabit the littoral and sublittoral zones of the East Siberian Sea, and inshore waters of the Chukchi Sea, where their biology is unknown. Spring staging in April–May also occurs in these areas or in polynyas of the Bering Sea.

Breeding biology: Becomes mature after third year. Pair formation occurs in April–May at wintering quarters and during spring migration. The birds appear in pairs on the nesting grounds. Pre-nesting period is no longer than 5–10 days. Some pairs nest solitary, while the others gather in colonies (up to 100 pairs), attached to gull colonies (mainly Sabine's and Herring Gulls) (Kistchinski & Flint, 1979; Kondratiev & Zadorina, 1992). The breeding part of the spring population is about 10–20% of the total spring number. Breeding females usually weigh 1,700–1,800 g by late June and show no signs of moulting. Females missing breeding have weight about 1,400–1,500 g by late June and usually start moulting of contour feathers (Kistchinski & Flint, 1979). This may mean that nesting may be afforded only if a female has enough fat reserves; if the fat reserves are not sufficient they start moulting earlier instead of making breeding effort.

Complete clutches contain 2–6 eggs (4.6 on average). Average egg size is 67.4 x 45.4 mm (Kistchinski & Flint, 1979; Krechmar *et al.*, 1991; Kondratiev & Zadorina, 1992). Nests are located close to water (2 meters on average). Males usually guard by the nest during the first half of the incubation period. This allows a second clutch to be laid if the first is lost at an early stage.

Incubation lasts 23–25 days. The incubation constancy is high and females leave their nests typically once a day for 30–40 minutes. They lose about 30% of their initial weight by the time of hatching. Non-breeding females (subadults, failed-breeders and birds missing breeding) gather into flocks numbering 5–30 birds and stay within the nesting habitats. They often occupy the same islands where nests are situated. If the latter are destroyed, non-breeders also abandon the area, and they might therefore be used as indicators of nesting females (Kistchinski & Flint, 1979).

Hatching occurs in mid-July at Chaun Bay (Kondratiev & Zadorina, 1992). After 1–2 days females lead their broods to the nearest lake or pond, and after some days they move further, thus changing lakes several times on their way until they will stop on a favourable one rich in food for ducklings. Joint broods and creches are sometime observed. Juveniles grow faster than those of Common Eiders and take on wings at the age of 55 days, i.e. in the first two weeks of September.

Food habits: In the pre-nesting and the first part of the nesting period the eiders feed mostly in shallows by up-ending and head-submerging, taking chironomids and trichoptera larvae from the bottom of shallow lakes, and tipulid larvae and other moss invertebrates washed out by melt water adjacent to moss areas. This picture is typical until late June, when the mass emergence of insect imagoes occurs. After this various plankton and benthic crustaceans become their main food. Among the latter species of Phyllopoda, Anostraca and Conchostraca are of great importance. At Chaun Bay a close connection between the presence of *Cyzicus* (Conchostraca) and Spectacled Eider broods on the lakes has been revealed (Kondratiev & Zadorina, 1992). Juveniles are able to dive from their first days of life, but they also prefer to feed on shallows. In the marine period of life their feeding behaviour is unstudied. It might be assumed, according to their distribution patterns, that they can either dive to the bottom for different benthic invertebrates such as molluscs or feed on plankton crustaceans among pack ice (Cochrane, 1992).

Predators and unfavourable factors: Nesting success varies to a great extent from year to year and it is not uncommon that total breeding failure occurs (Kistchinski & Flint, 1979; Kondratiev & Zadorina, 1992). Mostly this is caused by unfavourable weather conditions coinciding with low lemming densities and high predation pressure. The same has been noticed also in Alaska, where breeding success varies from 0 to 80% (60% on average; Dau, 1974). When the eiders breed in colonies a high number of nests every year suffer from gull predation. This causes loss of a large proportion of the clutches, but in some favourable years, when other food sources for gulls are abundant, many eider nests survive, especially those located within a protected area around gull nests.

Economic importance and human impact: The Spectacled Eider, along with the other eider species, has been a traditional hunting object of natives in Chukotka and Alaska, though to a smaller extent than Common and King Eiders, because of the weak connection with coasts. In Chukchi and Eskimo native cultures the peculiar head skins of Spectacled Eider males were used for clothing even at the beginning of the 20th century (Portenko, 1972). Nowadays, the hunting ban for all eiders protects them from hunting in Russia. The modern legislation allows subsistence hunting on all animal species (aside of those registered in the Red Data Book) by native people living their traditional way of life. The species have no practical importance for down collection. This both because there is no tradition for this activity, and because the species nest in very remote and inaccessible habitats. The colony size and amount of down are also small for down collection to be practical.

The limited range of the species and the habit of concentrating during moulting and wintering periods make the species very vulnerable. Among the main negative factors responsible for a sharp decline in numbers degradation of their marine habitat as a cumulative result of oil pollution of the Bering Sea by ships and oil explorations might be considered first. The negative consequences of development of shipping along the NSR area may become critical for Spectacled Eiders because they could add to factors of similar origin that are already working.

Conservation: Sharply declining. Listed as an Endangered Species by the Federal Register, US. Recommended to be included into the second edition of the Red Data Book of the Russian Federation by Commission for rare and endangered animal, plant and mushroom species of the Russian Ministry of Nature Protection. Protected on the territories in Lena-Delta State Reserve and Chaigurino State Refuge in Yakutia. No specific protection exists in marine biotopes, which are crucial and seem to be responsible for the population decline.

5.11 Steller's Eider (Polysticta stelleri *Pall.).*

by Diana V. Solovieva

Status: Nesting migratory species.

General appearance, size. The smallest of eiders, with average body length of 462 mm (423–514) in males and 458 mm (427–507) in females. Average mass of males arriving at the breeding grounds is 768 g (623–882) and that of females 836 g (651–999).

Sexually dimorphic. A male in definitive plumage has a typical dominance of the black-white colouring of the body and differs well from the males of other eider species. The female is dark-brown and differs from other eider females by the presence of a purplish speculum contoured from above and below by white lines.

Distribution: Two separate geographical populations exist differing in the winter and breeding grounds. These are the Atlantic and the Pacific populations. The Atlantic population breeds on the tundra from the central Taimyr Peninsula to the Varanger Fjord. Its winter range is distributed over the sea areas of the Atlantic Ocean with the most important area extending from Varanger Fjord to the ice edge of the Kola Peninsula (Nygård *et al.*, 1995). The Pacific population inhabits the maritime tundra of Northeast Asia and sporadically breeds in W. Alaska. The deltas of the Olenek, Lena and Indigirka Rivers, as well as the New-Siberian Islands are apparently optimal, respectively annually inhabited, areas for the species. The main winter quarters of the Pacific population are located in the eastern Bering Sea off SW. Alaska. An insignificant portion winters near the Far Eastern shores (Podkovyrkin, 1951).

Seasonal migrations. Steller's Eider is a typical long-distant migrant, although the birds practically do not leave the Arctic and sub-Arctic zones during the annual cycle.

Pacific Steller's Eiders begin spring migration from the winter grounds in the Bering Sea in April (part of the yearlings remains within the winter range). A minimum number of the Steller's Eider remains in the winter lagoons by mid-May (Podkovyrkin, 1951; Petersen, 1980). According to band recoveries, migration seems to go on a wide front from the Bering Sea through the inland parts of Chukotka, Magadan Region and Yakutia. The birds pass over the Bering Strait in mid-May–20 June depending on the conditions in the specific year. Mass migration takes not more than 5–7 days (Tomkovich & Sorokin, 1983; Konyukhov, unpubl.). The dates the first birds appear on the East Siberian coast are as follows: Chaun Bay, 31 May; lower reaches of the Kolyma River, 1 June; New-Siberian Islands, 7 June; Lena-Delta, 10 June; and Khatanga Bay, 18 June. The flyway of spring migration for the Atlantic population has not been described yet. Birds arrive on the tundra by mid-June, and the mean dates of mass arrival to the New-Siberian Islands is 17 June (1902, 1939–40 and 1948–49; Birulya 1907; Rutilevskiy 1957) and 15 June to the Sagastyr Island (Lena-Delta) (1987–89 and 1993, own data). The first birds usually appear 2–7 days before mass migration occurs. Intensive migration takes 1–2 days. The summer migration of the non-breeding group begins already in mid-June. There is no well-defined geographical direction, but the birds are always observed flying from the mainland to the sea. Males that finished breeding (with a part of the failed-breeding females) fly to the sea during early July–mid-July. On the moulting grounds near the Chukchi Sea coast males appear already in mid-July while reaching the lagoons of SW. Alaska by early August only. Autumn migration of broods is rarely observed. Brood rearing females leave breeding grounds by late August; the last birds can stay as late as mid-September. Autumn migration of all sex and age groups passes over the sea.

Moult. Moult of minor body feather in males and down in non-breeding females begins already on the tundra. A vast majority of the eiders moult at the wintering grounds in the lagoons, but a part of the population stays for moult in the coastal waters adjacent to the breeding grounds. Moulting aggregations of the Steller's Eider has been recorded near the SW. Stolbovoy Island (Rutilevskiy, 1963). The flightless period stretches from late August till early October.

Population numbers and trend. According to winter counts the total number of Steller's Eiders declined tenfold from about 1 million at the beginning of this century to 100,000–150,000 individuals in the 1990s (Tugarinov, 1941; Fish and Wildlife Research Service unpubl. data; Dau, pers. comm.; Nygard *et al.*, 1995). The largest decrease in numbers is recorded at the winter grounds near the Far Eastern shore of Russia. The Alaskan winter population, being the largest in the world, also continues to decline. At the same time the Atlantic winter population demonstrates an increasing trend (Nygard *et al.*, 1995). An increase in numbers is also documented for the western breeding population (Tugarinov, 1941; Yessou & Lappo, 1992; Chernichko *et al.*, 1994; Mork *et al.*, 1994; Chupin, pers. comm.). The bulk of the world population breeds within the NSR area.

Habitat. The Steller's Eider nests on the Arctic and sub-Arctic tundra along the sea. Sometimes the nests can be as far as 130 km from the coast. In the Lena-Delta the optimal nesting biotopes are polygonal moss-lichen tundra with abundant ponds. To gain protection nests are attached to nesting areas of Pomarine Skuas. Outside the breeding season the birds stay in sea shallows less than 10 m in depth. During the spring migration eiders stay on melt water bodies in tundra and forest-tundra zones.

Breeding. The stay of the Steller's Eider at breeding places is limited to a 70 day period. During this time the sex-age population structure changes (Fig. 5.2). The birds become mature after the third year. In the spring migration to the breeding grounds both adults and immature birds are involved (Rutilevskiy, 1957). Only the breeding cohort (sex ratio is 1:1) arrives at the breeding places in the Lena-Delta. Most males depart the area after 12–20 days, when incubation begins. Part of the failed-breeding females joins the males. The females that have lost the clutches after the males left stay at the breeding grounds. They form flocks of up to 20 individuals and move over the tundra lakes (males do not exceed 14% in such flocks). After the broods appear, these females join them. Steller's Eider is known to nest solitary (Rutilevskiy, 1957; Cramp, 1977). However, under optimal conditions (the Lena-Delta) it is found to nest in loose colonies.

Steller's Eiders occupy the nest sites during 1–5 days after arrival. Egg laying begins on 18–23 June. The eggs of the Steller's Eider are smaller in size as compared to other eiders, with mean dimensions 60.1 x 41.3 mm. Clutches consist of 6 (5–8) eggs on average. Incubation lasts for 26–27 days. The brood leaves the nest the day after hatching. The first broods appear during the first two ten-days of July (on 4–5 July 1981 on the Wrangel Island (Dorogoy, 1984); and on 20 July 1993 and 1949 in the Lena-Delta and on the New-Siberian Islands (Solovieva, unpubl., Rutilevskiy, 1957)). Unlike eiders of the genus *Somateria* the Steller's Eider does not form joint broods. More often the brood is accompanied by two–three non-breeding females.

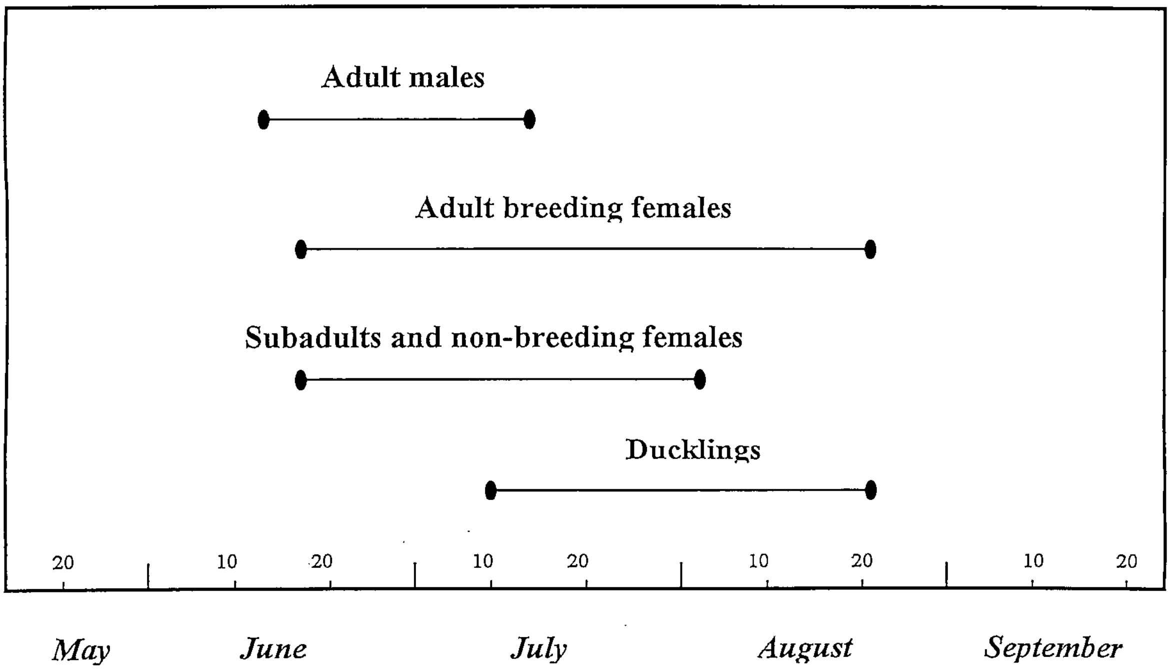


Figure 5.2. Sex-age population of the Steller's Eider and its dynamics at the breeding grounds in the Lena-Delta.

Food habits. At sea the littoral zone is the chief food biotope where eiders feed either by diving to a depth of 6 m or by dabbling. The diet at sea is mainly based on molluscs, crustaceans and polychaetes (Portenko, 1972; Petersen, 1981; Bianki, 1993). On the tundra fresh water bodies eiders prey on larvae of Chironomidae and Plecoptera (Chernov, 1967), and later in July on crustaceans, mainly Isopoda. When the season progresses the available feeding places are reduced due to dry-up of ponds. However, this limited resource is used by incubating females and flightless ducklings only, whereas non-breeding females perform daily foraging flights to the sea.

Predators, unfavourable factors. Similar to other seaducks, the Steller's Eider follows the K-selected life-history strategy. The species following this type of strategy are more sensitive to elimination of adult individuals than of juveniles (Goudie *et al.*, 1994).

On tundra the predators include Arctic Foxes, Glaucous and Herring Gulls, and Arctic and Pomarine Skuas. During the egg-laying as much as 15% of eggs are taken by predators. The Steller's Eider can have complete breeding failure in seasons of low lemming densities. Successful reproduction is achieved under the protection of breeding Pomarine Skuas when at peak of lemming cycle.

Economic importance and human impact. It has no significant economic importance. In some of the settlements along the Siberian coast both meat and fresh eggs of the Steller's Eider are used for food. Hunting takes place during the spring migration. The harvest of eiders during the spring hunting season continually exceeds a maximum permissible level (estimated on the basis of life strategy of the species at 5–10% of adults). The largest hunting bag is known for Chukotka where the flyway passes near the settlements.

As it spends much time at sea, the Steller's Eider is strongly subjected to a risk of contamination, primarily by oil spills.

Larger gulls are attracted by anthropogenic food sources such as offal and edible waste. This may lead to increased populations of these species and increased predation on eiders. Scaring of females from the nests during human visits at the nesting sites leaves the eggs unattended and increases predation risk.

Thus, the development of shipping along the NSR will hazard the Steller's Eider to an increased risk of oil pollution and, to a lesser extent, to increased illegal hunting and disturbance at the nesting places due to the development of land-based infrastructure.

Conservation. In 1994 it was proposed to include the population of the Steller's Eider nesting in Alaska into the List of endangered species of the USA (The Endangered Species Act of 1973). It is included in the Red Data Book of the Yakut ASSR as a declining species with a declining range (Solomonov, 1987) and proposed to be included in the Red Data Book of Russia (Solovieva, in press). The main known breeding places of the species are protected by the Lena-Delta State Reserve. The Great Arctic and Taimyrskiy Reserves also cover parts of the breeding range.

5.12 DUCK AGGREGATIONS

5.12.1 Introduction

by Maria V. Gavrilo

The group under consideration includes ducks inhabiting the maritime and littoral biotopes: lacustrine coastal depressions, brackish marshes, beaches, lagoons and coastal shallows along the NSR area. Most widespread are the eiders with nesting ranges located only within the tundra zone along the NSR area. The breeding ranges of the Northern Pintail, the Greater Scaup and the Long-tailed Duck reach the Arctic coast in some places only. The other mentioned ducks are largely observed on the maritime tundra and in the coastal water areas during migration, moult or staging. The species most related to the sea during the entire annual cycle (eiders and Long-tailed Duck) are described separately (see above), hence they are mentioned here only when forming aggregations.

Summer migrations connected with the departure for moult, play an important role in the life cycle of the ducks, as well as in all wildfowl. Soon after the arrival the non-breeding segment of the population begins flocking and flights to the moulting grounds. They are joined by males when egg laying has completed. Dabbling ducks that nest earlier than the diving ducks are the first to start migration (in some regions already in mid-June). The summer migration of seaducks occurs during the last ten-days of June to the first half of July depending on the region and conditions in the specific season. A part of the migrating birds only shifts from the nesting biotopes to the other biotopes, but within the breeding range (for example, Northern Pintails, Greater Scaups and Long-tailed Ducks move from the shallow nesting lakes to larger lakes of the maritime tundra). However, the tundra species are especially characterised by summer migrations in the northern direction. The spatial separation between breeding and moulting or staging grounds is most distinctive in the Northern Pintails, Mergansers and the Long-tailed Ducks. The farther north, the more species, whose summer migrations are directed seaward. The marine pagophilous species are assumed to reach the drifting ice edge during the summer migrations. Summer migrations are usually more pronounced than other seasonal movements. The most intensive summer migration is observed in Common and Velvet Scoters, as well as eiders. The mass moulting aggregations over the coastal waters within the NSR area are reliably known only for Long-tailed Ducks, King Eiders, Pacific Common Eiders and at the westernmost territory for Mergansers. The majority of scoters, Steller's Eiders and, probably, Spectacled Eiders departs for moult towards the wintering grounds, and only an insignificant part of the populations moult within the territory under consideration. Dabbling ducks and, partly, Long-tailed Ducks and Greater Scaups moult on tundra lakes and channels of the lower deltas. Successful females seem to moult at the wintering grounds, but see article on the *Long-tailed Duck*.

The autumn migration of ducks that is not related to the coast occurs gradually; ducks move over tundra, flocking at lakes and channels and disappear unnoticed. As the coastal waters of much of the NSR area are ice-free in late summer, diving ducks that are related to the sea while migrating, can form large aggregations inshore before departure. The largest ones are reliably known for the easternmost zone of the NSR area.

Concerning the state of knowledge on the biology of seaducks, it should be mentioned that the non-breeding period of their life is poorly studied. There are very few data on abundance and population dynamics of ducks at places of mass aggregations. Data on geographical distribution and habitat use as well as on feeding patterns when at sea, are completely absent. All data on the phenology of seasonal movements refer to the terrestrial residence of seaducks because only land-based observations have mostly been carried out.

5.12.2 Vaigach Island

by Yuriy N. Mineev

Vaigach Island with the adjacent water areas and small islands is a region of mass nesting, moulting and staging during seasonal migrations of the majority of the wildfowls inhabiting the region under description. Nine species of ducks are found here, six of them are nesting. The Long-tailed Duck and the Common and King Eiders are the most common breeders, the Common and Velvet Scoters are the most numerous migrating species, whereas mergansers occur in considerable numbers during moulting.

Goosanders and the Red-breasted Mergansers are observed along the entire coast of Vaigach Island, mainly in sheltered inlets, as well as off the majority of the coastal islands. Mass migration of these ducks is from the Urals, part of birds passes Yugor Shar Strait in transit. Mergansers arrive to the moulting grounds near the coast of Vaigach Island by mid-July, and fly away by mid-September–early October. The total numbers of these birds are guestimated at ca. 3–5,000 individuals.

Scoters do not stay long nearby Vaigach and are observed in considerable numbers only when migrating. The Velvet Scoters in flocks of 20–60, sometimes up to 150 individuals fly westward passing Yugor Shar Strait during the first half of July (Uspenskiy, 1965; Karpovich & Kokhanov, 1967). Migration finishes by late July. A mass migration of male ducks in flocks up to 200 individuals in the northern direction has been observed near the Bolvanskiy Nos Cape in late July (Nazarov, pers. comm. in Mineev, 1994).

