CIRCUMPOLAR SEABIRD BULLETIN

Conservation of Arctic Flora and Fauna

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CIRCUMPOLAR SEABIRD BULLETIN

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Preface

During the second Conservation of Arctic Flora and Fauna (CAFF) meeting in May 1993, the USA presented a proposal to publish a Circumpolar Seabird Bulletin in 1994. The proposal was approved by the CAFF delegates and a process was initiated to publish the first issue of the Circumpolar Seabird Bulletin in 1994.

The concept of the bulletin was further discussed and refined at the Circumpolar Seabird Working Group meeting in January 1994. As originally proposed, the primary purpose of the bulletin is to improve communication and the exchange of seabird information between scientists and managers interested in northern seabirds. Improved coordination of seabird projects and seabird conservation activities of mutual interest is also an important purpose of the bulletin.

It was envisioned that the bulletin would be a joint effort between interested countries signatory to the Declaration on the Protection of the Arctic Environment. Seabird specialists from other countries working in the Arctic can also contribute materials for the bulletin. It was also recognized that the bulletin would be a quick and inexpensive method of exchanging seabird information and publishing summaries of the Circumpolar Seabird Working Group meetings and other CAFF seabird initiatives. The working group agreed that the bulletin would contain short descriptions of ongoing seabird investigations occurring in the Arctic, proposed investigations, and seabird management issues and conservation activities. It was agreed that articles would be one to three pages in length or about 500 words, published in English only and published in an 8.5 x 11 inch format.

This first issue of the bulletin contains contributions provided by Canada, Finland, Iceland, Norway, and the USA. The bulletin also contains the summary of the 1994 meeting of the Circumpolar Seabird Working Group and its Charter.

This *Circumpolar Seabird Bulletin* is a product of the CAFF program and the result of the combined efforts of the representatives of the Circumpolar Seabird Working Group. Any mistakes in the *Bulletin*, however, are entirely mine as the editor. This *Bulletin* would not have been possible without the special assistance of Linda Campbell and Patti Gallagher (Fish and Wildlife Service, Anchorage) and Martha Springer, Fairbanks, Alaska. I extend my gratitude to them for their valuable roles in bringing this bulletin to fruition.

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Research Projects in the Eastern Canadian Arctic, 1993-1996

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The National Wildlife Research Center of the Canadian Wildlife Service has been conducting research on seabirds in Hudson Strait and northern Hudson Bay since 1979. The program has three major components:

- Mapping the distribution and abundance of breeding seabirds, including dispersed tundra-breeders, such as phalaropes, jaegers, and King Eiders
- Monitoring population changes in colonial seabirds, especially gulls and auks
- Conducting demographic studies of Thick-billed Murres to study the impact of hunting in Newfoundland

To date, the location of most coastal seabird colonies and the distribution of many tundra-breeders has been mapped. These data are currently being input in a seabird colony registry, created by the Atlantic Region of Canadian Wildlife Service, that will cover eastern and Arctic Canada. Baseline data on population numbers and reproductive success has been obtained for gulls, and Thick-billed Murres at Digges Sound and Coats Island, and at Akpatok Island. Intensive studies of Black Guillemots have been carried out at Nuvuk Islands. Population trend data are available only for Thick-billed Murres, which appear to be stable in the region over the past two decades.

The demographic studies of Thick-billed Murres have involved the banding of about 2,000 chicks and 200 adults annually at Coats Island since 1984. Observations of banded birds at the colony in subsequent years and recoveries from hunters in Newfoundland have provided data that allow the estimation of adult and immature survival rates. We have also measured age at first breeding and the effect of age on reproductive success.

At Coats Island, a parallel study on the effect of predation by Glaucous Gulls on murre eggs and chicks has also been conducted. The colony supports about one pair of gulls for every 1,500 breeding pairs of murres and these birds forage almost exclusively on the murre colony. Observations of predation have shown that the success of the gulls is much affected by wind speed. High winds allow them to successfully hover beside nests to snatch at breeding murres. Predation is much reduced during periods of calm and some gulls switch to other food sources in such conditions.

Research over the next three seasons will concentrate on monitoring the effects of changes in hunting regulations on the survival of murres at Coats Island. This involves visiting the colony every year to record the presence or absence of banded birds. In addition, we are studying the development of chicks in relation to nutrition and the effect that varying nutrition has on their age at colony departure.

Collaborators and funding agencies in this research include the Universities of Ottawa and British Columbia, Queen's University, Kingston, the Polar Continental Shelf Project of Department of Energy, Mines and Resources, the Science Institute of Northwest Territories and the Natural Sciences and Engineering Research Council.

Common Murre in Finland: The Varying Phases of a Peripheral

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The small Finnish population of Common Murre is confined to two small colonies. At its height in 1990, the population was estimated at 80 pairs. In 1993, there were 35 pairs remaining.

The population trend of the Common Murre in the Finnish part of the Baltic Sea is shown in Figure 1. Breeding was first recorded in 1957. For the first 20 years, the population remained fairly stable, at around 20 pairs. Then, between 1980 and 1991, it increased by an average of 12% per annum. This rate, which is clearly higher than that estimated for the whole Baltic population, 4% per annum (from 8,800 in 1974 to 13,000 pairs in the mid-80s, see Lyngs 1992), was a result of vast immigration from the biggest Baltic colony, Karlsö in Sweden (Hario 1982, Lyngs 1993).

For the first 30 years of its existence, the population was totally dependent on this recruitment. It was only in 1990 that the colony's own recruit first managed to enter the population. This long delay was mainly due to the high mortality of fledglings under the pressure of heavy Herring Gull predation (Hario 1982).