The mass migration of the Common Scoter (mainly males) is observed across Yugor Shar Strait during the last 10-days of June and first 10-days of July. The flocks number from several individuals to 400 birds. Migration finishes by mid-July (Uspenskiy, 1965; Karpovich & Kokhanov, 1967). The total numbers of birds passing the area are estimated at tens of thousands. Greater Scaups, Long-tailed Ducks and mergansers pass by Vaigach in smaller numbers.

Data on habitat use and population numbers when at autumn staging are absent for the area under consideration.

The relief of Vaigach Island is largely gentle-ridgy, the largest plain zones are located in the central and southern parts. The island is abundant in rivers and streams and has more than 4,000 lakes. The character of the shores is different, about 2/3 of the coastline is represented by sand or pebble beaches and laidas. The western, Barents seaside, of the island, as well as of Kara Gate and Yugor Shar Straits is more rugged. This provides many species of waterfowl with good biotope protection and food resources when nesting and moulting.

The most important moulting and staging grounds for seaducks in the Vaigach area are as follows:

- coastal waters and skerries in the Kara Gate Strait;
- Lyamchin Bay; and
- coastal shallows of the Yugor Shar Strait.

The period from mid-July to the end of August is the time of the most intense use of these areas by ducks.

Vaigach Island is located in one of the areas most heavily used by shipping in the Russian Arctic; the Kara Gate and Yugor Shar Straits are the westernmost boundary of the NSR and the zone of shipping routes overlaps during actually all-year-round navigation. This strongly enhances the risk of contamination of the area by oil products and other pollutants. Many regions are accessible for visits onboard small vessels which contribute to illegal hunting and disturbance. However, at present the level of human impact is relatively low. There is the Federal Refuge 'Vaigachskiy' at the territory of the island.

5.12.3 Yugor Peninsula

by Yuriy N. Mineev

On the Yugor Peninsula, in addition to the duck species reported for Vaigach, the Northern Pintail also nests. The Common Teal, the Wigeon, the Common Scoter, the Red-breasted Merganser and the Goosander can be found at the territory almost during the entire ice-free period. The Long-tailed Duck dominates among ducks (50% of the population), the King Eider is abundant (more than 22%) and in some years the Northern Pintail (about 13%) and the Greater Scaup (7%) are relatively abundant. The other species in decreasing order are as follows: Common Teal, mergansers, Velvet Scoter, Common Scoter and Wigeon. The total numbers of ducks for the peninsula are estimated at 130–200,000 individuals.

The Northern Pintail is distributed everywhere, but it nests only in the central elevated zones of the peninsula. Summer migrations begin already 10–15 days after the arrival at the tundra, i.e. from mid-June. The most distinctive migration is observed in the region of the Kara Bay. The flocks mainly fly from the east, from West Siberia. The first males appear on the Kara Sea coast in mid-June. The most intense migration in flocks of 10–60 ducks is observed in the last 10-days of June. There are no records of large concentrations at the territory of the Yugor peninsula, probably most birds fly to the Bol'shezemel'skaya and other north-western tundra areas. Moulting flocks of up to 20–30 individuals are observed at maritime meadows with small fringed lakes and along the coast. In August, flocks of up to 300 individuals make foraging flights over the tundra and disappear by the end of the month. Only small groups and single ducks remain.

The Greater Scaup is common on the peninsula. While feeding during July–August ducks make extensive use of the tundra water bodies and the littoral zone as well. In September they are common at the river mouths and lower reaches and at sea. The departure of the non-breeding part of the population and the birds that have finished breeding, begins by late June, it is especially well pronounced from very late June to early July. Single birds, pairs and small flocks of males up to 25 individuals move to sea.

Mergansers are not numerous, the majority of the birds pass by the peninsula without staying. The Red-breasted Merganser is rare for the territory; moulting birds in groups of up to three individuals are observed in different freshwater bodies and at sea. Migration of Goosanders, mainly of males, is observed along the coast. A distinctive migration across the Kara Bay from the Urals is recorded during the last 10-days of June to the very beginning of July. The intensity of the migration varies between years. Moulting concentrations are not known on the peninsula. Ducks moult mainly as single birds; groups of up to 20–30 individuals are observed only at sea near the western coast of the Peninsula between the Lymbada-Yakha and Korotaikha Rivers.

The beginning of summer migrations of the Common Scoter in tundra is not cleared up yet. Single flocks are observed in mid-July. In the first half of July migration is observed in the region of Amderma (Karpovich & Kokhanov, 1967). Vast flocks of the Common Scoter are known to occur in Baidaratskaya Bay and Torasavey Bay in late July. Mass migration of the Velvet Scoter passes over the sea, flights for moult are not observed in tundra.

No active movements of ducks occur in August. Autumn migration starts in September. During September–October most of the diving ducks (Long-tailed Duck, King Eider and mergansers) accumulate at the sea shallows. Flocks exceeding 100 individuals are recorded only for the King Eider; most Long-tailed Ducks gather in flocks of up to 10–20 individuals, and the flocks of mergansers do not exceed 5–10 birds. The autumn departure occurs gradually, and new birds from the east replace the birds that have left the territory.

The most important moulting and staging grounds for seaducks at Yugor Peninsula are as follows:

- Coastal lowlands with bogs and halophilous meadows
  - including interfluves of the Tabyu-Sopchayu-Kara Rivers (moulting grounds of the Northern Pintail, King Eider and Greater Scaup),
  - interfluves of the Lymbada-Yakha - Sed-Yakha and Belkovskaya - Vasyakha Rivers (moulting grounds of the Northern Pintail and the Greater Scaup).
- Coastal shallows and sheltered bays

- Belkovskiy Bay (moulting grounds of the Long-tailed Duck and mergansers).
- Baidaratskaya Bay, Torasavey and Belkovskiy Bays (staging grounds of seaducks).

Although the total numbers of waterfowl including ducks, are relatively small on the Yugor Peninsula, it is one of the important regions of reproduction of waterfowl in the European North-East of Russia. However, the area both of the Yugor Peninsula and Vaigach Island are more important as a part of the migration route of the seaducks departing for moulting and wintering from the western region of Siberia.

5.12.4 Novaya Zemlya

by Maria V. Gavrilo

The only evidence of duck concentrations along the eastern coast of the Novaya Zemlya Archipelago was obtained several decades ago. Flocks of the Long-tailed Ducks including moulting males have been observed in Blagopoluchiya, Neupokoeva and Sedova Bays (Gorbunov *et al.*, 1929), and nearby Zhelaniya Cape (Antipin, 1938). A few Red-breasted Mergansers were also observed in the north-easternmost Novaya Zemlya (Antipin, 1938). Taking into account the vast area rich in sheltered bays and remote from industrial activity, one can expect the inshore zone to be important as habitat for non-breeding pagophilous seaducks either while moulting or fattening.

5.12.5 Yamal and Gydan

by Irina V. Pokrovskaya

At Yamal and Gydan there are recorded 21 and 20 duck species and nesting is proved for 16 and 8 species, respectively. The most abundant ducks are the Long-tailed Duck and the King Eider, that are tied up with the maritime tundra. In the coastal band of herbaceous lowland swampy tundra of Yamal their share comprises about 40% of the total population of waterfowl with total density of 120 individuals/km^2 of the water bodies (Pugachuk, 1965). In the sub-zone of arctic tundra the Long-tailed Duck comprises 85% of the total duck population (Bakhmutov *et al.*, 1985). Everywhere, except for the arctic tundra on Yamal, the Northern Pintail is also numerous. On Gydan it nests on the southern tundra (Rutilevskiy, 1977) and is sporadically distributed as nesting northward (Chernichko *et al.*, 1994) at least up to 72°N (Zhukov, 1995). The Steller's Eider is a rare and sporadically nesting species on the coast everywhere in the area. The Common Eider is recorded as a vagrant only. The nesting grounds of the Common Teal, the Wigeon, the Northern Shoveler, the Tufted Duck, the Common Goldeneye, the Smew and of the more rare Common and Velvet Scoters are confined to southern Yamal. The Tufted Duck and the Common Scoter are found to nest on Gydan to the north up to 69°N (Zhukov, 1995). Nesting of the Greater Scaup is only supposed to occur, although it is regularly observed all over the peninsula (Naumov, 1931). The status of the Black Scoter is also unclear although it is frequently observed up to the mouth of the Yuribey River in the north. The northernmost known record of the Smew was obtained on Gydan, in the Yuribey River mouth, in 1989 (71°N) (Zhukov, 1995).

The major moulting grounds and places of mass concentration before autumn departure of the dabbling ducks are confined to the flood-plain and the Ob-Delta, while seaducks including the Long-tailed Duck and the King Eider as well as the Northern Pintail are centred along the coast of the territory under description. The total duck stock both on Gydan and Yamal fluctuates significantly between years. In 1977 V.G. Krivenko with co-authors (1980) counted 250,000 dabbling ducks and 450,000 diving ducks on Gydan (without the northern region), while in 1978 these figures were equal to 60,000 and 350,000, respectively. As is seen, the most significant variations are found in dabbling ducks which is attributed to their redistribution within the northern region of West Siberia during moulting depending on the flood level in the flood-plain of the Ob. Thus, large moulting accumulations of the Northern Pintail were observed in the southern tundra of the Yamal and Taz Peninsulas in 1977 (low flood) and were not recorded in 1978 under condition of mean water level of the Ob' flood-plain (Krivenko *et al.*, 1980).

The Northern Pintail is the first among the ducks (along with the Common Teal) to begin summer migration (already in mid-June). An insignificant number of males remain for moulting near the nesting grounds. Most of the Northern Pintails moult in the lower zones of the flood-plains of rivers at south-western Yamal forming concentrations numbering hundreds of birds (Molochaev, pers. comm.). North of the lower reaches of Yuribey (Yamal) the moulting grounds are not recorded. Considerable migrations of the Northern Pintail for moulting to the more northern regions are characteristic of the years with a low flood in the flood-plain of the Ob. When moult is over, the Northern Pintails move in large numbers to the north of Yamal, being observed mainly in the maritime regions and in the near-mouth areas of rivers (Danilov *et al.*, 1984). Flocks of birds up to 200 individuals are observed off the north-eastern tip of the peninsula. At the eastern coast main accumulations of as many as 2,000 individuals are observed along the shore of the Ob Bay a little to the south of the Drovyanoy Cape (Sosin *et al.*, 1985). In some years the Common Goldeneye can arrive to southern Yamal for moulting (Kucheruk, 1948).

Flocks of male Long-tailed Ducks appear all over the peninsula from the second half of July. At the same time the northward migration in flocks as much as of several hundreds is observed, being most pronounced along the coastal polynyas. The coast of the peninsula within the subzone of the arctic tundra serves as an important region for moulting of the Long-tailed Duck, predominantly of males and not only of the Yamal population. At the western coast from the Kharasavey Cape to the Skuratov Cape flocks of hundreds of moulting Long-tailed Ducks are centred during July at the near-mouth shoal areas of all relatively large rivers. The largest accumulations are observed in the Laindte-Yakha mouth (about 1,000 individuals) and in the Malygin Strait in the Yakhady-Yakha River mouth (more than 2,000 individuals). Moulting Long-tailed Ducks are regularly observed but do not form large accumulations anywhere along the eastern coast of the peninsula (Sosin *et al.*, 1985), although a vast number of these ducks were centred off the coast of the Ob Bay in the 1960s (V.S. Smirnov, pers. comm., Danilov *et al.*, 1984). The females mainly moult at Southern and Middle Yamal, gathering in flocks of up to several tens of individuals. In spite of high nesting density, the King Eider does not form large moulting accumulations anywhere on Yamal, unlike the Long-tailed Duck. The migration routes of males for moulting are not restricted to the given region, continuing farther west to the Barents Sea (Ryabitsev & Alekseyeva, 1995). A number of males are likely to moult along the coast of Novaya Zemlya where large accumulations were observed in July–August 1992 (Pokrovskaya & Tertikski, unpubl.). On Gydan most mass accumulations, consisting of flocks of thousands of birds both of Long-tailed Ducks and King Eiders, are known in the mouth of the Yessya-Yakha River (Uspenskiy & Kistchinski, 1972b) and around the Oleniy Island (Chernichko *et al.*, 1994).

The shore of the Baidaratskaya Bay seems to be quite an important moulting ground for ducks of southern Yamal as well. Moulting accumulations numbering hundreds of individuals of the Northern Pintail and tens of individuals of the Velvet and Common Scoters are recorded here (Kalyakin, 1986; Pokrovskaya & Tertikski, unpubl.).

Thus the coastal regions of the northern zones of Yamal and Gydan are found to be key areas for maintaining the non-breeding populations of dabbling and seaducks (such as Long-tailed Duck, King Eider and Northern Pintail). The most important areas are:

- Northern coast of Yamal and Malygin Strait, river estuaries and deltas in particular (moulting grounds of the Long-tailed Duck, fattening of the Northern Pintail).
- Western coast of Yamal from the Kharasavey Cape to the Skuratov Cape (moulting grounds of Long-tailed Ducks).
- Baidaratskaya Bay (moulting and staging area of different seaducks).
- Yessya-Yakha River and Oleniy Island (moulting grounds of Long-tailed Ducks).

The current human impact on the Yamal Peninsula is rather big. One of the largest gas-condensate fields known for the continent, is located here. The Ob Bay is already at the current anthropogenic load one of the most heavily used regions along the NSR. Polar stations and seasonal hunting and fishing bases are scattered along the coast. In spite of this, unlike the goose population, the total duck stock both of moulting and breeding birds, fluctuating significantly, does not demonstrate a distinct decline during the last decades. The data from aerial surveys carried out in 1968–1969 and 1977–1978 (Krivenko *et al.*, 1980) support this. The total numbers of ducks on Yamal and Gydan were estimated at 1 million individuals at the end of the 1960s (Uspenskiy & Kistchinski, 1972b), 0.4 and 1.2 millions of ducks were counted only on Yamal (without its northern zone) in 1977 and 1978, respectively (Krivenko *et al.*, 1980). However, N.N. Danilov with co-authors (1984) reported a decrease in the number of the dominating moulting species, the Long-tailed Duck, on the moulting grounds in the north of the peninsula in the 1980s, as compared with the 1960s.

In general, in spite of the intensive industrial exploration of Yamal, its shores still remain quite important for ducks primarily as a habitat of a significant part of the population during moulting (mainly the Long-tailed Duck) and fattening (the Northern Pintail). The coastal tundra is also important nesting grounds, first of all for the King Eider and the Long-tailed Duck. This spatial distribution of the populations of the dominating duck species leads to high vulnerability regarding pollution of the coastal areas and the coastline by oil products. The moulting accumulations of the Long-tailed Duck in the second half of the summer are exposed to the greatest risk. Most vulnerable is the northern coast of Yamal and especially the mouths of the rivers in Malygin Strait. At present it is planned to establish the Yamal state reserve which will include these territories and a band of the seaside coastal area.

The Gydan Peninsula plays an important role as nesting and moulting grounds for maintaining the populations of sea ducks and also serves as reserve moulting grounds for a significant number of dabbling ducks, which usually accumulate for moulting in the more southern regions. However, it should be stressed that the bird fauna of Gydan is poorly investigated and that key areas for waterfowl populations are expected to be found here taking into account the large areas of suitable habitats there. At present, the territory of the Gydan Peninsula, unlike Yamal, is rather poorly explored, only a number of small settlements are scattered along the coast (including polar stations, and hunting and fishing bases), thus increasing the importance of Gydan as a refuge. However, the network of existing protected territories does not include the peninsula. All these features should be taken into account when planning the development of infrastructure and the use of the Northern Sea Route.

Experience gained during exploration of the gas-condensate fields of Yamal has confirmed that the ducks are not as vulnerable to disturbance as the geese. However, this group is highly vulnerable for spreading of illegal hunting. With the development of the NSR and land-based infrastructure in particular, this factor should be taken into consideration to provide strict control of the timing and harvest of sport and commercial hunting.

5.12.6 Taimyr

by Elena Lappo

Twelve duck species are recorded on Taimyr, but only eiders nest on the Arctic coast. The Long-tailed Duck being a very numerous nesting duck on the typical tundra, does not nest in the maritime arctic tundra (Vronskiy, 1986), but the non-breeders are observed in significant numbers there. The most widespread duck species is the King Eider, of which the maximum nesting density is recorded on Eastern Taimyr, as well as in the mouth of the Pyasina and Nizhnaya Taimyra Rivers on the western coast.

The Northern Pintail is the only dabbling duck regularly observed on the Arctic coast as nomadic before autumn departure (in August). Tundra water bodies along the shores of the Yenisey Bay and the north-western Taimyr, and lakes densely fringed by *Arctophila fulva* in the lower reaches of the Pyasina River are known to be regularly used. Flocks up to 5–16 birds have been observed up to September 1 on small water bodies in the lowlands nearby Dikson (Tomkovich & Vronsky, 1988). The species was observed in small numbers (flocks of maximum 20 birds) in the mouth of the Uboinaya River when migrating in the first 10-days of August (Tomkovich *et al.*, 1994).

The Long-tailed Ducks appear near the coast of Taimyr as soon as some open water occurs at sea; from early June to early July depending on the region and the conditions of the specific season. The ducks perform local movements during summer. In June groups of 3–15 birds are encountered, increasing in July to 50 individuals. When the coastal areas becoming ice-free (in July–August), the Long-tailed Ducks gather in inlets and lagoons in flocks of as much as 200 birds. It is not abundant on northern Taimyr and on the islands of the Kara Sea. A distinct migration for moulting was observed on south-western Taimyr in mid-June 1930 (Kolyushev, 1933). In the lower reaches of Lenivaya River Long-tailed Ducks moult on tundra lakes and at sea, and in the lower reaches of the Pyasina they are tied up with lakes densely fringed by *Arctophila fulva* and with small islands in the delta. In the Khatanga River valley the Long-tailed Duck is common, sometimes numerous on tundra lakes. It forms moulting concentrations in the lower reaches of the Bolshaya Balakhnya River. In autumn the Long-tailed Ducks leave Taimyr later than other ducks. The departure begins in September, and the last birds stay till October.

The King Eider is the most abundant and widespread among eiders both when breeding and during migrations. In autumn the eiders gather in flocks of hundreds of birds on water along the coast of the Yenisey Bay. The mass summer migration (flocks of hundreds of individuals, predominantly females) used to be observed from mid-June in the Pyasina-Delta (Kolyushev, 1933). On the north-western coast of Taimyr the King and Steller's Eiders are observed all summer as nomads, concentrating on lagoons and at sea near the fast ice edge sometimes in mixed flocks with Long-tailed Ducks.

In addition to the duck species described above, the Common Teal, the Common Scoter, the Velvet Scoter, the Greater Scaup and the Red-breasted Merganser can sometimes be found at the arctic coast of Taimyr during migration. Concentrations of Greater Scaups before departure are known in the lower reaches of the Yenisey nearby Brekhovsky Islands.

Peculiarities of coastal landscapes (shores are chiefly of an abrasion type, developed uplands not abundant in lakes) as well as severe climatic conditions (ice cover remaining for much of the summer at sea) are reasons for the limited importance of the arctic coasts of Taimyr as moulting and staging grounds for ducks. Nevertheless, the river mouths, inlets and bays, as well as coastal water with numerous small islands provide ducks with suitable habitats for moulting and feeding. These are the following:

- The Yenisey mouth region including coastal waters the Yenisey Bay and islands in the delta.
  - The Ovtsyn Strait and coastal waters of the Yenisey Bay (autumn concentrations of eiders, tens of km from the shore), and Leskino (duck concentrations before departure).

- The Rogozinka River mouth. The shore of the eastern coast of the Yenisey Bay nearby the Rogozinka River mouth is steep and precipitous, but in some places there are beaches. The lowlands with lakes are developed. In August small flocks of Northern Pintails and Velvet Scoters migrate along them.
- The Dikson area. The coastline nearby Dikson is represented by rocky capes and inlets. In the near-mouth zones of rivers pebble beaches with drift-wood are developed. Concentrations of Long-tailed Ducks and King Eiders at sea in leads and near the fast-ice edge. Northern Pintails are found on the tundra water bodies in small numbers.
- The Uboinaya River mouth. A spurry plain with a river running along the canyon. The sea shore is with pebble beaches and drift-wood. Long-tailed Ducks and King Eiders keep to the sea and ice edge, while Steller's Eiders are tied up with the lagoons. Northern Pintails migrate over the tundra water bodies.

- The Pyasina River lower reaches and Northern Taimyr.
  - A network of channels with numerous islands is developed in the lower reaches of the Pyasina and in the delta. The low tundra is swampy in some zones, and there are a lot of small and medium-sized lakes. Mass moulting and staging grounds of Long-tailed Ducks, King Eiders and Northern Pintails.
  - The Lenivaya River, the Sterligov Cape. This is a highly swampy spurry plain with ponds. The river is of a mountainous character. The sea shore is largely precipitous, the narrow beach is piled up with drift-wood, and there are sand-pebble spits. Moulting grounds of Long-tailed Ducks (tundra lakes and sea). King Eiders are recorded at sea in leads.
  - Knipovich Bay, the Backlund Peninsula. There are exceptionally few lakes, but the river network is well-developed. The sea shore is of a skerry type with sand spits in small lagoons or in the near-mouth river zones. Long-tailed Ducks and King Eiders keep to the coastal waters.
- Khatanga Bay.
  - Concentrations of diving ducks at lakes in the vicinity of Khatanga and in the lower reaches of Bolshaya Balakhnya.