In 1992, an exceptionally heavy mortality of seabirds took place in the easternmost Gulf of Finland during the breeding period; a total of 1,000 seabirds were found dead. Razorbills and Common Murres accounted for 50% and Arctic Terns for 30% of the mortality. The steady increase in the local Razorbill and murre populations turned into a sharp decrease of 40-50% (Fig-

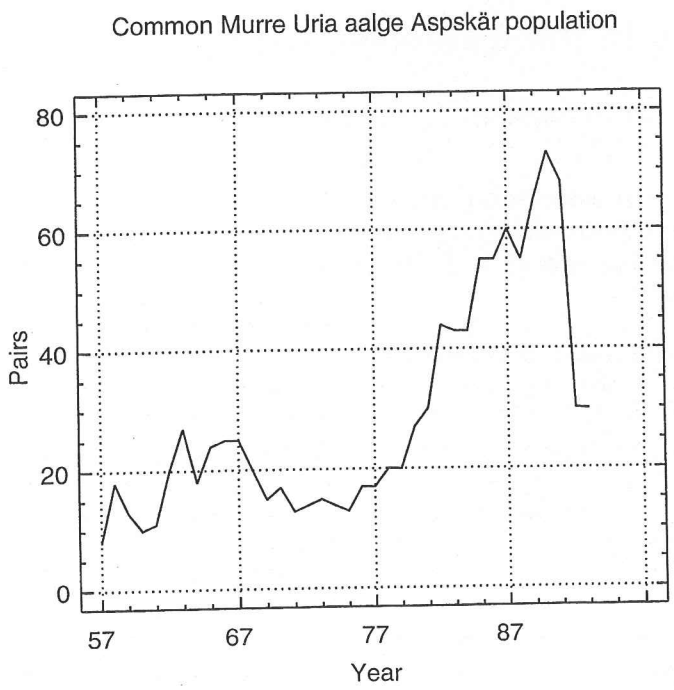

Figure 1. Population trends of the Common Murre in Finland from 1957 to 1993. The population crash in 1992 clearly deviates from the "normal" fluctuation of the species.

ure 1). In 1993, the populations had not recovered from the crash.

There is strong evidence linking the mortality with poisoning due to the ingestion of toxins produced by marine algae. This appears to be the first case in the Baltic of seabird mortality of this nature, colloquially known as Paralytic Shellfish Poisoning (PSP). The toxin accumulates primarily in mollusks, but also in marine zooplankton, to levels that are lethal to planktivorous fish. Birds obtain the toxin through normal feeding on mollusks or fish.

This incidence of heavy adult mortality is the first serious drawback suffered by this tiny satellite population. Because of its reliance on immigration, the Finnish population is totally dependent for its existence on the overall welfare of the species in the Baltic. In this respect, the near future seems fairly bright. The survival of immatures to breeding age at Karlsö (36%) ranks among the highest known in the Atlantic (Hedgren 1980, Hudson 1985). Of the several population dynamic parameters, juvenile survival has probably the most profound effect on future population trends (Hudson 1985). There are indications of an even higher juvenile survival in the Danish major colony at Bornhom (P. Lyngs in litt.). Intercolony movements among Baltic murres occur regularly, and many small colonies apparently owe their existence to immigration (Lyngs 1993).

The feeding conditions for fish-eating seabirds in the Baltic have not shown anomalies comparable to those in the Atlantic. There are no human perturbations, and the species and its breeding sites are legally protected in all the countries on the Baltic. The most serious threats today are drowning in fishing gear and oil spills. Also, the PCB loads in murre eggs are 10 times higher and the DDE loads 100 times higher than elsewhere in the northern Atlantic (Cederberg et al. 1991). Yet, the high residues have not had any discernible effect on breeding success at Karlsö (Hedgren 1980).

The 1992 mass mortality of birds caused by the blooms of algae thought to be toxic in the Gulf of Finland is a further reminder of the unpredictability of today's marine conditions.

References

Cederberg, T., E. Storr-Hansen, M. Cleeman, and J. Dyck. 1991. Organochlorine pollutant in guillemot eggs from the Baltic Sea and northern Atlantic. 11th Int. Symp. Chlorinated Dioxins & Related Compounds, North-Carolina USA 1991 (poster).

Hario, M. 1982. On the size and recruitment of a peripheral breeding colony of the guillemot (*Uria aalge*). Ornis Fennica 59: 193-194.

Hedgren, S. 1980. Reproductive success of guillemots (*Uria aalge*) on the island of Stora Karlsö. Ornis Fennica 57: 49-57.

Hudson, P. J. 1985. Population parameters for the Atlantic Alcidae. In: The Atlantic Alcidae, D. N. Nettleship and T. R. Birkhead (eds.). Pp. 233-254. London: Academic Press.

Lyngs, P. 1992. Breeding birds on Graesholmen, Ertholmene in the Baltic Sea, 1925-90. Dansk Orn. Foren. Tidsskr. 86: 1-93.

Lyngs, P. 1993. Colony interchange in Baltic guillemots (*Uria aalge*). Dansk Orn. Foren. Tidsskr. 87: 247-250.

Potential Mortality Factors of Auks in Iceland

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A great number of factors can influence auk populations, both natural ones and those due to humans. In this paper I discuss several factors that influence Icelandic auks.

Changes in the food base: This is probably the most crucial factor which can influence seabird populations. It has been seen in Norway, for instance, how the scarcity of food can lead to drastic declines in puffins and Common Guillemots. It is known from Iceland that in years when small and variable food items are brought to puffin chicks in the Westmann Islands, breeding success is poor. Conversely, when food loads include few food species and large items, the breeding success is good. The changes in the food base may occur because of natural or anthropogenic causes. The distribution and abundance of pelagic fish, which is the main prey of most of the alcids (Black Guillemot the exception, being a benthic feeder) can vary from one year to the next. The alcid populations can readily withstand one or two years of reduced forage fish populations since they are long-lived birds. If fisheries are driven to the very margin of sustainable yield, several years of reduced fish populations may result; this has happened with the Norwegian-Icelandic herring population. Such disasters can be detrimental to the auk populations.

About 70% of Iceland's national income comes from fishery resources. Many Icelanders consider seabirds competitors with the fishing industry. Such opinions have increased in recent years; they have been raised at the biannual meetings of the fishing industry. Some people maintain seabirds have increased because they are utilized to a lesser degree now than formerly. This assertion is just as wrong as saying that seabird populations decline if birds are caught. The influence of hunting on the populations depends on how many are taken, what age classes are involved, and generally how the hunt is carried out. Several factors suggest that hunting, both direct (shooting, egging, pole netting) and indirect (pollution, bycatch in fishing gear), is greater now than in the past. Those who maintain that competition for forage fish from seabirds is real, also state that seabird populations need to be controlled. Yet it is most likely that commercial fishing activity has, in the long run, increased the food availability for many seabird species, perhaps most obviously the Fulmar and the kittiwake, rather than alcids. A multi-species research program was started recently by the Marine Research Institute, in which the role of seabirds (and other biotic factors) in the marine ecosystem are being investigated.