The Yenisey Bay is one of the key northern shipping routes. The explored regions adjacent to the Khatanga and Dikson ports have the largest anthropogenic load at present. In addition to the risk connected with the ship traffic and port operations, as well as disturbance related to aviation, an increased hunting pressure, including illegal hunting, is observed in the vicinity of the settlements. Fishery is rather developed in the region, and diving ducks are found to die in the fishing nets. The human impact decreases with distance from shipping rivers,. The Northern Taimyr is poorly explored, but there is disturbance from aviation, a few Polar stations and single fishing points. The largest settlement is at the Cheluskin Cape.

The system of the Great Arctic Reserve has in many respects resolved the problems of nature protection at the arctic coast of Taimyr. In particular, the reserve includes large shallows and coastal grounds important for the migrating birds, as well as concentrations of diving ducks at sea. At present it is already planned to establish a network of protected wetland areas that are important for wildfowl as nesting, moulting and staging grounds. One of the main migration routes of the water-birds inhabiting the inland area of Taimyr passes along the Yenisey River. It is suggested to establish a nature-protection regime in the lower reaches of the Yenisey, in the zone 'Brekhovsky Islands – lower reaches of Tanama River' where concentrations before departure of different ducks, as well as of geese are known (Rogacheva, 1992; Syroechkovskiy & Rogacheva, 1994).

With further development of shipping along the NSR it should be taken into account that due to severe climatic conditions in North Taimyr, seaducks usually use very limited ice-free zones of the coastal waters and have a tendency to concentrate along the fast ice edge. This increases the risk of the ducks being contaminated in the case of an oil spill considerably. On the other hand, the skerries with numerous small islands give good biotope protection, but their accessibility highly depends on the specific ice conditions near the coast.

5.12.7 Severnaya Zemlya

by Maria Gavrilo

The breeding fauna and population of ducks, consisting of 2–3 seaduck species, is the poorest within the entire NSR area. Being the northernmost land with very low productivity of the terrestrial ecosystems and being bound up with ice cover almost around the year, the archipelago does not provide wildfowl with any suitable habitats to be used as moulting or fattening grounds. The only observations of non-breeding residence of ducks are of scattered groups of a few King Eiders and flocks of several Long-tailed Ducks recorded on the western coast of the archipelago (Gavrilo, unpubl., de Korte at al., 1995).

5.12.8 Yakutia and the New Siberian Islands

by Diana V. Solovieva

The Arctic coast of Yakutia from the eastern shore of Khatanga Bay to the eastern shore of the Kolyma-Delta is inhabited by 10 duck species without taking into account vagrants.

Among the species enumerated, the Baikal Teal is a Siberian endemic (included into the Red Data Book of the Russian Federation) and the Common Eider and Steller's Eider are included in the Red Data Book of the Yakut ASSR (1978). The most abundant nesting species inhabiting tundra of various regions are the Northern Pintail, the Long-tailed Duck, the King Eider, the Steller's Eider and the Spectacled Eider. The ducks known to form large moulting and pre-flight concentrations within this region are King and Steller's Eiders, Long-tailed Ducks, Northern Pintails and Greater Scaups.

The Northern Pintail nests in the zones of the forest tundra and taiga, penetrating the deltas along the river valleys where it is observed as nesting up to the sea coast. From mid-June males that have left the females at the nesting grounds begin to appear in the maritime tundra and deltas. Mass migration in flocks of 10–40 birds is recorded in the area between Konkovaya and Chukochya Rivers and on the coast of the Buor-Khaya Bay. The migration of this group continues up to July 20. The males migrate to the deltas for moulting not only in the meridian, but also in the latitudinal direction (Tomkovich, 1988). Moulting grounds are known in the eastern zone of the Lena-Delta, in the Yana-Delta, Indigirka-Delta and at the nearby coastal shallows, on the Lopatka Peninsula, in the lower reaches of the Alazeya River and in the Khalerchinsk tundra. In mid-August brood rearing females with ducklings also shift north. The flocks of females and young join the flocks of males that finished moulting and move down to the lower channels of deltas. In the shallow zones in the mouths of the Lena-Delta channels, large flocks of Northern Pintails gather numbering up to several hundreds of birds. The departure eastward begins in late August and continues till late September (Tomkovich, 1988). The majority of the ducks departs from the Low Kolyma tundra within the second 10-days of September (Krechmar *et al.*, 1991).

The northern boundary of the Common Teal's breeding range is confined to the shrub tundra, but it reaches closest to the coast along the Konkovaya River. The teals moult and gather in flocks on lakes and channels on the Low Kolyma tundra before departure. They leave the tundra by mid-September (Krechmar *et al.*, 1991).

In the forest tundra the Greater Scaup is common, in some places numerous, but penetrates tundra along the river valleys only. It becomes common as a nesting species on the Low Kolyma tundra already 50 km south of the coast. Migration for moult occurs in the first 10-days of July. Numerous moulting concentrations are known at the Krugloye lake. The concentrations before departure are formed in channels from late August. The bulk of the Greater Scaups departs by mid-September (Krechmar *et al.*, 1991).

The breeding range of the Velvet Scoter does not reach ashore. Within the territory under consideration, concentrations of these ducks are reliably known only for the eastern zone of the Lena-Delta and nearby shallows (Solovieva, 1995). Other moulting grounds of the Velvet Scoter are suggested to exist in the Yana-Delta. Flocks of males that have finished breeding in the forest tundra and the taiga zones of Yakutia, arrive for moulting at the Lena-Delta by the last 10-days of June. The fraction of females in these flocks does not exceed 5–10%. Moulting occurs in the main river bed and in the Bykovskaya channel, but a small number of birds moult on large lakes on the islands in the Bykovskaya and Olenekskaya channels. As the moult is over, the Velvet Scoters migrate downstream the Bykovskaya channel and gather in the shallow Neyelov and Buor-Khaya Bays. Here flocks are recorded up to mid-September. The moulting stock in the Lena-Delta does not exceed 500 individuals.

The Long-tailed Duck is a common breeder of the coastal mainland tundra, while it is abundant on the Low Kolyma tundra. During migrations and when moulting it occurs along the sea coast and on the New-Siberian Islands. The males moult in the sheltered coastal shallows, in the mouths and lower courses of rivers, and in smaller number at sea near the drifting ice edge and on the tundra lakes. The largest moulting concentrations are known in the lower deltas of big rivers and adjacent shoals, and shallows of the Anjou and Lyakhovsky Islands. The males begin arriving at the moulting grounds by late June to mid-July. Moult of the flight feathers occurs from mid-July to mid-August. The last flightless male was observed on August 24. The failed-breeding females moult at freshwater bodies on the mainland tundra. Autumn migration occurs from late August to mid-September (Rutilevskiy, 1973).

The Wigeon and the Baikal Teal appear on the coastal tundra of the eastern part of the study region during summer migrations in small numbers only.

The coast of Yakutia is abundant in deltas and estuaries of the large rivers providing wildfowl with well-protected biotopes and abundant food resources. The coastline of the watersheds is largely represented by laidas and pebble beaches, while cliffs are almost absent. The rocky and precipitous shores are found only on some islands of the New-Siberian archipelago. The coastal seaside area presents a vast shallow zone, highly freshened due to the abundant river runoff.

Based on available data, the most important areas for maintaining duck populations when moulting and fattening are as follows:

- Delta regions of large rivers including lower river zones rich in lowland islands, and nearby shoal sea zones:
  - lower Olenekskaya channel and adjacent sea shoal zone (moulting grounds of the Long-tailed Duck);
  - the sea shallows along the northern shore of Erge-Muora-Sise Island (moulting grounds of the Eiders and the Long-tailed Duck);
  - lower eastern Lena-Delta and Yana-Delta (moulting and fattening grounds of the Northern Pintail);
  - islands of the north-eastern Indigirka-Delta (moulting grounds of the Long-tailed Duck) and lower channels (fattening grounds of the Northern Pintail);
- Khroma and Omulykhskaya Bays which present a system of two brackish water bodies with narrow mouths which are deeply entrenched into the coast and almost isolated from the sea (moulting grounds of the Long-tailed Duck);
- Coastal lacustrine lowlands with vast polygonal swamps and salty meadows:
  - Svyatoy Nos Cape, Volchya and Alazeya Rivers lower reaches, the north-western Bolshoy Lyakhovskiy Island (moulting grounds of the Long-tailed Duck);
  - Lopatka Peninsula (moulting grounds of the Northern Pintail);
  - Low Kolyma tundra (moulting grounds of the Northern Pintail);
- Coastal shallows adjacent both to the mainland and islands:
  - shallow waters between Konkovaya and Chukochya River mouths and off the northern coast of Lopatka Peninsula (moulting grounds of the Long-tailed Duck);
  - off the south-western shore of Stolbovoy Island (moulting grounds of King and Steller's Eiders);

- shallows around Lyakhovsky Islands and Anjou Islands (used to be chief moulting and fattening grounds of the Long-tailed Duck, present status is unknown). The coastline of the Lyakhovsky Islands is slightly rugged, and the ducks moult at sea. The low gently sloping shores with deeply entrenched sheltered bays provide good protection for ducks;
- the Great Siberian polynya: a zone of open water in April–May with depths up to 20–30 m, assumed (and recently confirmed; Solovieva, 1996, in prep.) to be a place of spring staging of Long-tailed Ducks and King Eiders.

The northern coast of Yakutia is poorly explored at present, with Tiksi port being the largest settlement. There are also some settlements, hunting bases and Polar stations along the coast, that serve as sources of local human impact (hunting pressure, disturbance from boats and aviation, and dogs). However, the main moulting grounds are located at distances of several tens of kilometres from the settlements, except for the Bykovsky settlement in the eastern Lena-Delta. Within the coastal zone under consideration there are two protected territories: the Lena-Delta Nature Reserve and the 'Chaigurino' Refuge. The former, including the buffer zone, covers only an insignificant part of the sea area and the wetlands important for the ducks while moulting and migrating.

Low coasts and well-developed network of channels in deltas are most exposed to the risk of oil and other sea-borne pollution as they can be easily contaminated when strong surge.

5.12.9 Chukotka

by A. Ya. Kondratiev

The territory under consideration extends from the east bank of the Kolyma River to the Bering Strait over more than 2,000 km of the shore (including the coasts of the Chaun and Kolyuchin Bays, but without numerous lagoons and small bays). Here, 15 duck species are recorded (without vagrants), with 12 as nesting species. On the coastal tundra, the Long-tailed Duck is the most widespread and abundant nesting duck. The population density and the relative abundance of the remaining abundant ducks (the Northern Pintail, and King, Pacific and Spectacled Eiders) vary from region to region. The Greater Scaup and Common Teal come ashore only penetrating along the river valleys up to the mouths while the eiders are absent on the more southern tundra.

The Common Teal nests in the lower Kolyma reaches and Chaun Lowland, being tied up with shrub tundra. It moults in flocks of several tens of birds on channels and tributaries of the lower Kolyma reaches. Aggregations before departure are recorded in early September in the Kolyma-Delta in some years. Departs the area by 20th September.

The Northern Pintail is one of the most common ducks in the Chaun Lowland (nesting density in optimal biotopes varies by years from 0.1 to 1.2 pairs/km^2). In the vicinity of the Kolyuchin Bay it sometimes outnumbers other ducks (population density in different zones 0.06–4.8 ind./km^2), however, in the east of the Arctic coast of Chukotka it is not an abundant nesting species. The flights of the males for moult occur from mid-June to early July. Local migrations of males before moult are known at the lakes of the Chaun Lowland. Males take on wings and start autumn migration by the first 10-days of August. Aggregations before departure involving both adults and young form in the second half of August and are confined to the lacustrine maritime meadows and river deltas. The density during this period can reach 100–150 ind./km^2 (the Chaun Lowland). The departure of the first Northern Pintails begins already in mid-August and migration lasts until September.

The population density of the Greater Scaup is close to that of the Northern Pintail in optimal biotopes of the Chaun Lowland while it is only assumed to nest on the coast of E. Chukotka.

The Long-tailed Duck is the most common and abundant species nearby the Chaun Bay, but it nests in small numbers only at E. Chukotka. The males begin flocking at large lakes of the maritime tundra and lagoons in late June and by mid-July the majority of the birds shifts to the sea for moult.

The Black Scoter is not abundant in summer in the Chaun Bay and on the nearby tundra. There is a migration of males upstream the Chaun-Palyavaam Rivers in August.

The migration route of the seaducks along the entire coast of Chukotka should be specially mentioned. The summer–autumn movements of eiders and Long-tailed Ducks flying eastward, strictly following the coastline, are quite intensive during late July–August (Portenko, 1972–1973; Tomkovich & Sorokin, 1983).

The plain landscapes along the coast under consideration are some places broken by the more or less extended bedrock outcrops which are more typical of the zone east of the Chaun Bay. Lowlands adjacent to deltas and networks of shallow lagoons are widespread over the coast. Within the area under consideration the following regions can be defined:

- Medvezhiy Cape – Rauchua-Delta. On the whole, the population density of birds is very low, since much of the territory presents a hillocky elevated surface, and lacustrine depressions and swampy plains are quite rare here. The region of the Bolshoy Baranov Cape and east of it is most rich in lakes. The current anthropogenic pressure on the ecosystems of the coast is relatively low and not constant here. This includes impact from hunters, fishermen and personnel of the Polar station Rauchua.
- The Chaun Lowland presents a vast quite uniform plain, gradually lowering towards the sea. The lowland is crossed by numerous rivers, which are divided into many branches in the lower courses. In the maritime tundra of the lowland the attention is primarily drawn to the abundant lakes occupying up to 50% of the area. These are mostly shallow thermokarst water bodies with highly irregular shores. As a result of the drift of the lakes, many drained lake troughs are formed which are favourite habitats for concentrations of many waterfowl species. The lowland shores of sea bays are occupied by swampy meadows and marshes alternating with pebble terraces and sand dunes. Brackish lagoon lakes are abundant. In spite of a rather high anthropogenic pressure, the Chaun Lowland still has a quite high

productivity and is one of the most important regions of the Arctic coast of Chukotka with regard to nature protection.

- Shelagskiy Cape – Amguema-Delta. The lowland landscapes which provide suitable habitats for waterfowl are rare here and highly transformed by the mining industry. The western part up to the Kiber Cape is largely mountainous. East of the Pegtymel River mouth the mountain masses outcrop on the coast only as rare relics. The sea coastline presents 'endless' pebble terraces and spits disjunction vast shallow lagoons. Lagoon shores and banks of the rivers falling into them are the principal waterfowl habitats.
- Kolyuchin Bay area. The maritime tundra of Vankarem Lowland, shores of the Kolyuchin Bay and large lagoons (including Neskan-Pilgyn in the east) are of great importance for maintaining populations of many waterfowl species both while nesting and migrating.
- East Chukchi Peninsula. East of the Serdtse-Kamen Cape, the most important waterfowl habitat is the shores of the Inchoun and Uelen lagoons with the adjacent tundra of the lower reaches of the Uteveyem and Usunveyem Rivers.

In general the human impact on the ecosystems of the Arctic coast of Chukotka is of a scattered local character, however, it is largely confined to the most productive regions (the river mouths). The Chaun Lowland is the arena of the most intensive industrial activities. Here the large sea port Pevek and some settlements are located. There are two reindeer farms with quite large pastures, mainly in the north-western and the south-eastern regions. There are intensive mining activities on the eastern coast of the Chaun Bay. The road-transport communications are relatively well developed.

The most valuable wetlands of the Arctic coast of Chukotka are within the formally established protected territories, including Chaunskiy Federal special purposes reserve and the natural-ethnic park 'Beringiya'. Unfortunately, the reserve is only nominally defined and has no real importance for nature protection. As to the 'Beringiya' park, the process of its creation has been extended over years and is still far from being completed.

The lagoons and the bays where ducks aggregate are quite well protected from oil spills at open sea. With intensification of shipping along the NSR and the development of coastal infrastructure, the coast and the area of the Chaun Bay which are already under quite high anthropogenic pressure, will be subjected to the highest risk.

5.12.10 Wrangel Island

by Maria Gavrilo

There are 15 duck species recorded on the island, including 5 breeding ones. Only the Common and King Eiders, are common and abundant breeders, while the Northern Pintail, the Long-tailed Duck and the Steller's Eider are rare and irregular breeders. The overall density (both breeders and non-breeders) of the Common Eider varies depending on habitats from 1–2 *ind./km^2 in* the inner uplands, to 15 ind./km^2 in middle and lower reaches of rivers, and up to

15–40 ind./km^2 in preferable coastal biotopes of lagoons and deltas. Autumn concentrations are known to form along the southern shore. Departure begins by mid-September. Unlike the Common Eider, the King Eider is tied up with inland tundra lakes during the breeding season with overall density at 15–40 ind./km^2 of water body surface. Males having finished breeding keep to the coastal habitats. The majority of females with broods join them by late August–early September. Being a rare breeding species, the Long-tailed Duck is an abundant non-breeding visitor. It inhabits lagoons, deltas and estuaries as well as tundra lakes. Shallow bays and lagoons are preferable biotopes with densities varying from 40–60 ind./km^2 just after ice cover break up to 150–200 ind./km^2 by mid-August. Duck distribution depends strongly on ice conditions nearby the island. Solid ice cover brought by the wind forces birds to remain in sheltered bays and lagoons. Under conditions of open waters around the island, the Long-tailed Ducks aggregate along the narrow seaside band of spits or coast, while open drifting ice leads birds to disperse among the ice-floes. The overall stock of the Long-tailed Ducks in the Wrangel Island area is estimated at 20,000 birds. Autumn migration of ducks occurs mainly in September, but in some years the Long-tailed Ducks are common during October and the last Common Eiders can be observed till November (all data on Wrangel Island are based on Stishov *et al.*, 1991).

Thus, the most important areas for non-breeding marine ducks on Wrangel Island are found along low shores of accumulative character abundant in lagoons, sheltered bays and river mouths. They are as follows:

- northern coast of the Academy Tundra from Bruch Spit to Medvezhya River mouth;
- southern coast:
  - Blossom Cape area;
  - lagoons at the eastern part of Somnitalnaya Bay;
  - Rogers Bay.

6. VEC 3. WADERS AT FEEDING AND RESTING AREAS

6.1 Introduction

by Maria Gavrilo

The vast territory along the NSR area is inhabited by more than 30 wader species (vagrants not included). This species group is the most species rich among the birds in the area. During the nesting period the waders are scattered within the breeding range and, in general, they are not directly connected with the coast. Only few species, such as the Ringed Plover and to a smaller extent, the Temminck's Stint and the Turnstone make use of the coastal habitats (beaches and spits) while nesting. An insignificant part of the populations of some other species that nest on the maritime tundra close to coast can use the littoral zone as a feeding biotope (for example the Purple Sandpiper and the Little Stint).

However, during the non-breeding period in the course of summer and autumn migrations most of the waders make extensive use of the coastal habitats. Spring migration in waders at the Arctic coast is less pronounced than other seasonal movements and is not connected with the sea coast, as the birds keep to the snow-free tundra zones at once after they appear at the nesting grounds. The most important factors influencing on the dates of the spring arrival are as follows: the transition of mean daily temperature through 0°C and the beginning of snow melt on the tundra. However, the observed arrival dates are quite stable and do not depend on the specific conditions of the year. This is characteristic of the transequatorial migrants, include waders (Gavrilov, 1990). On average, at the coast along the NSR, the mass arrival of waders occurs during June: at the beginning of the month at the sub-Arctic tundra, in the second week of June at the northern barren grounds tundra and by mid-June in the extreme northern regions. The species that are known to be highly specialised feeders (for example, phalaropes, snipes and the Long-billed Dowitcher) arrive a little later than the other species.

Summer migrations are also common in the northern waders, as in geese, ducks and gulls. They begin soon after the spring arrival to the nesting grounds, i.e. in some regions already in the first half of June. The non-breeding segment is the first to move. Probably, it mainly consists of one year old individuals, but there is no reliable evidence (Estafyev, 1991). They are followed by failed breeders and by individuals of the sex not staying with the young in the species where only one parent takes care of the offspring. Summer migrations of the latter are usually more pronounced. Some of the species begins intensive moult quite soon. The moult of the flight feathers near the nesting grounds is considered to be more typical of the species adapted to temperate habitat conditions (Gavrilov, 1987). Some of the moving birds (phalaropes) only changes between biotopes within the nesting grounds shifting from ponds to large lakes. Other waders make distinctive summer migrations northward of the nesting grounds. First of all these are the Bar-tailed Godwit, the Ruff, the Pectoral Sandpiper, the

Long-tailed Dowitcher and partly the Red-necked Phalarope. The Grey Phalarope migrates to the sea, like the wildfowl.

Autumn migrations begin in the second half of July with migration of adult waders leaving the grown young. Soon after fledging, the young birds of many species also move from the tundra to the coast. It should be mentioned that migrations even of the young birds in some species are first directed northward (Ruff, Grey Phalarope). Most waders disappears from the coasts by mid-August (the northernmost regions of the NSR area) to early September. The intensity of the seasonal migrations depends in many respects on the conditions of the season; in unfavourable years the migration activity is higher and is shifted to earlier dates.

The open littoral of the Siberian Arctic Seas is quite narrow and lifeless due to the scouring effect of ice. The hydrobios under such conditions shift to the sub-littoral zone, i.e. become inaccessible for waders. The most suitable places for wader aggregations are the protected coastal habitats: silty shoals, lagoons, shoals in the estuaries, deltas and laidas, or coastal shallows (for Phalaropes).

It should be stressed that the biology and distribution of waders during the non-breeding period are very poorly studied, unlike the nesting biology. In particular, there are extremely few data on the number, habitat use and distribution of staging areas during migration and fattening periods. An obvious lack of data on the key territories during the non-breeding period of the waders is reflected in the new Russian list of Ramsar Sites adopted in 1994. Among 35 new sites, none is located at the Arctic coast of Siberia (Lebedeva & Tomkovich, 1995). Taking into account the evident shortage of data concerning the non-breeding period, the characteristics of the breeding population and peculiarities of the biology of the abundant wader species are included in the present study to get an idea of the problem under consideration.

6.2 Yugor Peninsula and Vaigach Island

by Alexey Estafiev

In the northern zone of the Yugor Peninsula and Vaigach Island 22 wader species including 20 nesting ones, are recorded. The Ringed Plover and the Little Stint are numerous on Vaigach Island; the Dotterel, Purple Sandpiper, Ruff and the Red-necked Phalarope are common; while the rest of the species are either rare or sporadically occurring. The Little Stint, Dunlin, Ringed Plover, Red-necked Phalarope, Temminck's Stint, Ruff and the Common Snipe are numerous; while the Pectoral Sandpiper and the Grey Phalarope are rare; and other species are common in N. Yugor Peninsula. There are no endemic wader species in the area.

Different tundra habitats are usually inhabited by 10–11 species of waders at a total population density in the nesting period from 60–77 ind./km^2 (dwarf birch and *Dryas* tundra, respectively) up to 560–780 ind./km^2 (sedge-moss tundra and willow bushes). A strip along the sea coast is occupied by lacustrine brackish maritime meadows. These habitats are the most species rich (up to 19 species) and occupy an intermediary position regarding population density (490 ind./km^2). The Ruff and the Red-necked Phalarope are abundant species here, while the Temminck's Stint, Little Stint, Dunlin, Grey Plover, Pintail Snipe, Dotterel, Jack Snipe, Turnstone and the Purple Sandpiper are common. The coastal biotopes also include the inter-zonal landscape elements. Here waders of the boundary habitats, as well as migrating birds prevail. The highest species diversity as well as high population density of waders in these biotopes is known for the rocky coast of the Yugor Peninsula; 13 species with a total density up to 335 ind./km^2 have been found in the region of the Chiaka Cape and the lower reaches of the Lymbada-Yakha River. Purple Sandpiper, Curlew Sandpiper, Ringed Plover and Turnstone are the characteristic species during the summer here, with the Ringed Plover being the most numerous one. The abundant food resources of the biotope attracts waders. However, the habitat is rather damaged by drifted wood and industrial waste that has already resulted in reduced utilisation by resting and feeding waders.

Summer movements of waders begin already in June. In the summer season (June–July) nomadic flocks of waders are rare in central Yugor Peninsula, whereas along the sea coast waders move more intensively. The first migrating flocks of males and non-breeding individuals of the Little Stint, Temminck's Stint and Turnstone are observed on Vaigach Island, nearby Amderma and in the N. Yugor Peninsula in the first half of July (Uspenskiy, 1965; Karpovich & Kokhanov, 1967; Estafyev, 1986a). Likewise, in these regions and at the coast of Yugor Shar Strait migrating Grey Plovers, Eurasian Golden Plovers, Dotterels, Curlew Sandpipers, Dunlins, Sanderlings and Purple Sandpipers are observed at this time. By late July migrating flocks of up to 30–40 male Little Stints and female Red-necked Phalaropes that have already finished breeding are formed.

Among the non-breeders there are individuals in different stages of contour and flight-feather moult, even within the same flock. The largest moulting concentrations are known for the Ruff at the western coast of the Kara Bay. The waders (mainly males) begin arriving at the moulting sites by early July in flocks of 10–30 individuals. In mid-July these flocks join and may number 300–400 individuals. The density of the Ruff in this region reaches 350 ind./km^2.

The autumn departure of waders from central Vaigach and the inner part of the Yugor Peninsula occurs earlier than from the coast (by late July). At the end of the nesting period, the broods of some tundra species move to the sea coast. These migrations are of a mass character from late August when most chicks reach the size of adult birds. From this period the birds mainly concentrate at the sea coasts and remain there all September. Autumn wader migration is recorded from mid-August to early October, finishing by the first 10-days of October. The Purple Sandpiper is the last to leave.

Although the summer movements of waders are distinctive, the prevailing direction of the movements differs between species and also varies annually. In autumn the visible migration is westward, but it goes along the coast following the configuration of the coastline.

In spite of significant differences in weather conditions in different years, there are no large fluctuations in wader populations of the N. Yugor Peninsula. However, the intensity of migration varies between years. This can be attributed both to differences in the breeding success on the Yugor Peninsula as well as in areas to the east and, probably, to the differences in weather conditions impacting on migration patterns (timing and routes).

There are very few data on the habitat use of waders during summer and autumn migrations and staging. On the coast of the Yugor Peninsula, littoral biotopes including laidas and marshes that usually attract waders for feeding are not well developed. The most developed habitats of this type are located nearby Torasavey. The NW Yugor Peninsula nearby the Chaika Cape with open intertidal coastal zones with abundant seaweed is the most attractive biotope for the Purple Sandpiper.

The most important regions for wader aggregations during the non-breeding period are found in rather restricted zones of the swampy tundra and littoral ecotones:

- extreme NW Yugor Peninsula;
- SE Vaigach Island;
- western coast of the Kara Bay;
- Torasavey area.

The current human impact on waders concentrating along the coast in the area is not high due to the relatively low extent of exploration of this territory. The settlements near the sites being important for waders, including Ust-Kara, Varnek, and the polar stations Yugor Shar and Bely Nos, can be a source of disturbance. However, their impact at the current development level can hardly be of significant importance. In the vicinity of the port settlement Amderma no sites of abundant wader aggregations are known. Currently, sea shipping has no direct influence on the waders aggregating at the sea shore. As the shipping increases, pollution of the coastal areas by oil products, as well as increased disturbance, mainly from aircraft, should be of primary concern. The most vulnerable sites are the Kara Gate and Yugor Shar Straits.

6.3 Novaya Zemlya

by Maria Gavrilo

Very few data on the distribution of waders along the eastern shore of the archipelago are available. The only breeding species is found to be the Purple Sandpiper. The Ringed Plover, the Little Stint, the Turnstone and the Oystercatcher have also been recorded in the north-easternmost Novaya Zemlya. The Grey Phalarope is found in small numbers on migration during mid-September to mid-October (Antipin, 1938).

6.4 Yamal and Gydan

by Irina V. Pokrovskaya

More than 20 wader species, including 17 nesting, have been recorded on the maritime tundra and at the sea coasts of the Yamal Peninsula. Among these, the Curlew Sandpiper is a Siberian endemic species. The group of numerous waders includes Dunlin, Ruff, Red-necked Phalarope and Temminck's Stint. The common species are Ringed Plover, Little Stint and Eurasian Golden Plover. The Dotterel is rare, but it inhabits the entire territory of Yamal. Due to a significant south-north extent of the peninsula there are two distinct groups of waders: those of the forest tundra and the sub-Arctic tundra in the S. Yamal and those of the barren-grounds tundra in the north of the peninsula. The first group includes the Spotted Redshank, the Whimbrel and the Bar-tailed Godwit. The Grey Plover, the Grey Phalarope, the Purple Sandpiper, the Sanderling and the Red Knot are in the second group.

The fauna and the population of waders at Gydan are much less well-studied. Only 17 species are recorded here (12–13 as nesting). Most abundant are the Ruff on the southern and typical tundra, the Little Stint and the Red-necked Phalarope on the barren-grounds tundra. The Temminck's Stint and the Pacific Golden Plover are common. The Dunlin nests everywhere in N. Gydan, but it is less abundant on the coastal tundra; here the Turnstone becomes numerous. The Curlew Sandpiper is a Siberian endemic species.

There are 8–9 wader species, on average, in different biotopes of the sub-Arctic tundra of Yamal. The Ruff dominates in most biotopes (with nesting density of 8–23 pairs/km^2; Danilov *et al.*, 1984). In some years the Red-necked Phalarope becomes dominant by density (7.6–27.3 pairs/km^2). The densities of Eurasian Golden Plover (0.5–1.4 pairs/km^2), Ringed Plover (0.2 pairs/km^2) and Wood Sandpiper (2 pairs/km^2) are relatively stable between years. The population of the Little Stint performs the highest fluctuations. It can be dominant among waders composing about a quarter of the entire population by the nesting density in some years and be extremely rare in other years, depending on the dates of the onset of spring (Ryabitsev, 1985). The Pacific Golden Plover and the Grey Plover are uncommon (1 pair per several tens of sq. km) with the former species being confined to the upper tundra while the latter prefers the flood-plains of the tundra rivers. On the sub-Arctic tundra of the southernmost region of the Yamal Peninsula the Whimbrel and the Bar-tailed Godwit are common. The Ruff, probably, also dominates in the S. Gydan, reaching 72°N at nesting. The population density of waders on the sub-Arctic tundra in different biotopes varies from 20–30 to 60–70 pairs/km^2, on average.

On the barren-grounds tundra the total bird population density decreases, but the fraction of waders increases. The background species of the wader population at Yamal is the Grey Plover with a maximum nesting density up to 4 pairs/km^2 (Danilov *et al.*, 1984). It is noted that the nesting habitats are confined to the boundary biotopes, and the flood-plains of the tundra rivers become populated intensively with the advance of the Grey Plover along the barren-grounds tundra to the north (Sosin *et al.*, 1985). In some years on the barren-grounds tundra, especially in the southern regions, the Dunlin dominates by number of nesting pairs (24–33 pairs/km^2).

The Temminck's and Little Stints are abundant on the barren-grounds tundra (local density up to 15 and 70 pairs/km^2, respectively; Danilov *et al.*, 1984). As a rule, the Curlew Sandpiper, Grey Phalarope and Turnstone nest regularly on the barren-grounds tundra, but at low densities, less than one pair per sq. km. There are 8–9 wader species on average in one biotope of the barren-grounds tundra with a total density of 90–110 pairs/km^2 (Danilov *et al.*, 1984; Ryabitsev & Alekseyeva, 1995; Paskhalny, 1985; Sosin *et al.*, 1985). The Ringed Plover demonstrates the greatest independence on zonal differentiation of habitats in its nesting distribution. In optimal habitats (coastal sand ridges) its nesting density reaches 10 pairs/km^2 (Ryabitsev & Alekseyeva, 1995).

There are similar population patterns at Gydan. The Little Stint is absolutely dominant in most biotopes of the north-eastern peninsula (local density up to 62 ind./km^2, constituting up to half of the total wader population). The Red-necked Phalarope and the Dunlin are co-dominant species (Chernichko *et al.*, 1994).

The shore is known to be a key habitat during the non-breeding period for most waders. Small flocks of migrating Temminck's and Little Stints appear on the coast already soon after arrival. Aggregations of Red-necked Phalarope females are formed at the coasts by early July, the largest (up to several tens of thousands of birds) being observed at the Sharapovy Koshki Islands. The summer aggregations of males and non-breeding or failed breeding females of the Ruff are recorded at the eastern coast nearby Tambey and Kamenny Cape (Danilov *et al.*, 1984). The Curlew Sandpiper is widespread during July along the coast, most often near Kharasavey, but it does not form distinctive aggregations. During the nesting period non-breeding high Arctic species are observed over the entire coast of northern and middle Yamal including the Purple Sandpiper, Sanderling and Red Knot (Danilov *et al.*, 1984). Summer migrations north of the nesting area are especially typical of the Bar-tailed Godwit, which is regularly observed in flocks of hundreds at laidas of northern and middle Yamal from early July.

The intensity of post-nesting migrations in the coastal biotopes of Yamal is subject to significant annual variations. In years with unfavourable weather conditions, most of the non-breeding Temminck's Stints, Little Stints, as well as female Red-necked Phalaropes having failed to breed, migrate to the south already by the first half of July (Danilov *et al.*, 1984). From early August the post-nesting movements gradually transform to distinctive seasonal migrations. Aggregations of waders before departure are formed in the mouths of many rivers along the western coast of the peninsula. One of the most important of these areas is located in the inner part and at the north-eastern coast of the Baidaratskaya Bay (Kalyakin, 1986; Pokrovskaya & Tertikski, unpubl. data). In the second half of August 1994 the density of waders in this area varied from 300 to 400 ind./km^2, with the Ruff and the Little Stint being the dominant migrants.

Most of the waders leave the Yamal coast by late August to early September.

On the whole, the coasts of Yamal are characterised by widespread laidas and sheltered river mouths that provide waders with rich food resources and well-protected biotopes during the non-breeding period. Based on available data, the most important regions for waders on Yamal are:

- the Kara coast from Kharasavey Cape to the mouth of the Baidarata River in the south. Much of the coastal area is occupied by laidas and a system of low sandy spits and islands. The waders make extensive use of these areas during postbreeding migrations during August and the first half of September. The largest aggregations are known at
  - Sharapovy Koshki Islands,
  - Litke Islands, and the region at the mouth of the Baidarata River.
- the northern and the north-eastern coast of Yamal southward to Kamenny Cape, which is also represented by a wide, up to 5 km, laida over a considerable length.

The maritime regions and the coasts of Gydan are almost unstudied. Analysis of the landscape charts (Kruchinin, 1977) suggests the presence of large wader aggregations in the N. Gydan and N. Taz Peninsulas and along the eastern shore of Taz Bay, since there are large areas of the same lagoon-laida landscapes as at Yamal, being key habitats for non-breeding waders. However, nowhere at Gydan do these landscapes form a continuous strip extending in the longitudinal direction, like at W. Yamal, which is optimal for migrating waders.

Under conditions of the on-going intensive industrial exploration of Yamal, there is an increasing danger of a stronger anthropogenic pressure on waders and degradation of their habitats. Thus the danger of pollution of the coastal areas by oil products from the increasing shipping activity along the Northern Sea Route will be aggravated by the already existing anthropogenic impact from the production and treatment of hydrocarbons on Yamal. The northern coast of Yamal, Sharapovy Koshki Islands and the Baidaratskaya Bay are the most vulnerable areas of Yamal with respect to waders and oil spills. The risk is high during the entire summer, as these places are used by waders both during summer movements and autumn migrations. However, taking into account a similar landscape and the low extent of industrial exploration, Gydan can turn out to be a reserve territory for non-breeding waders.

6.5 Taimyr

by Elena Lappo

There are 26 wader species on Taimyr including 21–23 breeding ones. Among these, the Curlew Sandpiper and the Red-necked Stint are Siberian endemic species, the last species breeding sporadically also in Alaska. The breeding range of the former is located mainly within the Taimyr area while the latter is a very rare breeder here (Rogacheva, 1992).

Along much of the coast of the peninsula, the arctic tundra is widespread, whereas the typical southern tundra comes to the coasts of the Yenisey and the Khatanga Bays only. In total, 9–13 species of waders can be observed in different regions of Taimyr in the arctic tundra sub-zone (Tomkovich & Vronskiy, 1988, 1994; Tomkovich *et al.*, 1994; Syroyechkovskiy-jr., 1995a) which compose up to 40–60% of the total numbers of the bird population by species (Stishov *et al.*, 1989). Most characteristic are the Grey Plover, the Turnstone, the Curlew Sandpiper, the Little Stint, the Grey Phalarope, the Red Knot, the Purple Sandpiper and the Sanderling. The Curlew Sandpiper, being a typical dominant species of the barren-grounds tundra of the Siberian sector, is tied up with inland regions with nesting density up to 50 ind./km^2 (Vronskiy, 1986), the fraction in the bird population of zonal communities is up to 23% by numbers of individuals (Stishov *et al.*, 1989). The Grey Plover is the most widespread species inhabiting different habitats with nesting density up to 6–9 ind./km^2 in optimal biotopes. The Turnstone is most numerous on the maritime tundra (up to 11–12 ind./km^2, Vronskiy, 1986). The Grey Phalarope and the Little Stint are common species on the typical tundra, and they are also common on the barren-grounds tundra except for the Far North. Both species demonstrate high annual population fluctuations. Nearby Knipovich Bay (N. Taimyr) the local nesting density of the Little Stint varied by years from 2 to 54 ind./km^2 (Tomkovich *et al.*, 1994). The Red Knot and the Sanderling are tied up with the maritime barren-grounds tundra, being common in some places. The Purple Sandpiper nests only within the narrow strip of the coastal tundra of N. Taimyr and on the Kara Sea islands. The Ringed Plover is typical, but not numerous at the sea coast, also nesting in the patchy tundra.

In the course of the seasonal migrations the maritime biotopes are widely used by the waders inhabiting different tundra sub-zones. Summer migrations begin for some species already in June. At N. Taimyr (Sdobnikov, 1959b; Tomkovich *et al.*, 1994) summer migrations of the adult waders begin from late June (Grey Phalarope females). The birds that have finished participation in breeding migrate in the first half of July (male Curlew Sandpipers and female Red Knots). Later in the end of July to early August the adult birds which have left the fledged broods migrate (Grey Plovers, male Grey Phalaropes and Red Knots, and female Curlew Sandpipers and Ruffs). Purple Sandpipers, which do not nest in this region, occur on migration in the second half of August. Migration of the adult birds ends by the last 10-days of August, in some years it is prolonged to early September. The migrating young waders appear in late July–early August, their departure begins with the end of migration of the adults. On average, young waders of all species depart from the nesting grounds 1–2 weeks later than the adults. During August most waders leave N. Taimyr. Only single waders were recorded at the Cheluskin Peninsula in the middle of the month (Gavrilo, pers. observation). Near Knipovich Bay nomadic flocks are observed up to late August, Purple Sandpipers and Turnstones staying longer than the others (up to September 10).

At NW. Taimyr (Uboinaya River; Tomkovich & Vronskiy, 1994) the first wave of migrating adults is observed in very late June (Little Stint) to first 10-days of July (Temminck's Stint). Summer migrations of the majority of the species begin from very early July peaking in the second half of the month. In early August the adults depart from the breeding region. The flying young appear from late July (Curlew Sandpiper) to early August (Red Knot). Departure of the young occurs from the first 10-days of August, and by the end of the month the number of migrating birds decreases noticeably.

Migrations on the Arctic coast of Taimyr of waders nesting on the more southern tundra, should be specially mentioned. These are the Bar-tailed Godwit and the Ruff. The former is found to be fattening before autumn migration on the swampy tundra next to the Knipovich Bay and the Backlund Peninsula (Tomkovich *et al.*, 1994). The Bar-tailed Godwit used to be a common spring and autumn migrant at the sea coast several decades ago (Sdobnikov, 1959b). This species is rare at the Sterligov Cape, but numerous during summer post-nesting migrations in the downstream and the middle reaches of the Lenivaya River. Large summer aggregations of the Bar-tailed Godwit were observed on the vast swampy tundra in the lower reaches of Lenivaya, nearby the Zarya Peninsula and near the Knipovich Bay (Sdobnikov, 1959b). Rich food resources available on the barren-grounds tundra (areas not suitable for nesting by the Bar-tailed Godwit due to climatic conditions) has governed a regular character of the northward migrations of waders having finished breeding. The swampy tundra of N. Taimyr is an important region for aggregations of Bar-tailed Godwits before their migration toward the wintering grounds (Tomkovich & Vronskiy, 1988).

The habitats along the coast of Taimyr that are important for waders during summer migrations and aggregations before departure in autumn are confined to protected shoals in the river mouths regions and areas of low swampy maritime tundra.

During migration and in the post-nesting period the waders along the Yenisey Bay and at the north-western coast of Taimyr are centred either in the coastal strip (the Turnstone) or on the wet tundra biotopes (or on thaw patches in spring; Grey Plover, Dotterel, Sanderling, Purple Sandpiper etc.) or in the near-mouth zones of rivers and at lakes (Phalaropes and Ruffs). In August the migrating flocks of waders stop here (Pacific Golden Plovers, Dotterels, phalaropes, Ruffs and Little Stints). Small flocks of waders concentrate along the coast in autumn (the northern part of the bay). The Little Stint (lower reaches of Uboinaya River) and the Bar-tailed Godwit (lower reaches of Lenivaya River) reach considerable numbers while migrating. Both species of phalaropes use the near-mouth zones of rivers and the coastal sea strip during the post-nesting migrations (in late August the aggregations reach several thousand individuals in the Dikson area).

In the lower reaches of Pyasina, in the flood-plain habitats, the Ruff dominates during migration.

At the islands of the Kara Sea migrating waders are rare in summer; some flocks are observed on the marshy plain tundra and in silty lagoons (Red Knot and Sanderling). Flocks of Bar-tailed Godwit are observed at autumn migration.

In N. Taimyr observations are made of migrating Little Stints (at floods of the streams, on swamps and on the wet plain tundra) and Red-necked Phalaropes (at sedge shallow floods of streams and on polygonal bogs). The Grey Phalarope is observed there during the first half of the summer as well. It becomes common at the lagoons along the sea shore during July–August. The Ruff is not observed at autumn migration every year, but sometimes it is abundant when resting at the slope swamps. In late August many wader species (Sanderling, phalaropes, Little Stint, Red Knot, Curlew Sandpiper, plovers and Purple Sandpiper) are observed in silty mouths of rivers and along the sea coasts, preferring the zones with porous sediments and turf shores. Mass aggregations at migration, known for the Grey Plover, Ruff, Bar-tailed Godwit, make this region a key area in the life cycle of these birds.

At the eastern shore of Bolshoy Begichev Island and in the strait between the Maly and Bolshoy Begichev Islands the waders do not form abundant flocks before departure, but on the whole along the coast tens of thousands of small waders are observed. Small wader aggregations are observed at the Taimyr coast from the Balakhnya mouth to the Khatanga mouth; in some years up to many tens of thousands (observations made from helicopter). Wader aggregations numbering not more than several tens are observed along the Khatanga valley at the shoals. The migrating flocks of the Ruff are observed in the Khatanga settlement up to early July.