Pollution: Iceland is not a densely-populated country; therefore, movements of oil are relatively small to and within the country. On that basis one should perhaps not be worried unduly about the effects of oil pollution. However, accidents can happen and if an oil spill occurs near important seabird concentrations, considerable bird deaths may result. It is important to be aware of the oil transportation routes in relation to seabird colonies and populations. Although far from the heavily industrialized parts of the world, Iceland is not free of industrial pollutants, such as PCB and DDT. It is important to look into the quantities of such pollutants in seabirds, and work together with other countries on this issue. A committee, instituted by the Ministry for the Environment, was established last year to look into possible effects of major pollution disasters on bird populations. Disasters, however, are only thought to account for some 20-30% of all pollution; chronic pollution, in which few birds may be killed at a time, accounts for the other 70-80%.

Bycatch: It is difficult to estimate both the extent of this mortality and its influence on seabird populations. Auks are those birds which are most commonly taken, especially Common Guillemots, Razorbills, and Black Guillemots and, to a lesser extent, puffins. As far as auks are concerned, gillnets are the most common cause of fishing gear mortality. For the pelagic auks (Common Guillemot, Razorbill, and puffin) cod nets are the most dangerous; however, lumpsucker fishing nets are most dangerous for Black Guillemots. There have been incidences when up to 4000 auks have drowned overnight in nets from one boat. In May 1990, about 10,000 auks were killed in cod nets off Grímsey Island. It is unknown how many birds are killed annually as a result of entanglement in fishing gear. It is important to know the magnitude of this mortality, which species are involved, which age classes, seasonal occurrence, regional distribution, and type of fishing gear to predict the possible effects on seabird populations.

Hunting: There are primarily three ways in which auks are harvested in Iceland: 1) pole nets, 2) shooting, and 3) egging. The Atlantic Puffin is the most commonly caught alcid, mostly taken with a pole net at colonies in summer. The greatest numbers are caught on the Westman Islands off Iceland's south coast. About 80,000-140,000 birds per year are harvested there. The majority of the 300 or so puffin colonies in Iceland are visited by catchers, and altogether the numbers harvested may be as many as about 200,000 birds per year.

The shooting season for alcids is from 1 September to 19 May. Puffins are shot in small numbers in spring. Razorbills and Common Guillemots are most commonly harvested through shooting, especially in the period November to May. These last two species are also taken in small numbers in pole nets at colonies in summer, principally on Grímsey Island off the north coast. The hunting of Brünnich's Guillemots is negligible, but eggs of the three last-mentioned species are collected in variable numbers at most colonies, possibly 50,000-120,000 per year. Some Black Guillemots are shot in autumn and winter.

Altogether about 100,000 auks are shot each year. How-

ever, no statistics are kept on the numbers of birds killed annually, so all figures are based on opinions or partial estimates. Little is known of the effects of hunting on alcid populations. The common belief is that this is small, although individual puffin colonies may suffer from over exploitation temporarily. If a new bill in parliament becomes law, hunters will be required to report their take. Harvest data will hopefully present a better insight of the numbers of each species taken.

Predation: Mink were introduced to Iceland in 1930; many escaped, and are now found ferally in all parts of the country. Of the auk species, it is only puffins, Black Guillemots, and Little Auks which should be in danger from mink. Mink are thought to have been the cause of the disappearance of puffins from the southernmost islands of the Breidafjördur. Many former colonies are now completely deserted, although there are now signs of a comeback at some. There are documented cases of mink reaching puffin colonies, with resulting heavy mortality. Mink are also thought to be the reason for the disappearance of Black Guillemots from many of their former nesting islands towards the north of Breidafjördur, and also in several other places in Iceland. In general it can be said that the cliff-nesting auks, Common and Brünnich's Guillemots and Razorbills, should mostly be secure from mink predation, although Razorbills in some places nest in screes. There is no doubt that if mink were introduced into such important seabird islands as the Westman Islands, Skrúdur, Papey, Grímsey, Vigur, and the outlying Breidafjördur Islands it could mean disaster for the puffins and Black Guillemots and in some places Razorbills. Arctic foxes are predators on auks at the three large colonies on the Northwest Peninsula. The birds principally move away from those ledges which are subject to such predation. Puffins and Black Guillemots, however, nest either on inaccessible islands or on cliffs, where foxes cannot reach them.

Competition with other species: Fulmars have significantly increased in Iceland during the past two centuries. In some bird cliffs fowlers have maintained that Fulmars have taken over ledges formerly occupied by guillemots. There is one record of guillemots returning to a former nesting ledge, after Fulmars had abandoned it.

References

Petersen, Æ. 1979. The breeding birds of Flatey and some adjoining islets, in Breidafjördur, NW Iceland. Náttúrufrædingurinn 49: 229-256. (Icelandic with English summary).

Petersen, Æ. 1981. Breeding biology and feeding ecology of Black Guillemots. Ph. D. thesis, Oxford University, England. 378 pp.

Petersen, Æ. 1982. Seabirds. In: Icelandic Birds, pp. 15-60. Landvernd 8. 216 pp. (Icelandic with English translation available).

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Status and Population Changes of Auks in Iceland

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Icelanders and seabirds: Apart from seabirds being important elements of the environment, Icelanders relate to them mainly in four ways: 1) as food, 2) as competitors for fish, 3) as important parts of an environmental experience (tourism), and 4) as bycatch in fishing gear. Three of these are discussed further in the overview of potential mortality factors. Seabirds have been used for food since the country was settled, and they are still utilized in considerable numbers. As a fishing nation, many Icelanders consider seabirds, alcids in particular, competitors with the fishery industry. Seabird colonies, particularly the large bird-cliffs, are important parts of the environmental experience of people. Tourism has increased in recent years in Iceland, while the traditional means of livelihood (fishery, farming) have experienced problems. Tourism now accounts for about 15% of the national income. Seabirds, especially alcids, drown in fishing gear in large numbers.

Seabird populations in Iceland: The sizes of seabird populations are highly variable. Alcids are both among the most common (e.g., 2-3 million breeding pairs of puffins) and the least common (e.g., 2-3 pairs of Little Auk) of Icelandic seabird species. Table 1 is based on a recent overview of Icelandic seabird populations, completed for the International Council for Bird Preservation, as part of the project "Conservation of Dispersed Species in Europe" (see Petersen and Nielsen 1991). The accuracy of estimates are highly variable depending on the species; of the auks, the population estimate for puffins is the least accurate. The estimates also depend on the reliability one attaches to the methods used for estimating (Gardarsson & Sigfússon 1988). Considerable work still needs to be done before we can be content with the estimates of the size of our populations. Most of the seabirds seem to be doing well, looking at the country as a whole. Of the auks, the population of Little Auks has declined most of this century because of the climate amelioration in the early part of the century. Puffins are probably increasing if the population is changing at all. The other auk populations appear to be stable.