Thus the regions most important for maintaining non-breeding wader populations at Taimyr are as follows:

- Northern Yenisey Bay
- Sibiryakov Island - a sand-hillocky island surrounded by a sea terrace with lakes and swamps. Wader aggregate before departure in the littoral zone (Sanderling, Curlew Sandpiper, Dunlin).
- Dikson area - characterised by rocky shores, pebble beaches and small rocky coastal islands. Mass aggregations of Grey Phalaropes in the coastal water.
- Pyasina-Delta. The near-mouth zone is represented by a marine accumulative-denudation plain. The swampy lacustrine lowland tundra. In the delta there are abundant arms and sedimentation islands. Mass wader migrations occur in the flood-plain wet biotopes and the delta.
- N. Taimyr. The plains of various origin are developed here, along the shore of the Kara Sea there are skerries with islands. The shores are rocky, pebble and sandy with numerous inlets and gulfs and sea shallow zones. In the Middendorf Bay area, including silty shoals in the near-mouth river regions, migration of different species of waders is observed.
- E. Taimyr, eastern shore of the Bolshoy Begichev Island and adjacent strait. Wader aggregations before departure.

Taking into account the generally poor exploration of the Arctic coast of Taimyr, as well as a sufficiently well developed network of protected areas, the current level of human impact in places of mass wader aggregations can be considered as low. The most vulnerable areas with regard to a potential oil spill, are the marine habitats of Grey Phalaropes located nearby Dikson; one of the key ports along the NSR. Very high level of floods at the Yenisey River and intensive surge phenomena exposes the littoral habitats and the lowland coasts of islands to high risk of oil pollution.

6.6 Severnaya Zemlya

by Maria Gavrilo

The wader fauna of the archipelago (Gavrilo, 1988b) is very poor, both in breeding species and numbers. The Purple Sandpiper and the Sanderling are the only breeding waders, with the first as an uncommon and the latter as an occasional breeder (de Korte *et al.*, 1995). Waders do not form any considerable aggregations in the area because the northern position of the archipelago results in very low ecosystem productivity and large sea-ice cover extension. Only groups of a few sandpipers are observed as nomadic both at the sea coast and inland, near fresh water bodies.

6.7 Yakutia and the New Siberian Islands

by Diana V. Solovieva

The coast of Yakutia from the eastern shore of Khatanga Bay to the eastern shore of the Kolyma-Delta is inhabited by 22 wader species, vagrants not included. Among these, the Red-necked Stint and the Sharp-tailed Sandpiper are endemic species for Siberia. There are no rare species or species of the Red Data Book at any level among the waders of the study territory.

Most numerous at the mainland coast of Yakutia are the Grey Phalarope (over 1 million individuals), Little Stint, Dunlin and the Pectoral Sandpiper. There are some differences in the breeding fauna of dominants in the western and eastern parts of the area under consideration. East of the Yana-Delta the Sharp-tailed Sandpiper becomes common (Kistchinski, 1988), the Long-billed Dowitcher becomes numerous with the largest population in the Kolyma-Delta. The wader fauna of islands (the New-Siberian archipelago) and mainland has zonal differences in the species composition of dominants. The Turnstone, Red Knot, Sanderling (these two species are not observed on the continental tundra at all), Grey Phalarope and the Little Stint prevail at the islands (Rutilevskiy, 1967).

Among the waders inhabiting the coast, the Grey and Red-necked Phalaropes that move to the sea immediately after breeding is finished, are tied up with the sea most of all. Turnstones, Pectoral Sandpipers, Red Knots, Little Stints, Ringed Plovers, Curlew Sandpipers, Sanderlings, Dunlins, Ruffs and Long-billed Dowitchers make extensive use of the maritime brackish biotopes while fattening before migration. Several more species occur on tundra near the sea, but they are not connected with brackish maritime landscapes during any period of the annual cycle. These are the Grey Plover, Ruff, Common Snipe and the Red-necked Stint. The remaining species from the above list nest at the coast only sporadically, and their breeding ranges come to the maritime tundra only in some places.

The Grey Phalarope inhabits the entire coast under consideration, with the highest densities found in the Lena-Delta and Indigirka-Delta, at the coast of the Yana Bay and in the area between Bolshaya Chukochya and Konkovaya Rivers (Kistchinski, 1988). The adult females gather in flocks during very early July. They are often joined by males (probably, failed breeders). Eastward movement from the breeding grounds begins in the first 10-days of July, but the migration is not pronounced. The birds often stay for feeding at small freshwater lakes on tundra or at sea. The phalaropes used to aggregate in considerable numbers before departure at the coastal shallows of Anjou and Lyakhovsky Islands (Rutilevskiy, 1958, 1960, 1964, 1967). The migration that has been observed goes chiefly right above the water line. The males that have finished brood rearing begin departing in the second 10-day period of July. Their flight patterns are similar to those of the females described above, the freshwater lakes also being the preferable food biotope. The young birds take on wings by very late July and begin moving around on the tundra within the breeding range until they move to the sea in August. Some phalaropes have been observed in the open sea up to October 10 (pers. comm. by participants of the LAPEX expedition).

The Red-necked Phalarope does not nest on the coastal tundra, as their breeding biotopes are tied up with the inner sub-Arctic tundra. The autumn migration of adults of both sexes appears to pass over the mainland. Only young birds appear at sea in August, where they keep to the coastal shallows.

The Red Knot, the Sanderling and the Turnstone nest on the dry barren grounds tundra. The former two species are found at the New-Siberian Islands only, and the nesting density of the latter on the mainland tundra is much lower. There are no data on departure of the adult birds. The fledged young birds appear on laidas in mid-August and they are known as nomadic at the northern coast of the Anjou Islands. In autumn the Sanderling can be also observed in small numbers on the mainland tundra in the Lena-Delta (Pozdnyakov, pers. comm.). The migration goes eastward (Rutilevsky, 1958, 1960, 1967).

The Pectoral Sandpiper and the Little Stint nest everywhere on the mainland tundra, while only the latter is common at the islands. They are not connected with the maritime biotopes during the breeding season. The Pectoral Sandpiper prefers the polygonal sub-Arctic tundra attaching to deltas (Kistchinski, 1988). It departs the study area eastward, keeping to the sea coast during migration (Tomkovich, 1988). It feeds at the shoals in the lower deltas and small rivers. The migration goes in four waves, overlapping by dates (Kistchinski, 1988), consisting of the adult males (very early July), the failed-breeding females, the successful females and the young birds (the third 10-days of August). While fattening before departure, the Little Stint also occurs on islands in the lower deltas, although it prefers to feed at drying polygons and along the lake shores. While migrating, it feeds at silty lake shores on the maritime tundra (Tomkovich, 1988). The departure from western Yakutia (west of the Yana-Delta, presumably) is westward (Tomkovich, 1988; Solovieva, 1995). The direction of the departure of birds from E. Yakutia is unknown.

The Ruff nests on the southern sub-Arctic tundra far from the sea. Nomadic males that have finished breeding, occur on islands in the lower Lena-Delta (and, probably, in other deltas) during early July–mid-August. The departure from W. Yakutia eastward to the Yana-Delta

(Tomkovich, 1988) goes westward. Aggregations before departure are known in the W. Lena-Delta. The maritime brackish meadows and sedge marshes are the main feeding biotopes during migration (Tomkovich, 1988). It is also found at the New-Siberian Islands as a nomadic but not abundant species. A distinctive autumn migration of Ruffs, as well as of Pectoral Sandpipers, was observed in the eastern Anjou Islands in late August (Rutilevskiy, 1967).

The Bar-tailed Godwit breeds on sub-Arctic tundra, not reaching the sea coast, but as in other areas of the range, the non-breeding segment of the population make a northward summer migration. It used to be abundant on the Lyakhovsky, Kotelny and Faddeevskiy Islands during early July–first half of August several decades ago. Autumn eastward migration in flocks of up to 20 birds has been recorded on Faddeevskiy Island in late August (Rutilevskiy, 1967).

Regions of the Arctic coast of Yakutia that are important for maintaining non-breeding wader population, can be attributed to four main habitat types: the lower zones of big deltas, the maritime areas of watershed tundra, the coasts of sea islands and the coastal sea shallows. Since the accumulative relief forms, such as the shoals, beaches, spits and the coastal landscapes are represented by the lowland swampy plains and laidas (at the islands) are widespread along the coast, it may be suggested that during migration, waders make extensive use of the entire Yakut coast. The list of regions that are important for migrating waders is based on available data and it should be much longer:

- The lower deltas of large rivers with accumulated sand islands where sedge meadows and moss-lichen tundra dominate. The systems of lakes are connected with the sea or the delta arms by narrow meandering channels. The waders aggregate in these regions when moulting and fattening before departure.
  - the lower Olenekskaya channel of the Lena-Delta
  - the northern and eastern coasts of the Lena-Delta.
- The maritime zones of the watershed tundra that are represented by lacustrine depressions and brackish meadows bounded by silty-sand and pebble beaches in a narrow coastal strip. Used by waders during seasonal migrations.
  - Anabar Bay, Khorgo Cape;
  - coast of Satygan-Tala Bay;
  - interfluve of Bolshaya Chukochya and Konkovaya Rivers;
  - coast of the Yana Bay and the Lopatka Peninsula. These two regions correspond to the areas of dense breeding populations of the Grey Phalarope where migrations of adult birds on lacustrine tundra (often not connected with the sea) occur;
  - maritime tundra of Kotelny, Bungue and Faddeevskiy Islands;
  - lowland tundra of Bolshoy and Maly Lyakhovsky Islands.
- The coasts of sea islands. At the New-Siberian Islands, due to intensive destruction of the shores composed of porous materials, the accumulative relief forms are widespread, including beaches, drying zones, spits separating the inlets and lagoons from the sea. Used for fattening before flying across the sea.
  - northern coast of Kotelny, Bungue and Faddeevskiy Islands;

- mouth region of Ulakhan-Yuryakh River;
- coasts of Bolshoy and Maly Lyakhovskiy Islands.

- The sea shallows adjoining both the islands and the deltas are used by both species of phalaropes during fattening and migration.
  - northern shoal zone off the Lena-Delta;
  - coastal shallows of Anjou Islands;
  - coastal shallows of Lyakhovsky Islands.

The northern coast of Yakutia is rather poorly explored at present. The regions known as the places of wader aggregations are tens of kilometres from human settlements. The Lena-Delta State Reserve, including the buffer zone, covers a considerable part of the regions of mass aggregations of some species (phalaropes).

The areas most exposed to the threat of oil and other contamination are river mouth regions including deltas, estuaries and adjacent sea shoals (with a network of arms and lowland islands, that easily can be contaminated as a result of strong surge phenomena), as well as the coastal waters of the New-Siberian Islands adjoining at the south the extensively used NSR segment; the shallow Dm. Laptev Strait.

6.8 Chukotka

by A. Ya. Kondratiev

The territory of Chukotka (from the eastern coast of Kolyma to the Bering Strait) is inhabited by 26 wader species, vagrants not included. Among these the Sharp-tailed Sandpiper, the Red-necked Stint and the Spoon-billed Sandpiper are Siberian endemic species (the latter is included in the Red Data Book of the Russian Federation).

The following main types of habitats are found at the coast. The maritime *Dryas* patchy tundra extending along the shore in a narrow discontinuous strip up to 100 m wide; it covers not more than 2% of the total area. About half of the wader species nest on this type of tundra. The Temminck's Stint is the background species with breeding density of 30–100 nests/km^2. The Dunlin is also abundant with density up to 70 nests/km^2. The Grey Plover, the Turnstone and the Red-necked Sandpiper (density of 0.1–10 nests/km^2) are typical. For the Spoon-billed Sandpiper inhabiting the Chukchi Peninsula west of the Amguema mouth, this is actually the only suitable nesting biotope (the density in Vankarem Lowland is 30–50 nests/km^2). The total nesting density on the maritime patchy tundra of the Chaun and Vankarem Lowlands varies by years from 60 to 180 nests/km^2 (Kondratiev, 1982). For the low sea shores, the pebble and sand spits and beaches are very typical. Here, the nesting fauna of waders is represented by only three species including Ringed Plover, Turnstone and Temminck's Stint. The Ringed Plover is the only common inhabitant of the beaches and is absolutely dominant by nesting density (up to 9 nests/km^2 of a total density up to 10.2 nests/km^2 in the Vankarem Lowland;

Kondratiev, 1982). At the southern coast of the Chaun Bay nesting density of waders in this biotope is 4.5 nests/km^2 (3.85–5.25; Kondratiev, unpubl. data). The maritime marshes and swampy meadows occupying about 8% of the area along the coast of the Chaun Lowland are poorly inhabited by waders (1.0, range 0.25–5.0 nests/km^2; Kondratiev, unpubl. data).

In the eastern region of the Chukchi Peninsula Western Sandpiper and Rock Sandpiper are associated with maritime tundra and marine terraces (Tomkovich & Sorokin, 1983).

The hillocky tundra, which is rather non-uniformly inhabited by waders, prevails. The total nesting density has been found to be 20–35 nests/km^2 (Vankarem Lowland; Kondratiev, 1982) and 2.5–7.9 (4.0) nests/km^2 (Chaun Lowland; Kondratiev, unpubl. data). Also, in the Chaun Lowland the flood-plain shrub marshes are widespread. Wader density there varies from 18–72 nests/km^2 (45 on average; Kondratiev, unpubl. data). Dunlins and phalaropes are typical for the wet hillocky tundra; Ruffs, Dunlins and Red-necked Phalaropes dominate on bogs; while Pectoral Sandpiper and Long-billed Dowitcher are found in both habitats.

Like in other regions, the phalaropes are connected with the sea coast during the non-breeding period. Many sandpipers and Turnstones move to lagoons and beaches at the end of the nesting period, while the rest of the waders move along the beaches of the water bodies of the maritime tundra.

Female Red-necked Phalaropes migrate in small flocks along tundra lakes from the end of June, and by the first 10-day period of July they shift toward the sea coast where flocks numbering 150–200 waders stay on brackish lacustrine meadows and lagoons. A significant number of females also migrate to the inner freshwater bodies. The migrating males that have finished brood rearing appear from the end of July. Mixed flocks of males and young become numerous from August 10–15. Like the females during autumn migrations they are encountered at the seaside and on the tundra. At East Chukotka the Red-necked Phalarope is mainly observed during migration from the end of July and during the whole of August. The migrating flocks at sea number up to 50 individuals.

The biology of the Grey Phalarope is in many respects similar, but unlike the Red-necked Phalarope the Grey Phalarope keeps solely to the seaside after the end of the nesting period. Flocks of adult birds not exceeding 20–30 individuals are observed from the end of June (females) up to the end of July (males) on the tundra. The largest aggregations of phalaropes are observed at the coast of E. Chukotka at the end of July, where their flocks number thousands of birds. The density of feeding waders in the surf strip reaches 40,000 ind./km^2. At sea, next to Uellen, a mass night stage of waders was observed at the end of August. From the end of July small flocks of the flying young appear at sea. The flight of the young occurs during the second 10-day period of August and the flocks number hundreds of birds.

Dunlin females that have left the growing broods, and the failed-breeding males appear on the coastal tundra by the first 10-day period of July. Aggregations of nomadic waders are observed both along the shores of the lagoons and the maritime lakes and at pebble sea beaches. Gradually they are joined by the males that have left the broods. The Rock Sandpipers are often observed in mixed flocks with Dunlins. At E. Chukotka the young Red-necked Sandpipers (first half of August), Western Sandpipers and Baird's Sandpipers also migrate along the seaside. Young are observed at the coast only in August. Departure occurs in late August–early September in the Chaun Lowland. In the E. Chukchi Peninsula migration continues up to the second half of September.

The young Turnstones may move to the sea coast after fledging in family groups, but more often singly. They form groups of 10–30 individuals and fly away in mid-August–early September. In the E. Chukotka aggregations of Turnstones (as well as of Rock Sandpipers) are observed to attach to garbage dumping and hunting waste sites. In some years non-breeding Red Knot stays at the coast.

The Temminck's Stints which have left the broods, move along the shores of the lagoons near the breeding areas. They depart unnoticed in late August. The Ringed Plovers also migrate gradually; the non-breeders leave E. Chukotka in mid-July, successful breeders by mid-August and young birds by the end of August (Tomkovich & Sorokin, 1983).

Flocks of 10–15 adult Long-billed Dowitchers consisting of birds that due to different reasons have finished participation in breeding, appear from late June to the first 10-day period of July. The young begin nomadic movements along the silty shores and shallow zones of maritime lakes from mid-August. At the nesting grounds the waders stay up to late August, sometimes up to mid-September. Spotted Redshanks gather in flocks of 15–20 birds before departure and move along the coast with the Long-billed Dowitchers.

The nomadic females of the Ruff appear on the maritime lowland tundra in mid-July, whereas the young flying birds appear from late July to early August. During autumn migrations they are single or in small flocks of several individuals and depart gradually.

Unlike other sandpipers the Pectoral Sandpiper never appears at the maritime silty shoals during autumn migrations, but prefers banks of tundra lakes and lowland wet tundra. In E. Chukotka the migration of adult males is observed during July, of females from late July to the first 10-day period of August, and the migration of the young peaks at the second–third 10-day periods of August.

The Grey Plover broods having left the nests, move along the banks of the tundra water bodies. The adults depart in small groups by August 15–20. The non-breeding Pacific Golden Plovers migrate already from early July, the successful birds concentrate near the tundra water bodies only after the young take on wings in the first 10-days of August. Distinctive migration in E. Chukotka is observed from mid-August, and the young waders mainly fly along the coast (Tomkovich & Sorokin, 1983). The plovers leave the nesting grounds by mid-September sometimes remaining up to the end of the month (Kondratiev, 1982).

The plain landscapes along the coast under consideration are periodically broken up by more or less extended bedrock outcrops which are typical for the areas east of Chaun Bay. Near-delta lowlands and a network of shallow lagoons are widespread. The largest aggregations of waders are confined to the coastal shallow zones and lagoons, the maritime lowland tundra and brackish marshes, as well as to the sand-silty shoals and pebble beaches. Within the area under consideration the following regions, differing by habitats and wader populations, can be defined (the quantitative characteristics are based on observations from 1981–1983; Kondratiev, unpubl. data):

- Chaun Lowland. This is a vast quite uniform plain gradually sloping toward the sea. The lowland is cut by numerous rivers. Lakes are abundant on the maritime tundra of the lowland. These are mostly shallow thermo-karstic water bodies with strongly irregular shores. As a result of the drift of lakes, many drained lake troughs are formed which are the favourite places for waterbird aggregations. The lowland shores of the sea bays are occupied by swampy meadows and marshes with alternating pebble terraces and sand dunes. The brackish lagoon lakes are numerous.
  - Maritime marshes. A maximum wader density of 950–1,550 ind./km^2 is recorded here in the second–third 10-days of August;
  - Marine pebble-sand terraces. A maximum non-breeding wader density of 450–520 ind./km^2 is recorded here in the second 10-days of August;
  - Hummocky tundra and flood-plain shrub swamps. Maximum densities of 390–750 and 450–850 ind./km^2, respectively, are recorded here in the second–third 10-days of August.
- Shelagskiy Cape – Amguema-Delta. Lowland landscapes suitable for waterbirds are rare and strongly transformed by the mining industry here. The western region up to the Kiber Cape is chiefly mountainous. East of the Pegtymel mouth the mountain massifs reach the coast only in the form of rare relics. The coastline consists of continuous pebble terraces and spits separating vast shallow lagoons. The shores of these lagoons and the rivers falling into them are the main areas for water birds inhabiting this region. Phalaropes dominate in wader aggregations practically everywhere.
  - Erguveyem mouth – Kiber Cape. The density of phalaropes is 200 ind./km^2, and that of other waders is 100 ind./km^2;
  - Nolde inlet. The density of phalaropes is ca. 100 ind./km^2, of other waders 200 ind./km^2;
  - Eastern shore of the Pegtymel mouth. The density of phalaropes is ca. 200 ind./km^2, of other waders 480 ind./km^2;
  - Billings Cape. The density of phalaropes is 410 ind./km^2, of other waders 220 ind./km^2;
  - Kuekvun River mouth. The density of phalaropes is 220 ind./km^2, of other waders 630 ind./km^2;
  - Ekvyvatap River mouth. The density of phalaropes is 200 ind./km^2, of other waders 420 ind./km^2;
- Vankarem Lowland and the coast of Kolyuchin Bay. The coastal tundra is wet and low, and networks of lagoons, separated from the sea by spits and small islets, is widespread.
  - Belyaka Spit. The most abundant wader aggregations (except for the phalaropes) number 4,000 individuals (second half of August);
  - Neskan-Pilgyn Lagoon. The most abundant wader aggregations (except for the phalaropes) number 3,500 individuals (the last 10-days of August);

  - N. Kolyuchin Bay area including the coast and water. Aggregations of phalaropes are the most abundant, numbering up to 2,500 individuals (the first 10-days of August);
  - Vankarem Lagoon. The most abundant are phalarope aggregations numbering up to 1,200 individuals (the first 10-days of August);
  - W. Kolyuchin Bay, the lowland tundra. The largest wader aggregations (except for the phalaropes) number ca. 700 individuals (the last 10-day of August).
- East of the Serdtse-Kamen Cape. The most important region for the water birds is the shores of the Inchoun and Uellen Lagoons with the adjoining tundra of lower reaches of the Uteveyem and Usunveyem Rivers. Here the mass wader migration passes along the sea shore.
  - Uellen Lagoon and the adjoining shallows are the most important Grey Phalarope staging area known in the area;
  - Coastal lowland tundra and sea coasts. Sandpipers and aggregations of other wader species are observed before departure.