The location of the breeding colonies is mostly known, although these need to be compiled in a more standardized

Table 1. Seabird species breeding in Iceland, estimated size of their breeding populations and suggested trend in last decade (Petersen & Nielsen 1991). 0 = stable, - = decreasing, + = increasing, ++ = large increase.

Species	Est. no. breeding pairs	Suggested trend
Fulmar (*Fulmarus glacialis*)	1-2 million	++
Manx Shearwater (*Puffinus puffinus*)	7-10,000	0
Storm Petrel (*Hydrobates pelagicus*)	50-100,000	0
Leach's Petrel (*Oceanodroma leucorhoa*)	80-150,000	0
Gannet (*Sula bassana*)	25,000	+
Cormorant (*Phalacrocorax carbo*)	3,500	0
Shag (*Phalacrocorax aristotelis*)	8-9000	+
Eider (*Somateria mollissima*)	200-300,000	+
Arctic Skua (*Stercorarius parasiticus*)	5-10,000	0
Great Skua (*Stercorarius skua*)	5,400	0
Lesser Black-backed Gull (*Larus fuscus*)	25-35,000	++
Herring Gull (*Larus argentatus*)	5-10,000	+
Glaucous Gull (*Larus hyperboreus*)	10-15,000	++
Great Black-backed Gull (*Larus marinus*)	15-30,000	-
Kittiwake (*Rissa tridactyla*)	600-800,000	+
Arctic Tern (*Sterna paradisaea*)	250-500,000	0
Common Guillemot (*Uria aalge*)	1.1-1.3 million	0
Brünnich's Guillemot (*Uria lomvia*)	600-800,000	0
Razorbill (*Alca torda*)	300-400,000	+
Black Guillemot (*Cepphus grylle*)	10,20,000	0
Little Auk (*Alle alle*)	2-3	-
Puffin (*Fratercula arctica*)	2-3 million	0-+

way (i.e., Seabird Colony Register). There is also a question of what should be considered a colony; e.g., each island in a group of neighboring islands? Biologically this may not be correct, although practical in terms of cataloging. Common and Brünnich's Guillemots and Razorbills are often present on the same cliff, although they are by no means found at each colony. Their colonies number about 40 in all, counting the Westman Islands as one colony, where these species are distributed among nearly 20 individual islands. The Razorbill is the most widely distributed species, found at about 35 colonies, Common Guillemots are located at 30 colonies, while Brünnich's Guillemots are present at over 20 colonies. Here again it is the question of what is called "a colony", since in the Breidafjördur Islands (which number about 3,000) breeding puffins are found in some 200. About 100 colonies are found in other parts of the country, counting each of the 20 islands in the Westman Islands as a colony, but these islands harbor the largest puffin concentration in the country, with 700,000-800,000 breeding pairs (estimated from ringing). A few colonies include 100,000 or more pairs, and many have between 10,000-100,000 breeding pairs. The Black Guillemot is widely distributed, but the largest numbers are found in the Breidafjördur Islands, where Flatey alone harbors around 500 breeding pairs, as does Aedey, on the NW peninsula. They are the largest Black Guillemot colonies in Iceland. Little Auks may have vanished altogether as breeding birds, although the last census gave 2-3 pairs on Grímsey Island on the Arctic Circle.

The colonies of the large auk species appear to be strategically located in good places near important feeding grounds, including the spawning grounds of the herring and the migration routes of the capelin, two important food species, although this needs to be better correlated. The third, and by no means the least important prey species, is the sandeel, but very little is known of its distribution and life history in Icelandic waters.

Seabird conservation—Iceland's responsibility: It can be said that Iceland has a large responsibility for the conservation of seabird populations in the North Atlantic. Seabirds are a larger part of Iceland's bird species than in other countries. In terms of populations, there are more seabirds than other species groups. In an international context, about 50% or more of the world populations of some species breed in Iceland; e.g., puffins and Razorbills. One could also say that the importance of Iceland has increased as there have been large declines in neighboring countries; e.g., in Brünnich's Guillemots in Greenland and Common Guillemots and puffins in Faeroes and Norway.

In 1991, Iceland entered into an international agreement, known as the Roveniemi Declaration, with other circumpolar Arctic countries . This work includes taking cooperative steps towards the conservation of flora and fauna in the Arctic. This work is in its early stages, as only one meeting has been held

so far. [Editors Note: to date, two meetings have been held, with a third scheduled for September 1994.] However, it was agreed that seabirds should be a priority conservation and research issue, with a specific reference to the Common and Brünnich's Guillemots and a Seabird Colony Register.

Monitoring: Important as it may be to know the precise population size of various bird species, it can be considered even more important to know how the populations are developing. Are the numbers of birds increasing, declining, or stable? What are the long-term trends? No seabird species is adequately covered. Of the auks, the Black Guillemot is the most studied, but a monitoring program is confined to one area only, albeit the prime region of the species in the country. Individual censuses have been made at many auk colonies, either complete or partial coverage. These should be good baseline information for future monitoring.

There are no monitoring programs for auk populations outside the breeding season. Christmas Bird Counts, which are shore-based and once a year, give inadequate information on auks (except possibly the Black Guillemot) since they are primarily pelagic. Ringing as a tool to investigate the long-term changes in winter distribution is also far from sufficient, especially for the Common Guillemot and Razorbill, not to mention the Brünnich's Guillemot which has hardly been ringed at all, yet is one of the most common bird species. Puffins have been ringed extensively in the Westman Islands for 40 years (some 50,000 birds), but little in other parts of the country. The wintering areas of birds breeding, say, in the north and east where the sea is much colder compared to the south and the west, most likely differ considerably. Ringing does not give the answers to possible changes in the distribution of auks, since ringing effort has been insufficient while there are great interpretive problems attached to recovery rate of different age classes and distribution of recoveries.

Future research: Lastly, it is proper to address some of the priority research which should be carried out on auks in Iceland. The following list is not in priority order.

1) Seabird Colony Register. This has already been started, but the work under the Roveniemi Declaration gives additional possibilities to carry this work further.

2) Estimate individual colonies/total population size. Further work needs to be carried out on estimating the size of individual colonies, to gain better estimates of the total populations.

3) Monitoring. Work under the Roveniemi Declaration is likely to concentrate on seabirds, with an emphasis on the Common and Brünnich's Guillemots in the first stages.

4) Food studies. Very little is known about the food of different species (excepting the Black Guillemot) at different times of year and for different age categories. Hopefully this will be looked upon in greater detail within the multi-species program carried out by the Marine Research Institute.

5) Distribution/density at sea. Very little work has been done in this field, but the importance of different sea regions needs to be identified, and their importance at different times of the year. This could be important, for instance, in connection with possible pollution incidences.

6) By-catches. It is known that seabirds, auks in particular, are killed in fishing gear in large numbers. It is important to know the extent of this mortality.

7) Hunting statistics. Hunting is also a potentially important factor influencing auk populations. Should a present parliamentary bill be accepted, all hunters will keep records of their harvest.

8) Beached-bird survey. These surveys, usually carried out by amateur ornithologists, could be important in acting as a warning system for changes in mortality of auks, both from anthropogenic and natural factors.

References

Einarsson, T. 1979. Numbers of Brünnich's (*Uria lomvia*) and Common guillemots (*Uria aalge*) at Icelandic breeding stations. Náttúrufrædingurinn 49:221-228. (Icelandic with English summary.)

Gardarsson, A. 1982. Status of Icelandic seabird populations. Viltrapport 21:23.

Gardarsson, A. 1984. The bird-cliffs of the Reykjanes peninsula, SW Iceland. Arbók Feroafélags Islands 1984: 126-160.

Gardarsson, A. 1985. The huge bird-cliff, Látrabjarg, in West Iceland. Environ. Conserv. 12: 83-84.

Gardarsson, A. 1989. Introduction. In: Iceland, R. F. A. Grimmett and T. A. Jones (eds.). Pp. 325-327.

Gardarsson, A. and A. T. Sigfússon. 1988. The use of time budgets and species ratios at breeding colonies in estimating numbers of murres and Razorbill. Pacif. Seabird Gr. Bull. 15(1): 29.

Gudmundsson, F. 1972. The breeding of the Little Auk in Grímsey. Náttúrufrædistofnun Islands. Unpubl. confidential report. 6 pp. [Not for distribution.]

Petersen, Æ. 1979. The breeding birds of Flatey and some adjoining islets, in Breidafjördur, NW Iceland. Náttúrufrædingurinn 49: 229-256. (Icelandic with English summary.)

Petersen, Æ. 1981. Breeding biology and feeding ecology of Black Guillemots. Ph. D. thesis, Oxford University, England. 378 pp.

Petersen, Æ. 1982. Seabirds. In: Icelandic Birds. Landvernd 8. 216 pp. (Icelandic with English translation available.)

Petersen, Æ. 1982. Breeding population of Little Auk in Grímsey 1981 and 1982, Náttúrufrædistofnun Islands. Unpubl. confidential rep. 4 pp. [Not for distribution.]

Petersen, Æ. 1985. The birdlife of Mánáreyjar islands, NE Iceland. Tyli 15: 7-25. (Icelandic with English summary.)

Petersen, Æ. 1985. The animals of Innnes, SW. Iceland. In: Innnes, its natural history, natural assets, and land use, SW Iceland. Pp. 37-52. Náttúrufrædistofnun Islands for Heavy-Industry Commission. 103 pp.

Petersen, Æ. 1989. The natural history of the Breidafjördur Islands. Arbók Feroafélags Islands 1989: 17-52.

Petersen, Æ. and E. Olafsson. 1986. The animals of Sudurnes,

SW Iceland. Náttúrufrædistofnun Islands for Heavy-Industry Commission. 82 pp.

Petersen, Æ. and O. K. Nielsen. 1991. Conservation of dispersed species in Europe: Iceland. Unpubl. rep. to ICBP. 26 pp.

Skarphédinsson, K. H. and O. Einarsson. 1989. The birdlife of the southern part of the Reykjanes peninsula, SW Iceland. In: The natural history of the southern part of the Reykjanes peninsula, SW Iceland. Pp. 37-52. Náttúrufrædistofnun Islands for Sudurnes Planning Commission. 85 pp.

Skarphédinsson, K. H., S. Thórisson and P. Leifsson. 1989. The birds of Seley, East-Iceland. Bliki 7: 49-58. (Icelandic with English summary.)

(This paper was presented at the Nordisk workshop "Bestandsendringer hos alkefugl i Norden," Trondheim, 21-23 October 1992.)

Icelandic Seabird Research with Emphasis on Alcid Studies

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Research activity on seabirds, especially alcids, by the Icelandic Museum of Natural History, greatly increased in 1993. Two principal events led to this development. First, a special emphasis was placed on seabirds, Common (*Uria aalge*) and Brünnich's guillemots (*U. lomvia*) in particular, by the Conservation of Arctic Flora and Fauna, a program under the ministerial Rovaniemi Declaration or Arctic Environmental Protection Strategy. Second, a workshop sponsored by the Nordic Council of Ministers, held in Trondheim, Norway, in autumn 1992, emphasized the need for increased research on alcids. In both cases the need for increased cooperation between countries which share common alcid populations was stressed and the need for added national commitments was emphasized.

Additional research in Iceland, initiated in 1993, focuses on three main aspects: monitoring of colonies, feeding ecology, and seabird colony register. In addition, investigation of the distribution of seabirds at sea is being continued from earlier years. The new research programs include primarily Common and Brünnich's guillemots, Razorbill (*Alca torda*), and, to a lesser extent, puffins (*Fratercula arctica*). Research on the ecology of Black Guillemots (*Cepphus grylle*) and an extensive ringing program on puffins have been carried out for a long time.

Monitoring: Monitoring of breeding Common and Brünnich's guillemots at three colonies was initiated in 1993. Study plots were selected at Krisuvikurberg on the southwest coast, at Skoruvikurbjarg on the northeast coast and at Grímsey Island off the north coast. Methods, based on Birkhead & Nettleship (1980), were tested at Krisuvikurberg on six visits between 9 June and 7 July. The number of study areas and plots will be increased in 1994.

Feeding ecology: A study was initiated on the food brought to young by adults. Food was sampled from birds which feed in the two principal water masses surrounding Iceland, the cold north and east waters, and the warmer south and west waters. Methods for collecting food samples were tested, and study areas were selected. Only a few dozen samples were secured from Common Guillemots, Razorbills, and puffins, but none from Brünnich's Guillemots.

Seabird Colony Register (SCR): Preparations were carried out on establishing a general SCR for Iceland. The database will contain available information on individual seabird colonies, the number of pairs of each breeding species, and monitoring data. We hope that Icelandic ornithologists and other seabird enthusiasts will contribute to this new database. Different SCR software packages have been tested, but the final selection has not yet been made. We expect to finish the trial phase and start entering available data in 1994.