The lagoons and the bays that are principal habitats of aggregating waders, are well protected with regard to oil spills at sea. Grey Phalarope staging areas are located in the open sea (nearby Uellen, and apparently also in other places) are subjected to the largest risk of oil pollution. With intensification of shipping along the NSR and development of coastal infrastructure the coast and the area of the Chaun Bay, that are already under a high anthropogenic pressure, will also be subjected to a high risk. The Spoon-billed Sandpiper is exposed to the greatest potential risk of oil pollution being a rare Far East endemic species, with limited breeding range and overall number not more than several thousands of individuals. Although it does not aggregate within the study area it is a stenotopic species with a high nesting density only in the brackish habitats extending along the shore in a strip not more than 100 m wide. If there is a large oil spill, the pollution of the coast, as well as large-scale emergency operations, may have catastrophic impacts on the status of this species.

6.9 Wrangel Island

by Maria Gavrilo

More than 30 wader species are recorded on Wrangel Island, including 14–18 breeding and 14 vagrant species. The Grey Plover, the Turnstone, the Dunlin, the Grey Phalarope, the Pectoral Sandpiper and the Red Knot are found to be background species. The Pacific Golden Plover, the Ringed Plover, the Dotterel, the Ruff, the Red-necked Phalarope and the Buff-breasted Sandpiper are rare sporadic breeders, while the Baird's Sandpiper is a regular but rare breeding species. The Semipalmated Plover, Red-necked Stint, Temminck's Stint and the Curlew Sandpiper are very likely to breed on the island, and the Bar-tailed Godwit is recorded as a regular vagrant.

The most common, abundant and widespread are the Grey Plover, the Turnstone, the Dunlin and the Red Knot. The first two species inhabit the greatest variety of biotopes, with the maximum density during the breeding period (up to 50 and 100 ind./km^2 respectively, but most of them are non-breeders) found in wet depressions. Both species nest in coastal accumulative habitats; the Turnstone is common here (density 15–20 ind./km^2), whilst the Grey Plover is a rare breeder only. After the chicks have fledged, nomadic flocks numbering hundreds of Grey Plovers and dozens of Turnstones appear at tundra lake shores. Then, during late August–mid-September, the waders move along the sea coast and lagoons, but the flocks do not exceed ten birds. The last birds depart by late September.

The Red Knot is the third most abundant species together with the Turnstone and the Grey Plover. During breeding it is tied up chiefly with uplands with the maximum density (up to 35 ind./km^2) found on polygonal tundra. By late June nomadic non-breeders in flocks of 15–20 birds together with Turnstones and Grey Plovers start moving over wetlands with the most dense concentrations (up to 30 ind./km^2) in depressions and lake basins. By mid-July the broods shift to wetlands as well. As the chicks fledge, by late July–early August, the broods join in flocks of 30–40 birds and appear in the coastal habitats including lagoon shores and silty shoals. Most Red Knots depart by 20th August, but small flocks can be observed during all of September.

The Dunlins, unlike the species described above, prefer wet hummocky habitats (total density up to 80–150 ind./km^2) being dominant among waders and co-dominant in the overall bird community. Flightless broods move over the most wet habitats, lake basins chiefly, but do not form large aggregations due to prolonged timing of breeding. By mid-August, the young that took on wings, come ashore and gather in flocks of 10–15 birds. Silty shoals, sand-silty estuaries and brackish marshes are the preferable habitats, but the sand-pebble beaches are strongly avoided. Tidal habitats are the most extensively used areas, where flocks of several hundred birds are recorded during late August. Most Dunlins depart by early September.

The Pectoral Sandpiper is a common, sometimes abundant species. The breeding distribution patterns are similar to those of the Dunlin, but moss habitats are preferred (with density up to 25 ind./km^2). Summer distribution patterns in Pectoral Sandpipers suggest that waders from the mainland migrate to the island in summer. There is a distinctive migration (flocks of several hundreds) in the Tundra of Academy during the second half of June. By early July non-breeding waders gather in the most wet moss habitats (density up to 80–100 ind./km^2) in flocks of 10–30 birds. As chicks hatch, by the second half of July, the broods shift to depressions as well. As opposed to other sandpipers, the Pectoral Sandpipers very seldom come to the coast and never make aggregations there. Most of the population departs by early September.

The Long-billed Dowitcher is not abundant, but it is common as a summer resident. Summer nomadic movements start 7–10 days after the snow cover has gone. During this period (early June–second 10-days of August) it is found on the Tundra of Academy only. The Long-billed Dowitchers make extensive use of wet grassy-turfed areas rich in small lakes and ponds (density up to 35–40 ind./km^2) where they occur in flocks of 3–5 birds, usually together with Pectoral Sandpipers and Dunlins. In Autumn (mid-August to mid-September) the Long-billed

Dowitchers are distributed over S. Wrangel Island, occurring along lagoons, inter-lagoon depressions and lake basins as well.

The Grey Phalarope is the most marine wader on the island as well as in other parts of the NSR area. It is a common breeder on the plains only, with the maximum density (up to 50 ind./km^2) found in landscapes rich in lake basins. The Grey Phalaropes are abundant as nomadic and migrating. The non-breeding birds become common on the coast by mid-July, as ice has disappeared from their preferred habitats (lagoons and river-mouth areas). The maximum abundance of the Grey Phalaropes is reached during August. They are found to be most numerous (flocks numbering up to several thousand individuals) along the northern coast where lagoons, nearby shallows and silty shoals are the principal habitats. Feeding distribution patterns, found to be strongly dependent on ice conditions, are as follows: the Grey Phalaropes make extensive use of the narrow (less than 100 m wide) sea-side strip of the spits when there is open water (local density up to 500,000 ind./km^2); all birds remain inside lagoons (local density up to 2–2,200,000 ind./km^2) when close drift ice; the waders occur both in lagoons and adjacent sea shallows when ice-free water. Flocks of hundreds of phalaropes are observed feeding in the channels between spits during surge phenomena. Most of the population leaves Wrangel Island during September, but the last birds can be observed till the sea freezes.

The regions of Wrangel Island that are important for maintaining non-breeding wader population are of the following types:

- The maritime accumulative plains with different grass-moss tundra and bogs. Wet depressions covered by turfy grass-moss communities are used most extensively by non-breeding waders.
  - Tundra of Academy: mass migration of non-breeding Pectoral Sandpipers; summer aggregations of Pectoral Sandpipers, Dunlins, Turnstones, Grey Plovers, Long-billed Dowitchers and Red Knots;
  - the Southern Tundra including areas nearby Blossom Cape and Somnitelnaya Bay: summer aggregations of Pectoral Sandpipers, Dunlins, Turnstones, Grey Plovers, Red Knots; autumn aggregations of Pectoral Sandpipers and Long-billed Dowitchers.
- Low coasts with widespread accumulative habitats such as spits, beaches, lagoons, silty shoals and nearby shallows as well.
  - the northern coast: the most important area for non-breeding Grey Phalaropes; mass autumn aggregations of Dunlins, Turnstones, Grey Plovers and Red Knots;
  - the southern coast including Blossom Cape and Somnitelnaya Bay areas: autumn concentrations of Grey Phalaropes, Dunlins and Long-billed Dowitchers, as well as of Turnstones, Grey Plovers and Red Knots.

Since a strict nature reserve has been established on the territory of Wrangel Island and the nearby waters, all important habitats are under good protection at present. Taking into account the remote position of the island, one can suggest that increased shipping along the NSR will affect waders in this area only slightly.

7. CONCLUSIONS

The data presented in this paper describe the VEC's that have been chosen during previous work. As both separate species and groups of species can be considered as VEC's, two approaches were used to present relevant data. The presented information about distribution, numbers, phenology, food habits and breeding biology of the marine birds inhabiting the NSR area can be used as a basis for the Environmental Impact Assessment. However we should stress that there is an obvious lack of data on the non-breeding period of the birds' lives, especially at sea. It is the period spent in marine areas that is suggested to be the most vulnerable during the annual cycle. The quantitative data are also not good enough to make accurate modelling and assessment at the local sites considered to be important areas within the NSR region. There was no special field research within the frame of the INSROP to obtain necessary biological data, and we believe that complex biological and ecological survey under the INSROP aiming to obtain information which is of extreme importance for the EIA and cannot be taken from other projects, would be quite useful both in terms of science and politics.

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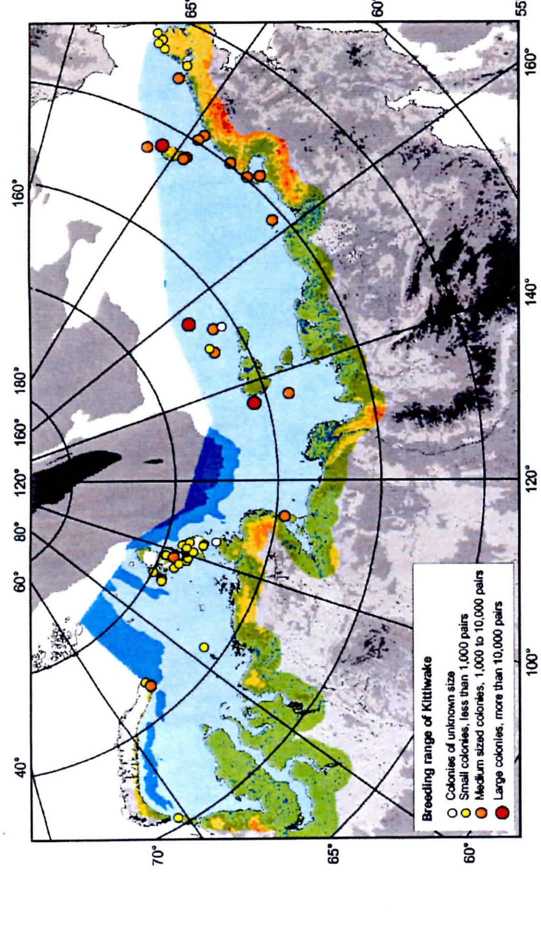
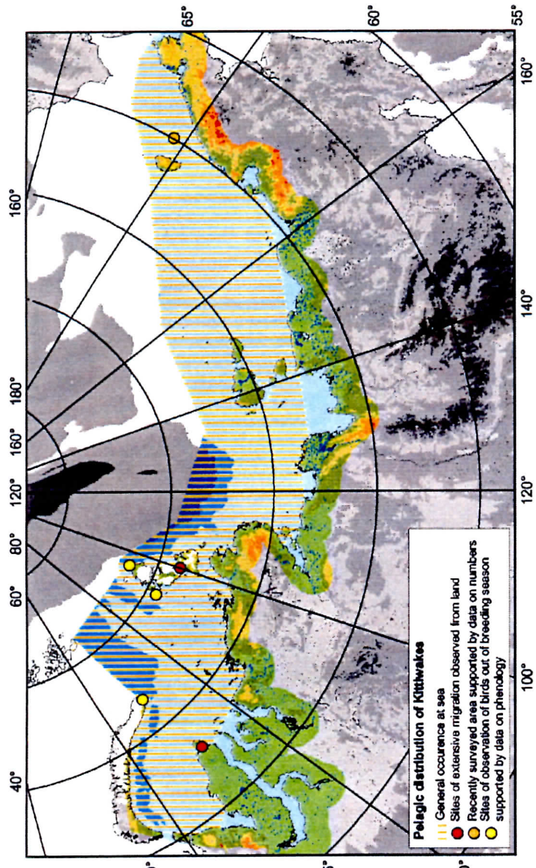
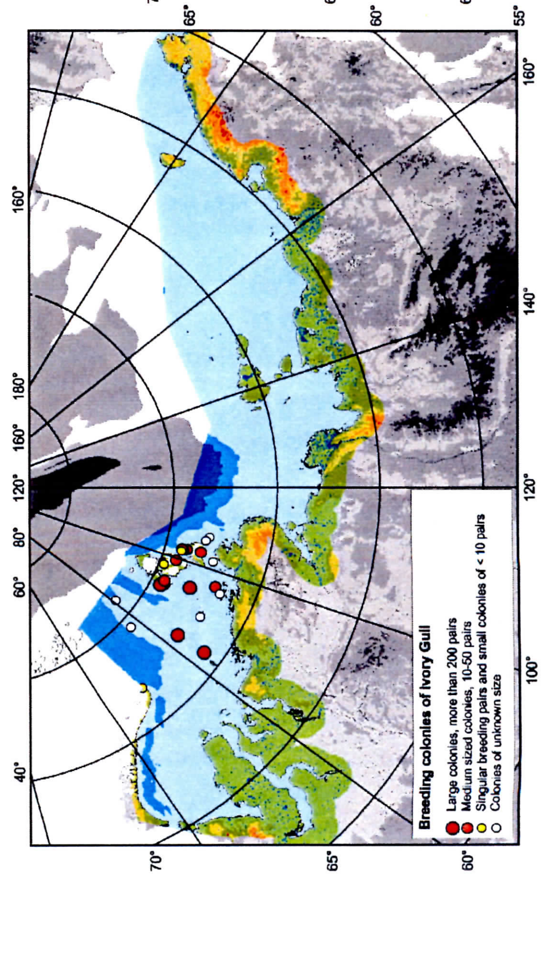
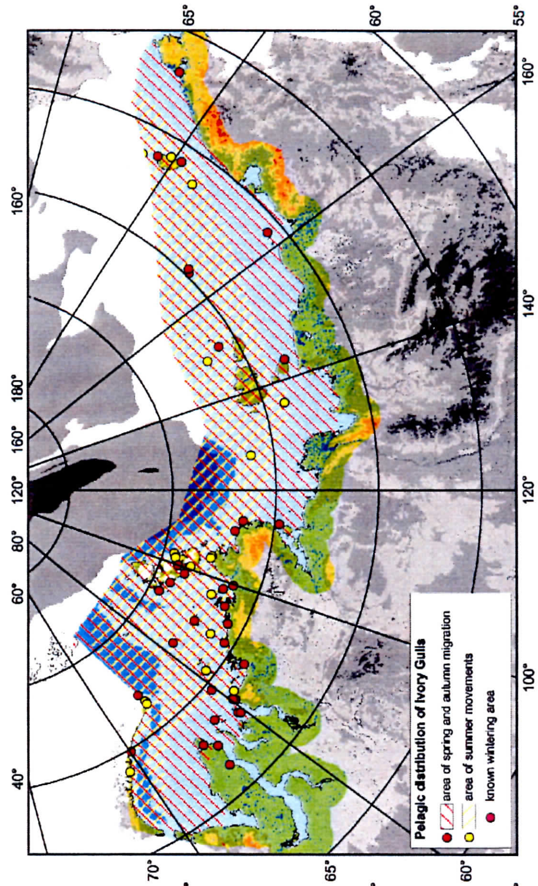
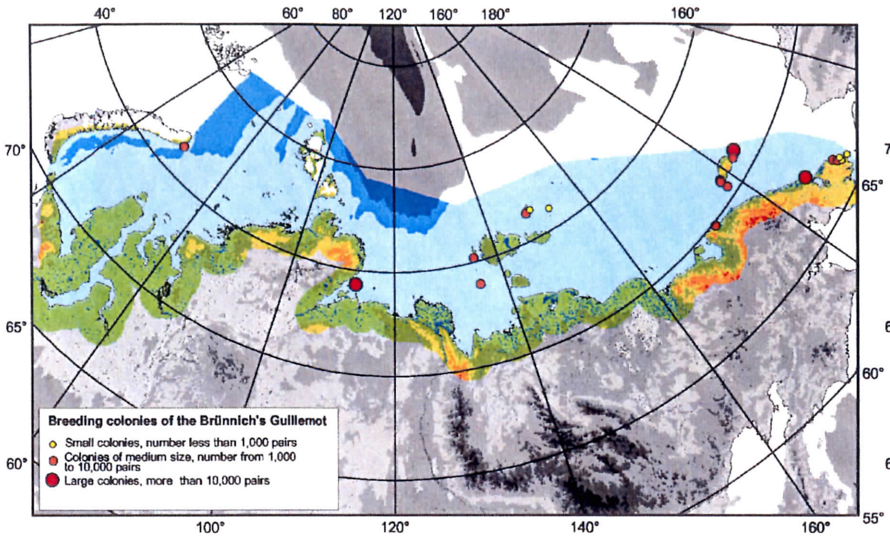
9. APPENDIX. DISTRIBUTION MAPS

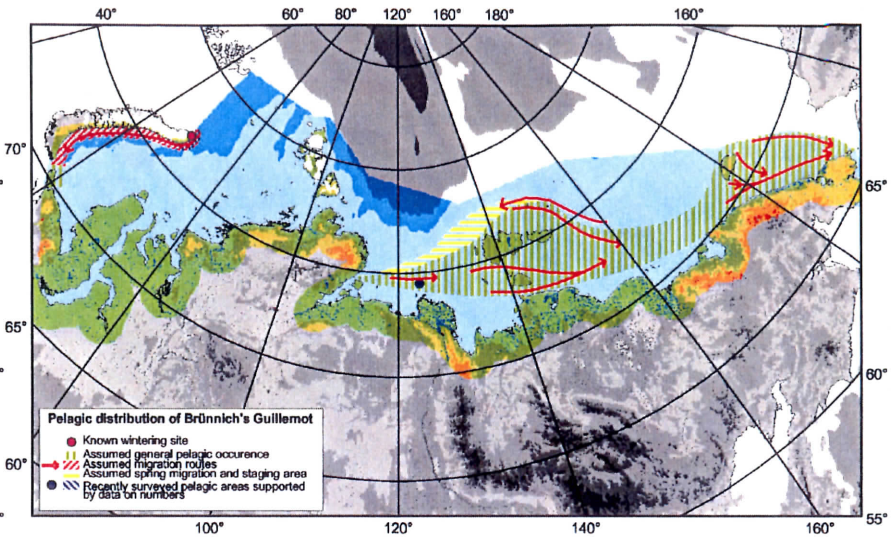

Breeding range of Kittiwake
Colonies of unknown size
Small colonies, less than 1,000 pairs
Medium sized colonies, 1,000 to 10,000 pairs
Large colonies, more than 10,000 pairs
70°
65°
60°
55°
40°
60°
80°
120°
160°
180°
160°
140°
100°
120°

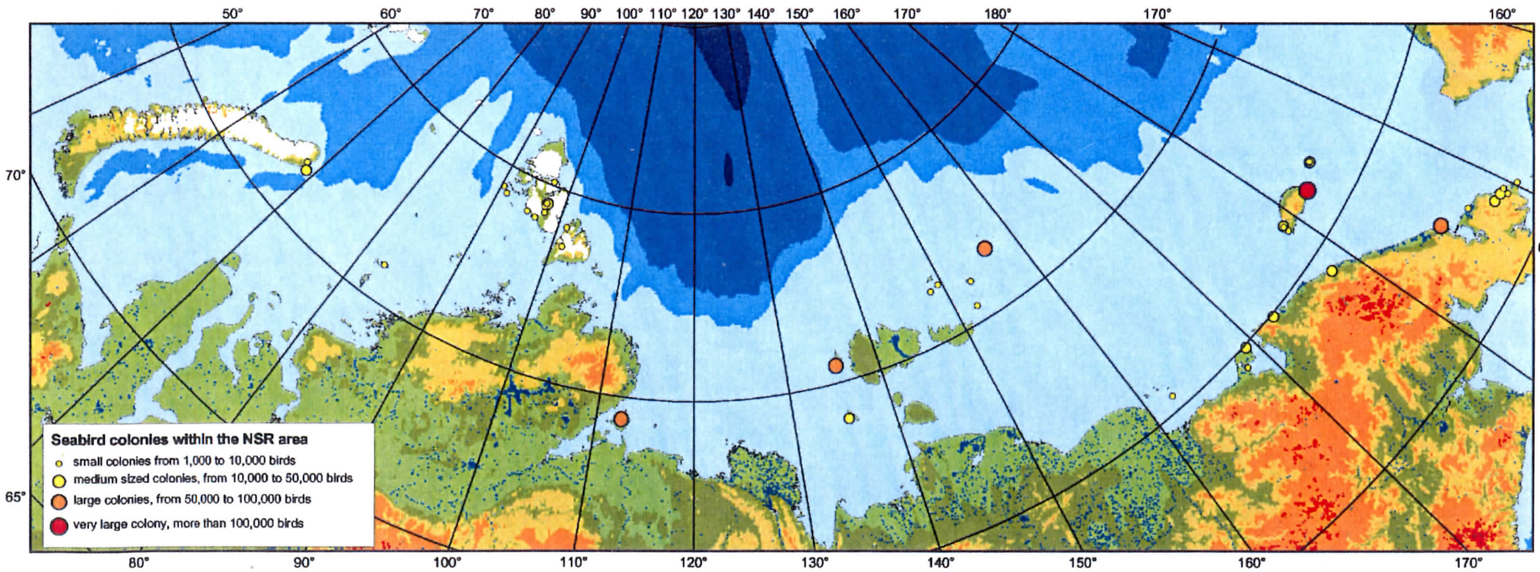

Pelagic distribution of Kittiwakes
General occurence at sea
Sites of extensive migration observed from land
Recently surveyed area supported by data on numbers
Sites of observation of birds out of breeding season supported by data on phenology
70°
65°
60°
55°
40°
60°
80°
120°
160°
180°
160°
140°
100°
120°