It is obvious that large gaps exist in the colony documentation for individual species, especially Fulmars, Herring Gulls, Glaucous Gulls, Black Guillemots, and Arctic Terns. The location of gannets, cormorants, shags, Common Guillemots, Brünnich's Guillemots, puffins, Black-headed Gulls, and kittiwake colonies are relatively well known. For some of these species good estimates of the breeding populations are available, especially through work of researchers at the University of Iceland.

Distribution at sea: Two methods have been used in the past to study the distribution of seabirds at sea: 1) traditional ringing and censusing from ships (Icelandic Museum of Natural History) and 2) aerial surveys (Institute of Biology, University of Iceland). Preparations for recording movements of breeding birds, using data loggers, began in 1993. These loggers or route-recorders (Bramanti et al. 1988) were developed by our co-workers at the University of Pisa, Italy. The loggers, which are glued on the birds' back, register their compass bearings on pre-programmed intervals, enabling reconstruction of their flight paths and even time budgets.

Common Guillemots, Brünnich's Guillemots, and Razorbills are among the largest populations of Icelandic birds which little ringing has been concentrated on. In the 70 years of ringing activities in Iceland, only about 900 Common Guillemots, 350 Brünnich's Guillemots, and 2,300 Razorbills have been ringed. In 1993, these numbers were increased by about 1,500, 30, and 800 birds, respectively. Approximately 20% of these

birds were ringed by personnel from the University of Iceland. About 12,700 Black Guillemots have been ringed in Iceland, especially in the past 20 years, and almost 60,000 puffins. Around 1,850 puffins were ringed on the Westman Islands under the general Icelandic Bird Ringing Scheme in 1993. Brünnich's Guillemots are by far the least studied of the alcid species, owing to the inaccessibility of their colonies.

A 3-year ringing program, starting in 1994, is planned for four of the above mentioned species, Common and Brünnich's guillemots, Razorbills, and puffins. The ringing program on Black Guillemots will also be continued. For puffins, the emphasis will be placed on the colonies on the north and east coasts where little ringing has taken place, in contrast to the Westman Islands south of Iceland where over 50,000 birds have been ringed during the past four decades (in particular by two ringers with the Icelandic Bird Ringing Scheme, Oskar J. Sigurdsson and Sigurgeir Sigurdsson).

In each September between 1987 and 1991, censuses were carried out along a fixed transect on the seas between Iceland, Jan Mayen, and Greenland. This was part of the Greenland Sea Project (Petersen and Petersen 1991). The results of this program are presently being analyzed with publication in spring 1994.

Acknowledgements

Thanks to Vidar Bakken and Fridjof Mehlum of the Norwegian Polar Institute for sending us their SCR database program, to David N. Nettleship for providing us with the Canadian program, Silvano Benvenuti, University of Pisa, and Kristjan Lilliendahl, University of Stockholm, for cooperation in testing the route-recorder application. Finally, our thanks go to the number of colleagues, ringers, and observers who have participated in the above programs.

References

Birkhead, T. R. and D. N. Nettleship. 1980. Census methods for murres, *Uria* species: a unified approach. Can. Wildl. Serv. Occ. Pap. 43. 25 pp.

Bramanti, M., L. Dall'Antonia, and F. Papi. 1988. A new technique to monitor the flight paths of birds. J. Exp. Biol. 134: 467-472.

Petersen, Æ. and I. K. Petersen. 1991. Seabirds at sea between Iceland, Jan Mayen and Greenland. Bliki 10: 57-60. (Icelandic with English summary.)

Ongoing Seabird Projects in Northern Norway (North of the Arctic Circle) and Svalbard

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This article gives a brief summary of ongoing projects on seabirds in northern Norway and Svalbard. Only projects dealing with species having a year round marine distribution are described. Each project summary has the following arrangement: year started, planned conclusion, aims, description, published data and name/address of contact person/project leader.

Work with seabirds in northern Norway and Svalbard is mainly carried out by three institutions: The Norwegian Institute of Nature Research (NINA), Tromsø Museum and the Norwegian Polar Institute (NP). The summaries of the projects listed below are roughly divided into projects in northern Norway and Svalbard, but for some projects this is an artificial border as they work in both areas.

Seabird projects in Svalbard and in the northern part of the Barents Sea

- Impact assessment for seabirds/oil in relation to oil drilling in the northern part of the Barents Sea
- Seabird investigations at Bjørnøya, Svalbard
- Migration routes and population size of Ivory Gulls in Svalbard
- Identification of seabird populations by DNA
- Monitoring seabird populations in Svalbard
- Seabird ecology in the Arctic
- Studies of Common Eiders in Svalbard
- Environmental pollutants in arctic seabirds

Seabird projects in northern Norway (north of the Arctic Circle) and in the southern part of the Barents Sea

- Colony registry for the Barents Sea
- The Norwegian Seabird Registry
- Seabird monitoring in Norway
- The feeding ecology, reproduction and population dynamics of Atlantic Puffins (*Fratercula arctica*)in Røst, northern Norway
- Seabirds and fishing nets in Norway
- Adult mortality, colony fidelity, and age of recruitment in important seabird populations
- Seabirds as top predator in the marine environment
- Relations of predators/prey in a marine environment: effects and adaptations to variable occurrence of prey
- Energy turnover in seabirds
- Population status and breeding success of northern Nor-

wegian seabirds in relation to prey fish stocks
- Marine ducks as predators of benthic communities
- Environmental contaminants in arctic seabirds
- Steller's Eider in Varangerfjord, northern Norway

Seabird projects in Svalbard and in the northern part of the Barents Sea

Impact assessment for seabirds/oil in relation to oil drilling in the northern part of the Barents Sea

Project start: 1993

Planned conclusion: 1995

Project aims: Evaluate the vulnerability of seabirds and determine the potential effects on seabird populations in relation to oil drilling in the northern part of the Barents Sea.

Project description: A preliminary vulnerability assessment was conducted to locate the seabird populations which were most exposed to oil spills on water. Supplementary field work was performed to map the breeding areas for Light-bellied Brant Geese and to develop methods for estimating total population and monitoring breeding colonies of the Little Auk. The next step is to map the Little Auk distribution and estimate the total population along the western coast of Spitsbergen, Svalbard (1994).

Publications:

Fjeld, P. E. and V. Bakken. 1993. Vulnerability assessment and conservational value for seabirds in relation to drilling for oil/gas in the northern part of the Barents Sea. Nor. Polarinst. Medd. 123: 48pp+Appendix. (Norwegian with English summary.)