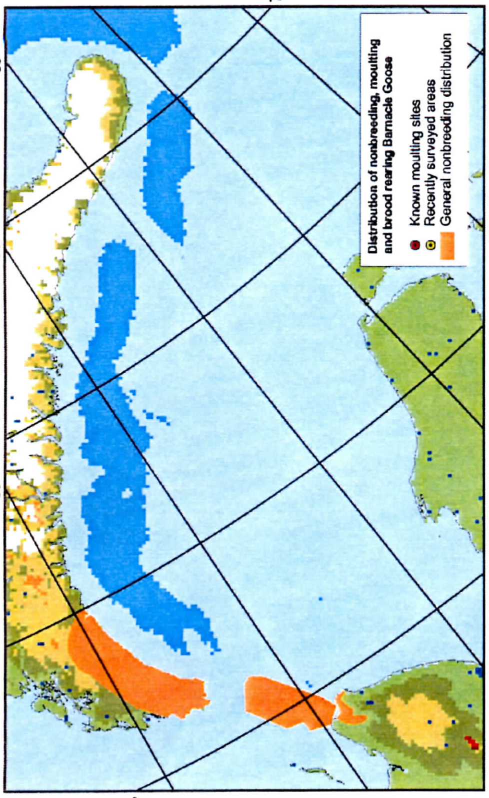

Breeding colonies of Ivory Gull
Large colonies, more than 200 pairs
Medium sized colonies, 10-50 pairs
Singular breeding pairs and small colonies of < 10 pairs
Colonies of unknown size
70°
65°
60°
55°
40°
60°
80°
120°
160°
180°
160°
140°
100°
120°

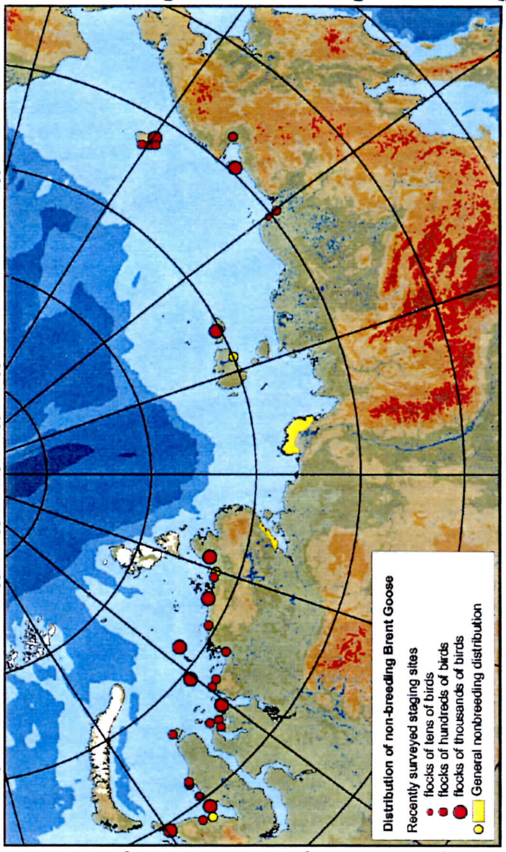

Pelagic distribution of Ivory Gulls
area of spring and autumn migration
area of summer movements
known wintering area
70°
65°
60°
55°
40°
60°
80°
120°
160°
180°
160°
140°
100°
120°

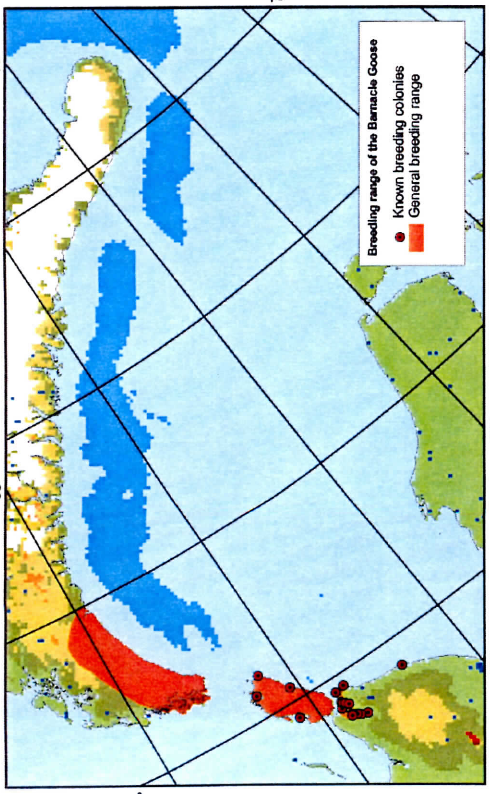

Breeding colonies of the Brünnich's Guillemot
Small colonies, number less than 1,000 pairs
Colonies of medium size, number from 1,000 to 10,000 pairs
Large colonies, more than 10,000 pairs

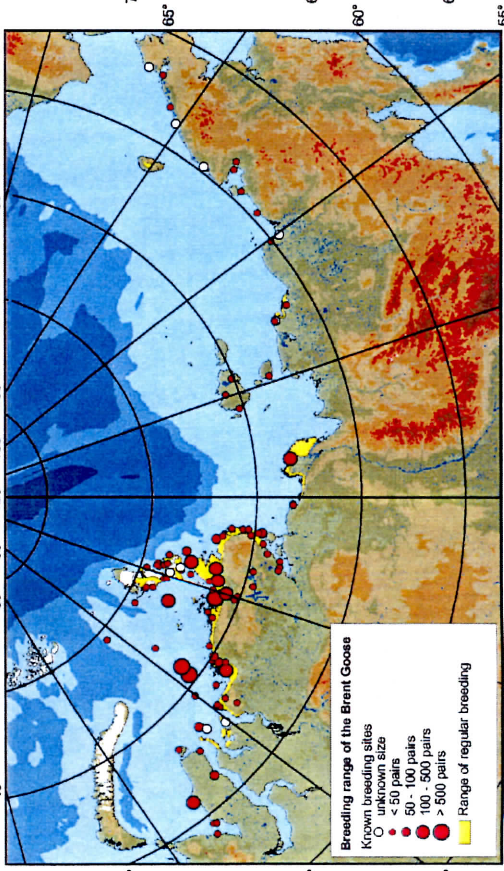

Pelagic distribution of Brünnich's Guillemot
Known wintering site
Assumed general pelagic occurence
Assumed migration routes
Assumed spring migration and staging area
Recently surveyed pelagic areas supported by data on numbers

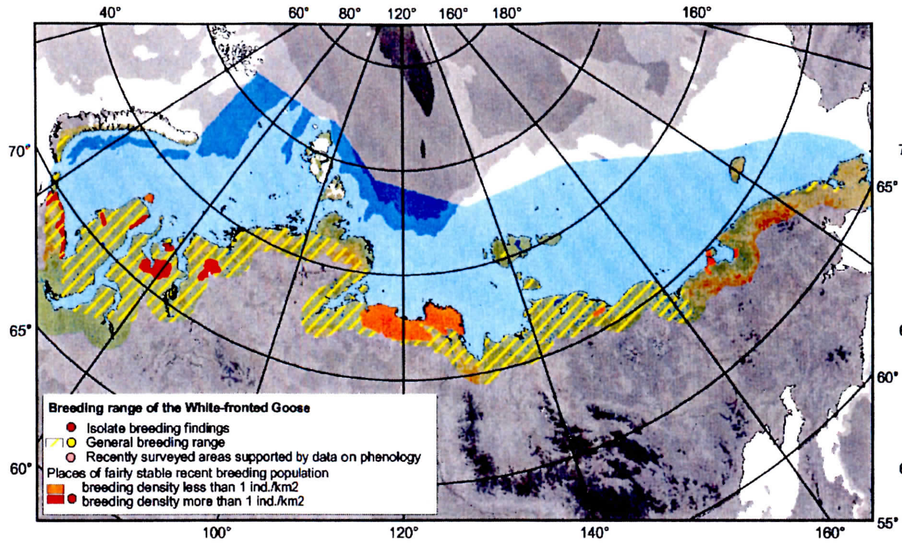

Seabird colonies within the NSR area
small colonies from 1,000 to 10,000 birds
medium sized colonies, from 10,000 to 50,000 birds
large colonies, from 50,000 to 100,000 birds
very large colony, more than 100,000 birds

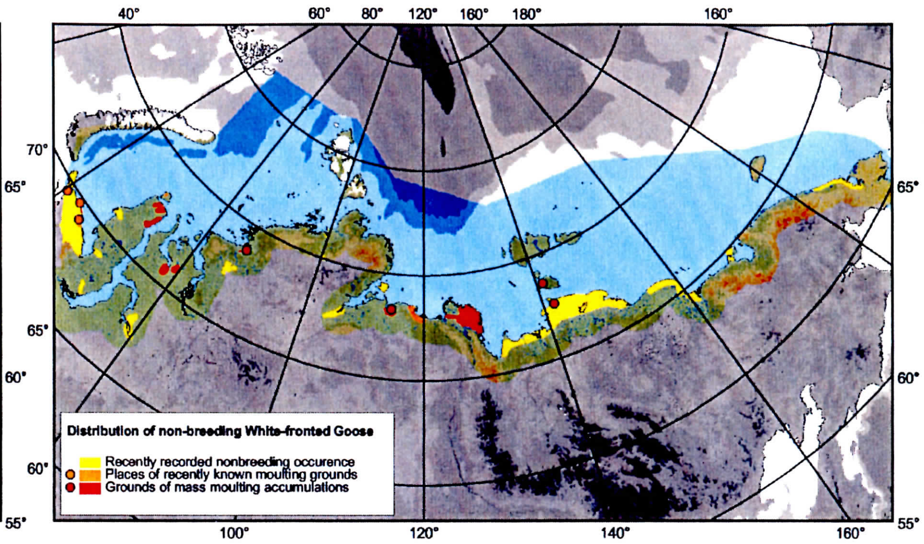

Distribution of nonbreeding, moulting and brood rearing Barnacle Goose
Known moulting sites
Recently surveyed areas
General nonbreeding distribution

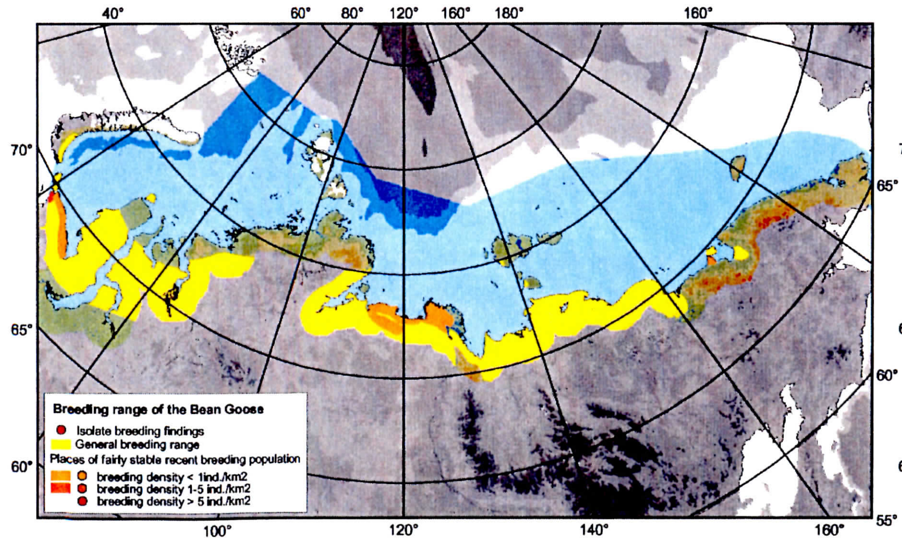

Distribution of non-breeding Brent Goose
Recently surveyed staging sites
flocks of tens of birds
flocks of hundreds of birds
flocks of thousands of birds
General nonbreeding distribution

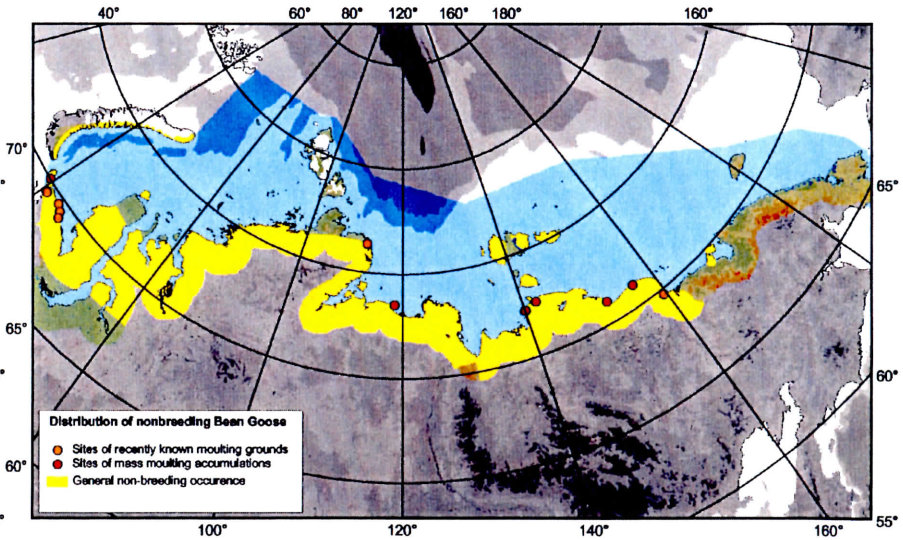

Breeding range of the Barnacle Goose
Known breeding colonies
General breeding range

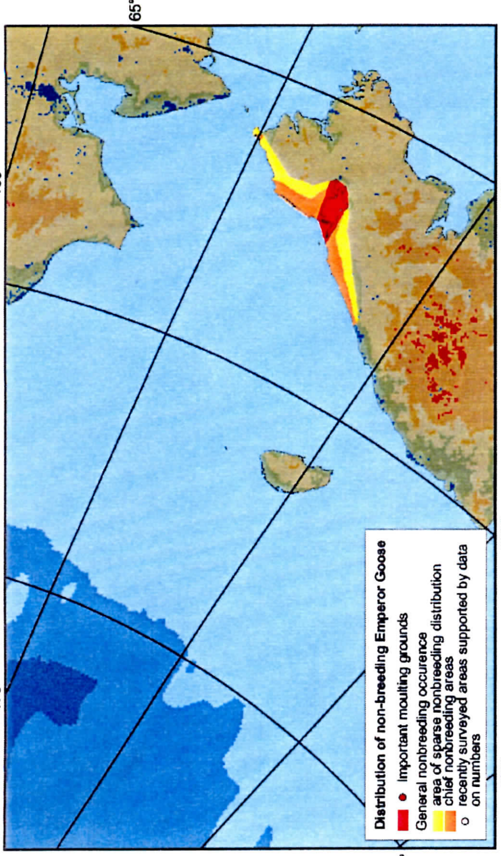

Breeding range of the Brent Goose
Known breeding sites
unknown size
< 50 pairs
50 - 100 pairs
100 - 500 pairs
> 500 pairs
Range of regular breeding

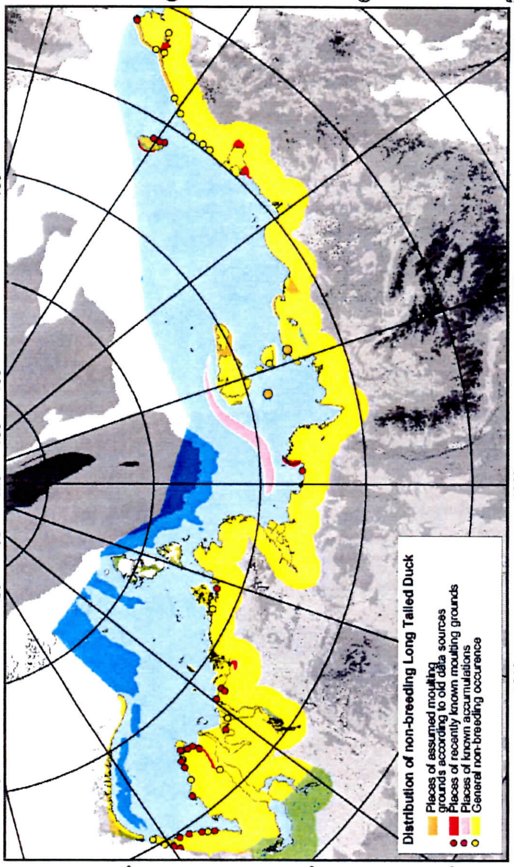

Breeding range of the White-fronted Goose
Isolate breeding findings
General breeding range
Recently surveyed areas supported by data on phenology
Places of fairly stable recent breeding population
breeding density less than 1 ind./km2
breeding density more than 1 ind./km2

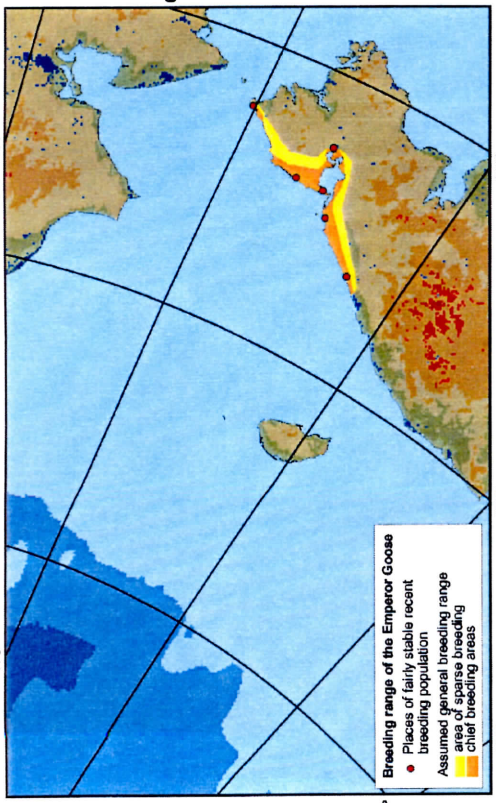

Distribution of non-breeding White-fronted Goose
Recently recorded nonbreeding occurence
Places of recently known moulting grounds
Grounds of mass moulting accumulations

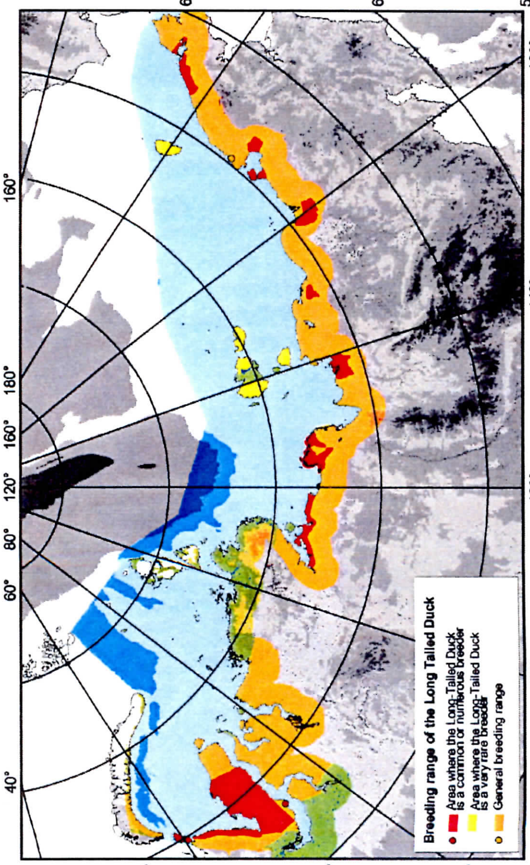

Breeding range of the Bean Goose
Isolate breeding findings
General breeding range
Places of fairly stable recent breeding population
breeding density < 1ind./km2
breeding density 1-5 ind./km2
breeding density > 5 ind./km2

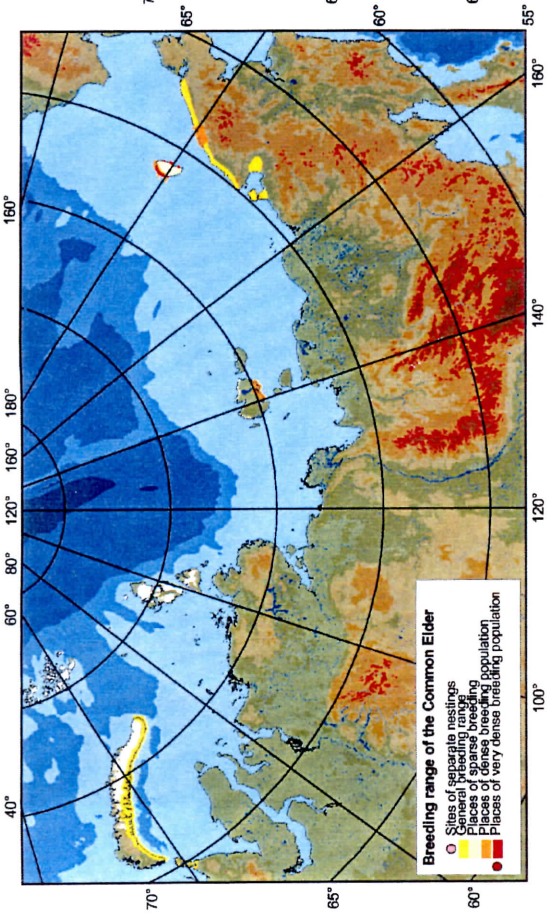

Distribution of nonbreeding Bean Goose
Sites of recently known moulting grounds
Sites of mass moulting accumulations
General non-breeding occurence