Contact persons: Vidar Bakken/Kjell Isaksen, Norwegian Polar Institute, POB 5072, Majorstua, 0301 Oslo. Norway. Tel.: +47 22 95 95 00. Fax: +47 22 95 95 01. E-mail: bakken@npolar.no

Seabird investigations at Bjørnøya, Svalbard

Project start: 1986

Planned conclusion: Long-term study

Project aims: Discover and quantify population changes of Common Guillemots, Brünnich's Guillemots, kittiwakes, Fulmars, and Glaucous Gulls. Discover change in chick food for Common and Brünnich's guillemots. Estimate adult survival, pair-bond rate and site fidelity for Common and Brünnich's guillemots. Determine whether PCB is an important cause of death for Glaucous Gulls at Bjørnøya.

Project description: Field work is performed on Bjørnøya. Monitoring of the seabird species is done according to standard methods. To estimate adult survival for example, the method of ringing individuals with colored rings is used. For the PCB studies, eggs, chicks, and adults (dead and alive) are collected for laboratory analysis.

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Migration routes and population size of Ivory Gulls in Svalbard

Project start: 1993

Planned conclusion: 1998

Project aims: Map the migration routes and estimate the population size of the Ivory Gull in Svalbard.

Project description: A significant number of Ivory Gulls will be ringed with colored rings. Recoveries will provide the basis for mapping migration routes. Population size will be estimated from the proportion of recovered birds. We will also visit Ivory Gull colonies to make new total counts. The project will be carried out jointly with Russian scientists, and Ivory Gulls will also be ringed in the eastern Barents and Kara seas.

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Identification of seabird populations by DNA

Project start: 1988

Planned conclusion: 1995

Project aims: Identify populations occurring in different geographic regions. Quantify exchange of genes between populations and estimate the possibilities of recolonizing areas where populations have become extinct.

Project description: Blood samples are taken from different arctic seabirds species for DNA extraction and identification of DNA polymorphism.

Contact person: Fridtjof Mehlum, Norwegian Polar Institute, POB 5072, Majorstua, 0301 Oslo, Norway. Tel.: +47 22 95 95 00. Fax: +47 22 95 95 01. E-mail: mehlum@npolar.no

Monitoring seabird populations in Svalbard

Project start: 1981

Planned conclusion: Long-term study

Project aims: Monitor seabird populations to provide a basis for management.

Project description: Annual censuses of study plots of selected seabird colonies in Svalbard are being conducted. The species registered are Fulmar, Common Guillemot, Brünnich's Guillemot, kittiwake, and Common Eider.

Publications:

Mehlum, F. and V. Bakken. Seabirds in Svalbard: Status, recent changes and management. In press.

Contact person: Fridtjof Mehlum, Norwegian Polar Institute, POB 5072, Majorstua, 0301 Oslo, Norway. Tel.: +47 22 95 95 00. Fax: +47 22 95 95 01. E-mail: mehlum@npolar.no

Seabird ecology in the Arctic

Project start: 1981

Planned conclusion: Continuing

Project aims: Produce scientific papers about birds in the Arctic relevant for use in assessment of the impact of human activity on seabird populations, e.g., oil pollution, fishing, hunting, environmental pollutants, and climatic changes.

Project description: The role of different seabird species as consumers in arctic marine ecosystems, and the factors determining distributions of arctic seabirds will be studied.

Contact person: Fridtjof Mehlum, Norwegian Polar Institute, POB 5072, Majorstua, 0301 Oslo, Norway. Tel.: +47 22 95 95 00. Fax: +47 22 95 95 01. E-mail: mehlum@npolar.no

Studies of Common Eiders in Svalbard

Project start: 1981

Planned conclusion: unknown

Project aims: Collect data on population ecology for use in the management of the Common Eider in Svalbard.

Project description: The population size and reproduction in selected colonies is being monitored. Important feeding and molting areas are being mapped.

Publications:

Mehlum, F. (ed.). 1991. Eider Studies in Svalbard. Nor. Polarinst. Skr. 195.

Contact person: Fridtjof Mehlum, Norwegian Polar Institute, POB 5072, Majorstua, 0301 Oslo, Norway. Tel.: +47 22 95 95 00. Fax: +47 22 95 95 01. E-mail: mehlum@npolar.no

Environmental pollutants in arctic seabirds

Project start: 1990

Planned conclusion: Long-term study

Project aims: Establish a longtime series to monitor the level of environmental pollutants in arctic seabirds. Clarify the importance of the pollutants for the population development for arctic seabirds. Since 1992, this project has been incorporated in the Arctic Monitoring and Assessment Program (AMAP).

Project description: Environmental pollutants in arctic seabirds are monitored by collection of seabirds for chemical analysis.

Publications:

Daelemans, F. F., F. Mehlum, and J. C. Schepens. 1992. Polychlorinated biphenyls in two species of arctic seabirds from the Svalbard area. Bull. Environ. Contam. Toxicol. 48: 828-834.

Contact person: Fridtjof Mehlum, Norwegian Polar Institute, POB 5072, Majorstua, 0301 Oslo, Norway. Tel.: +47 22 95 95 00. Fax: +47 22 95 95 01. E-mail: mehlum@npolar.no

Seabird projects in northern Norway (north of the Arctic Circle) and in the southern part of the Barents Sea

Colony registry for the Barents Sea

Project start: 1992

Planned conclusion: Long-term study

Project aims: Gather information about seabird colonies (description, total counts, counts in study plots, photo documentation and references) in the Barents Sea area, including Russian areas.

Project description: Cooperation has been established between 12 institutions (9 Russian) which contribute data. The project is administrated by the Norwegian Polar Institute. The first completed data set will be ready during 1994.

Contact person: Vidar Bakken, Norwegian Polar Institute, POB 5072, Majorstua, 0301 Oslo, Norway. Tel.: +47 22 95 95 00. Fax: +47 22 95 95 01. E-mail: bakken@npolar.no

The Norwegian Seabird Registry

Project start: 1979

Planned conclusion: Long-term study

Project aims: Long-term monitoring to provide a basis for management, environmental impact assessments and prevention of oil spills.

Project description: A national seabird project was established in 1979, focusing on seabird ecology and conservation. The registry has two main partitions: coastal database and the open sea database. The coastal database has three main divisions, one each for the breeding, molting and wintering seasons. Organized monitoring programs for breeding and wintering populations have been carried out for some time by the Seabird Group. The wintering counts are being coordinated with the IWRB international midwinter counts. Since the summer of 1988, a national monitoring program for breeding seabirds has been formally organized, and the data have been entered into the main database. The Seabird Registry plays an important role in oil spill prevention operations by being able to provide current distribution maps by fax on short notice.