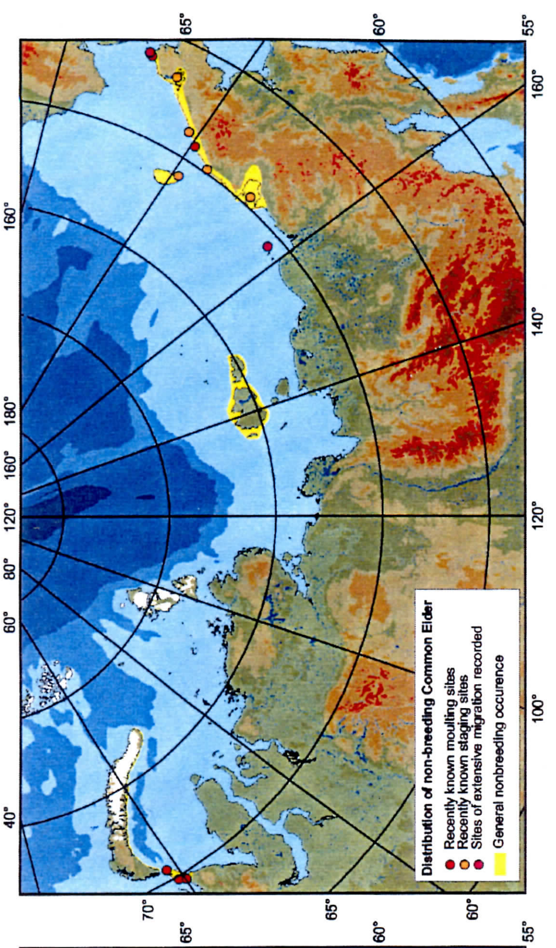

Distribution of non-breeding Emperor Goose
Important moulting grounds
General nonbreeding occurence
area of sparse nonbreeding distribution
chief nonbreeding areas
recently surveyed areas supported by data on numbers

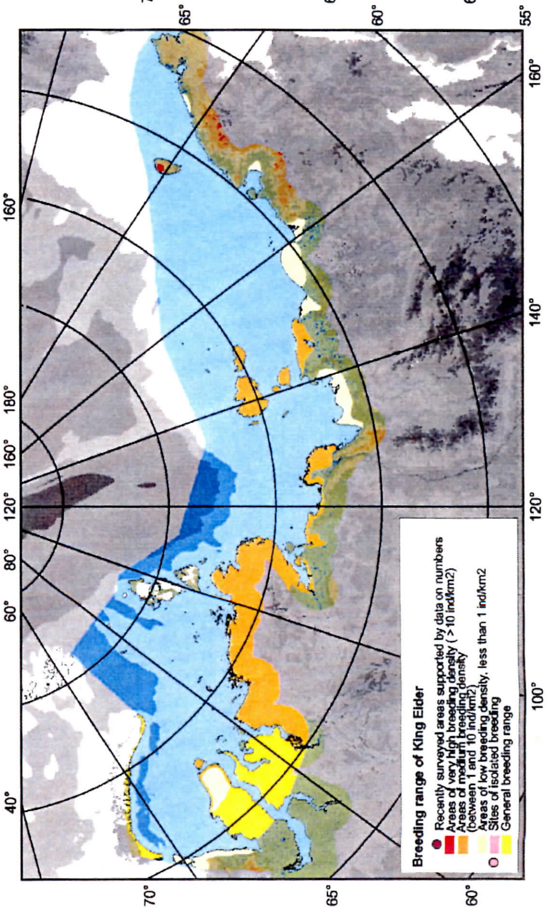

Distribution of non-breeding Long Tailed Duck
Places of assumed moulting grounds according to old data sources
Places of recently known moulting grounds
Places of known accumulations
General non-breeding occurence

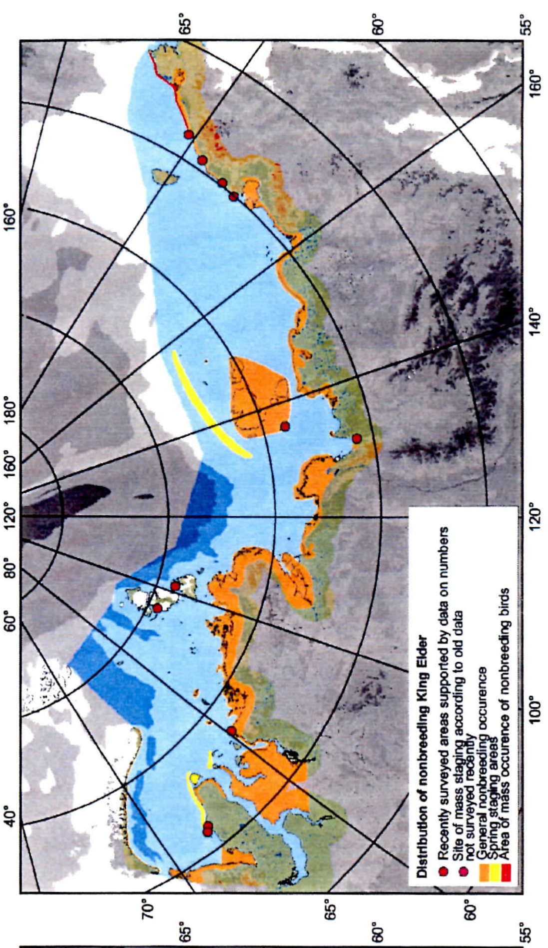

Breeding range of the Emperor Goose
Places of fairly stable recent breeding population
Assumed general breeding range
area of sparse breeding
chief breeding areas

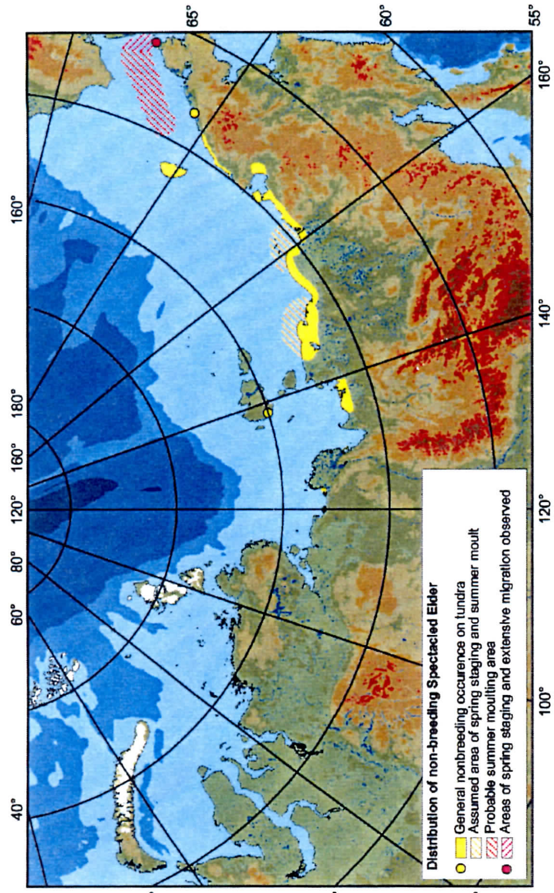

Breeding range of the Long Tailed Duck
Area where the Long-Tailed Duck is a common or numerous breeder
Area where the Long-Tailed Duck is a very rare breeder
General breeding range

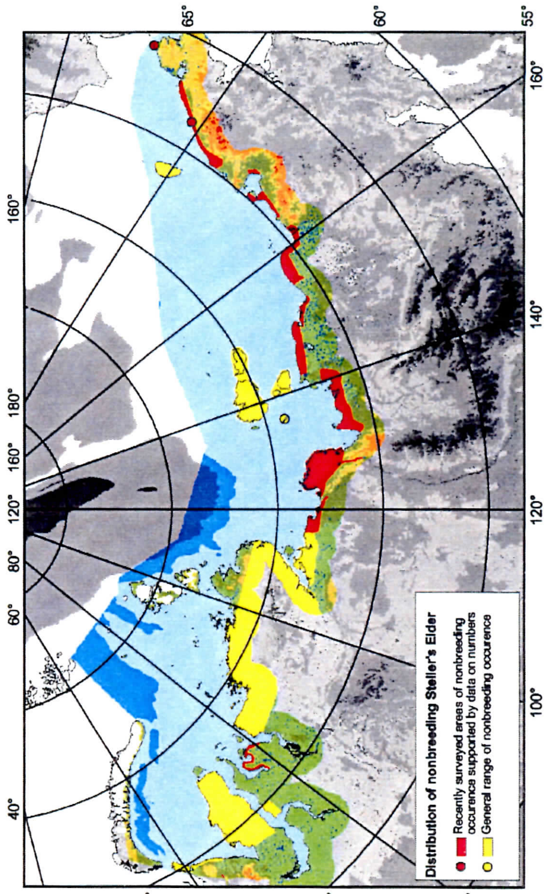

Breeding range of the Common Elder
Sites of separate nestings
General breeding range
Places of sparse breeding
Places of dense breeding population
Places of very dense breeding population

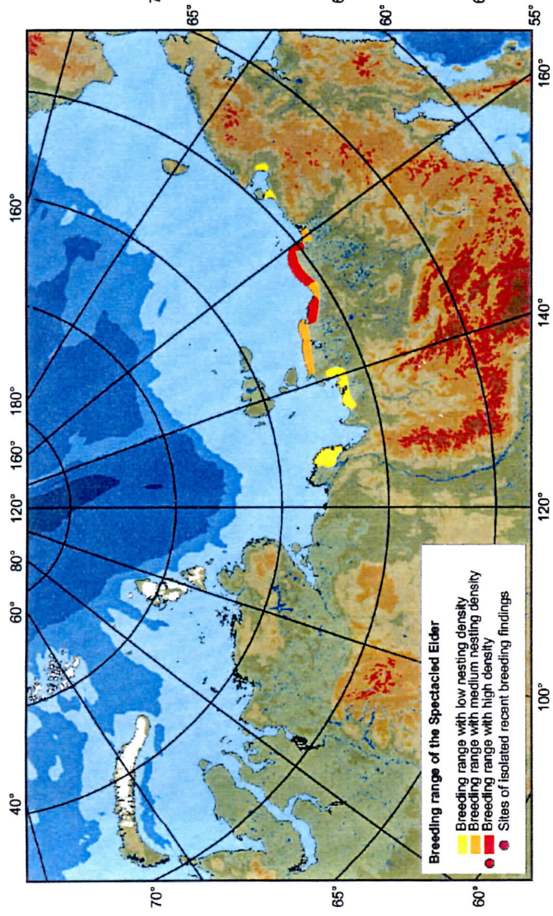

Distribution of non-breeding Common Elder
Recently known moulting sites
Recently known staging sites
Sites of extensive migration recorded
General nonbreeding occurence

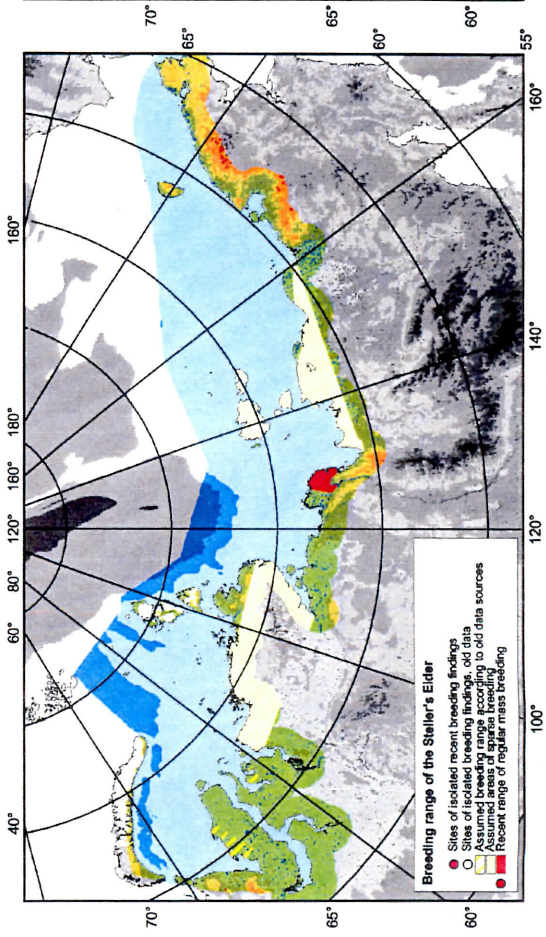

Breeding range of King Elder
Recently surveyed areas supported by data on numbers
Areas of very high breeding density (> 10 ind/km2)
Areas of medium breeding density (between 1 and 10 ind/km2)
Areas of low breeding density, less than 1 ind/km2
Sites of isolated breeding
General breeding range

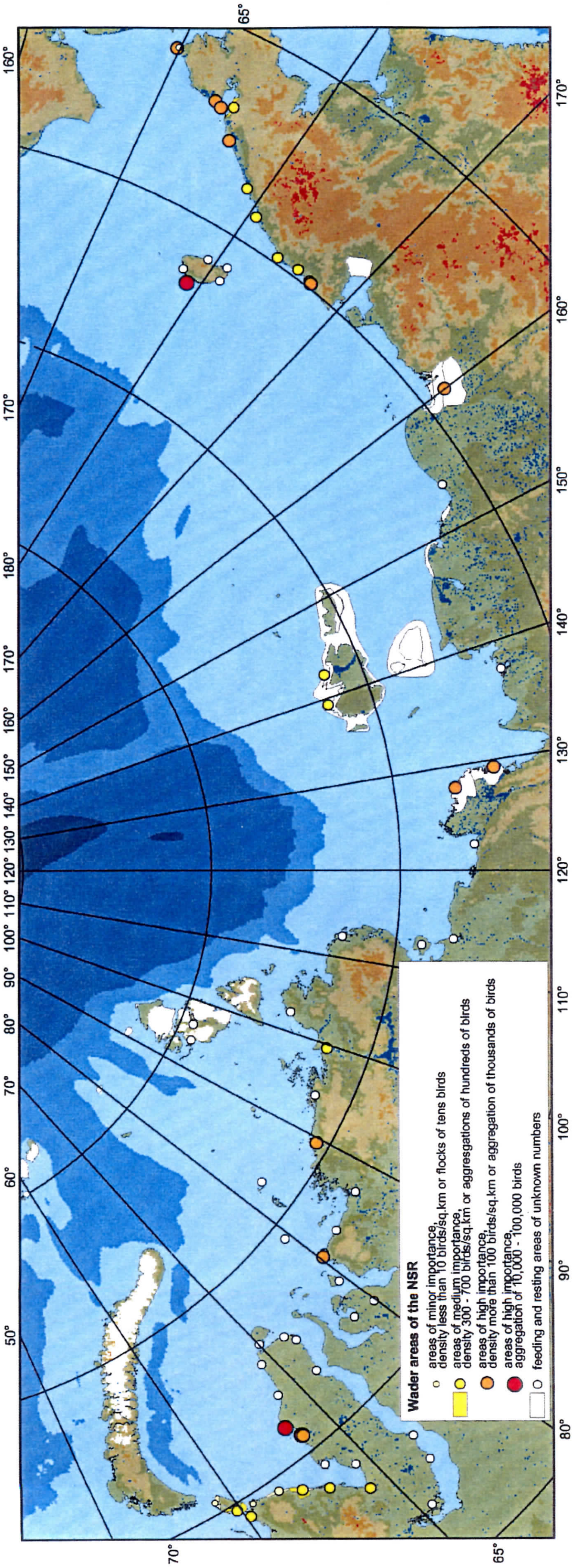

Distribution of nonbreeding King Elder
Recently surveyed areas supported by data on numbers
Site of mass staging according to old data
not surveyed recently
General nonbreeding occurence
Spring staging areas
Area of mass occurence of nonbreeding birds


Distribution of non-breeding Spectacled Elder
General nonbreeding occurence on tundra
Assumed area of spring staging and summer moult
Probable summer moulting area
Areas of spring staging and extensive migration observed


Distribution of nonbreeding Steller's Elder
Recently surveyed areas of nonbreeding occurence supported by data on numbers
General range of nonbreeding occurence


Breeding range of the Spectacled Elder
Breeding range with low nesting density
Breeding range with medium nesting density
Breeding range with high density
Sites of isolated recent breeding findings


Breeding range of the Steller's Elder
Sites of isolated recent breeding findings
Sites of isolated breeding findings, old data
Assumed breeding range according to old data sources
Assumed areas of sparse breeding
Recent range of regular mass breeding


Wader areas of the NSR
areas of minor importance, density less than 10 birds/sq.km or flocks of tens birds
areas of medium importance, density 300 - 700 birds/sq.km or aggregations of hundreds of birds
areas of high importance, density more than 100 birds/sq.km or aggregation of thousands of birds
areas of high importance, aggregation of 10,000 - 100,000 birds
feeding and resting areas of unknown numbers
70°
65°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°
170°
160°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
65°

REVIEW

Document: The Distribution, Population Status, and Ecology of Marine Birds selected as Valued Ecosystem Components in the Northern Sea Route Area.

INSROP Sub-program II: Environmental Factors, Project II.4.2: Mapping of Values Ecosystems Components, Marine Birds

Reviewer: Dr. John W. Chardine, Canadian Wildlife Service, Sackville, New Brunswick, Canada.

I have read through Section 4 (Vec 1. Seabirds) in detail and provide comments on the manuscript. Overall I found the reviews detailed and accurate to the extent of my knowledge of the area and its seabird literature, which is limited.

I read the other sections in less detail due to my limited knowledge of seaducks in the area. I have however, provide some editorial comments on the manuscript. The whole document would benefit from running it through an English spell checker- I found quite a few typographical errors in the List of references section but likely did not find them all.

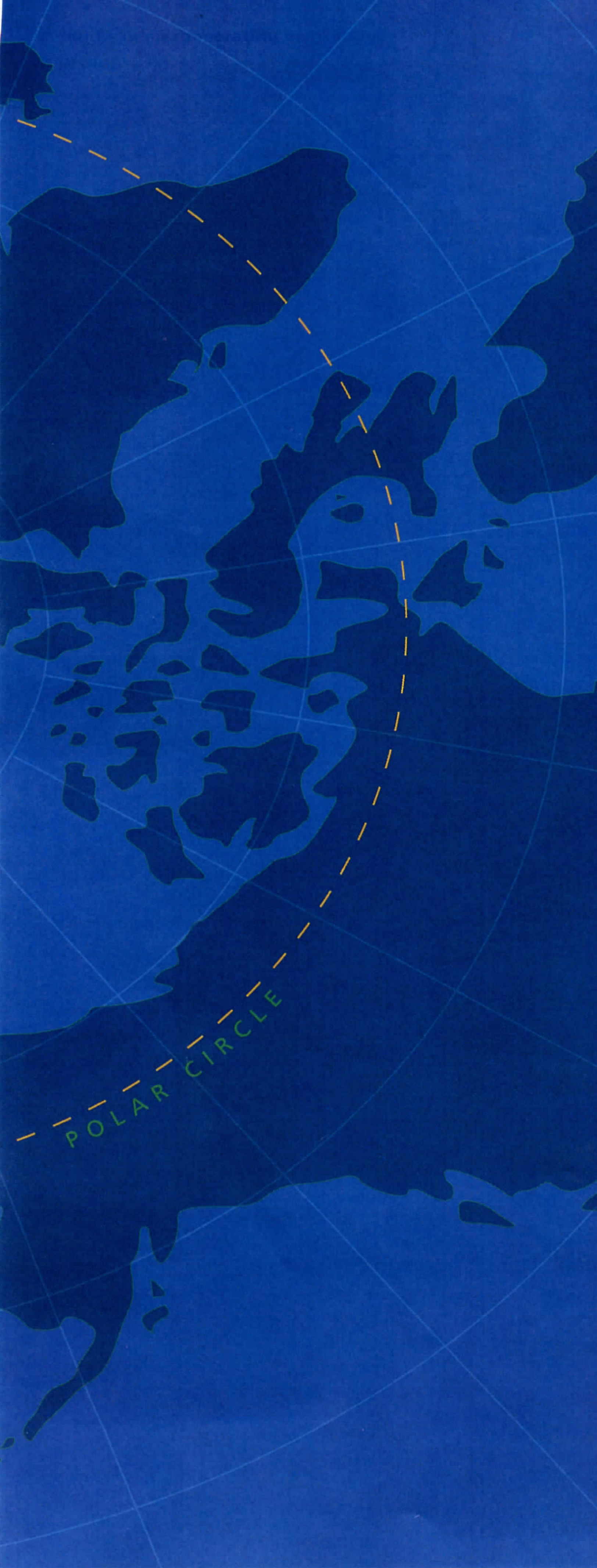
I hope you find my comments helpful.

John W. Chardine

Reply from the editors

We will thank John Chardine for his thorough review of our report. We have updated the report according to the comments.

The editors



The three main cooperating institutions of INSROP

Ship & Ocean Foundation (SOF), Tokyo, Japan.

SOF was established in 1975 as a non-profit organization to advance modernization and rationalization of Japan's shipbuilding and related industries, and to give assistance to non-profit organizations associated with these industries. SOF is provided with operation funds by the Sasakawa Foundation, the world's largest foundation operated with revenue from motorboat racing. An integral part of SOF, the Tsukuba Institute, carries out experimental research into ocean environment protection and ocean development.

Central Marine Research & Design Institute (CNIIMF), St. Petersburg, Russia.

CNIIMF was founded in 1929. The institute's research focus is applied and technological with four main goals: the improvment of merchant fleet efficiency; shipping safety; technical development of the merchant fleet; and design support for future fleet development. CNIIMF was a Russian state institution up to 1993, when it was converted into a stockholding company.

The Fridtjof Nansen Institute (FNI), Lysaker, Norway.

FNI was founded in 1958 and is based at Polhøgda, the home of Fridtjof Nansen, famous Norwegian polar explorer, scientist, humanist and statesman. The institute spesializes in applied social science research, with special focus on international resource and environmental management. In addition to INSROP, the research is organized in six integrated programmes. Typical of FNI research is a multidisciplinary approach, entailing extensive cooperation with other research institutions both at home and abroad. The INSROP Secretariat is located at FNI.