Publications:

Follestad, A., B. H. Larsen, T. Nygård, and N. Røv. 1988. Estimating numbers of molting Eiders (*Somateria mollissima*) with different flock size and flock structure. Fauna norv. Ser. C, Cinclus 11: 97-99

Follestad, A., T. Nygård, N. Røv, and B. H. Larsen. 1988. Distributions and numbers of molting non-breeding Greylag Geese in Norway. Wildlife 39: 82-87.

Follestad, A. 1990. The pelagic distribution of Little Auk (*Alle alle*) in relation to frontal system off Central Norway, March/April 1988. Polar Research 8: 23-28.

Nygård, T., B. H. Larsen, A. Follestad, and K. B. Strann. 1988. Numbers and distribution of wintering waterfowl in Norway. Wildfowl 39: 164-176.

Contact person: Tycho Anker-Nilssen, Norwegian Institute for Nature Research, Tungasletta 2, 7005 Trondheim, Norway.

Seabird monitoring in Norway

Project start: 1988

Planned conclusion: Long-term study

Project aims: Detect population changes in important seabird species

Project description: Annual counts in selected colonies are performed according to standard methods. Species registered in northern Norway are Fulmar, gannet, cormorant, shag, Common Gull, Lesser Black-backed Gull, Herring Gull, Great Black-backed Gull, Arctic Tern, Common Guillemot, Brünnich's Guillemot, and Atlantic Puffin.

Publications: Annual reports published by NINA.

Contact person: Jan Eivind Østnes. Norwegian Institute for Nature Research, Tungasletta 2, 7005 Trondheim, Norway.

The feeding ecology, reproduction and population dynamics of Atlantic Puffins *Fratercula arctica* in Røst, northern Norway

Project start: 1990

Planned conclusion: Long-term study based on studies conducted from the 1960s to the 1970s

Project aims: Through the continuation of a long-term investigation, monitor the inherent interplay between the huge puffin population in the Røst Archipelago (ca 600,000 breeding pairs) and its marine environment.

Project description: Special attention is being paid to the significance of the availability of the puffin's main chick prey, which is first-year herring (*Clupea harengus*) of the Norwegian spring spawning stock. This stock was depleted in the late 1960s but is now slowly rebuilding. Following the herring collapse, puffin reproduction in Røst failed in 17 of the first 20 years. The breeding population decreased by more than 60% during the 1980s. Since 1975, the abundance of first-year herring drifting past Røst in summer has explained most of the variation in fledging success of this puffin population. Among the parameters monitored annually are population size, breeding density, adult survival, adult condition, timing of breeding, adult attendance, direction to foraging areas, length of fledging period, quality of chick food throughout the season, chick growth, chick survival, and fledgling condition.

Published results:

Anker-Nilssen. T. 1987. The breeding performance of Puffins (*Fratercula arctica*) on Røst, northern Norway in 1979-1985. Fauna norv. Ser. C, Cinclus 10: 21-38.

Anker-Nilssen, T. 1992. Food supply as a determinant of reproduction and population development in Norwegian Puffins (*Fratercula arctica*). Ph.D. thesis, Univ. Trondheim.

Anker-Nilssen, T. and S. H. Lorentsen. 1990. The distribution of Puffins (*Fratercula arctica*) feeding off Røst, northern Norway during the breeding season, in relation to prey, sea temperature and salinity. Polar Research 8: 67-76.

Anker-Nilssen, T. and R. T. Barrett. 1991. Status of seabirds in northern Norway. Brit. Birds 84: 329-341.

Anker-Nilssen, T. and O. W. Røstad. 1993. Census and monitoring of Puffins (*Fratercula arctica*) on Røst, N Norway, 1979-1988. Ornis Scand. 24: 1-9.

Barrett, R. T., T. Anker-Nilssen, F. Rikardsen, K. Valde, N. Røv, and W. Vader. 1987. The food, growth and fledging success of Norwegian Puffin chicks (*Fratercula arctica*) in 1980-1983. Ornis scand. 18: 73-83.

Erikstad, K. E., T. Anker-Nilssen, M. Asheim, R. Barrett, J. O. Bustnes, K. O. Jacobsen, I. Johnsen, B. E. Sfther, and T. Tveraa. 1994. Parental investment and adult survival in Norwegian seabirds. NINA Forskningsrapport 49: in press. (Norwegian with English summary).

Vader, W., T. Anker-Nilssen, V. Bakken, R. Barrett, and K. B. Strann. 1990. Regional and temporal differences in breeding success and population development of fish eating seabirds in Norway after collapses of herring and capelin stocks. Trans. 19th IUGB Congress, Trondheim 1989 (1): 143-150.

Contact person: Tycho Anker-Nilssen, Norwegian Institute for Nature Research, Tungasletta 2, N-7005 Trondheim, Norway

Seabirds and fishing nets in Norway

Project start: 1991

Planned conclusion: 1994

Project aims: Obtain data on the size of accidental catches of seabirds in fishing nets, the breeding populations involved, and the age structure of the birds caught.

Project description: The project has summarized the present state of knowledge concerning the numbers of seabirds accidentally caught in fishing nets in Norway. A further summary based on ringing recoveries is in preparation. The problem differs in nature from one type of fishery to another.

The project has carried out further studies to obtain better information on the scope and nature of the problem in Norway, at first with emphasis on the Common Guillemot. This has included ringing of Common Guillemots at breeding colonies and requesting fishermen to provide entangled birds, both with and without rings, so that the birds' age, body condition etc. can be determined. This approach was not successful regarding the Common Guillemot during the first year of the project as few birds were caught in fishing nets. This could have been because of changed practices on the part of the Norwegian fisheries for cod.

Close cooperation has been established with fishermen and their organizations to ensure that fishermen receive information on what data we want to collect and why a project of this kind has been initiated.

Published results:

Follestad, A. and K. B. Strann. 1991. Seabirds and fishing nets: The scope and nature of the problem in Norway. NINA Oppdragsmelding 78: 1-14.

Bustnes, J. O., G. H. Systad, and K. B. Strann. 1993. Drowning of seabirds in bend nets for salmon within the nature reserve at Loppa. NINA Oppdragsmelding 236: 1-17.

Contact person: Arne Follestad, Norwegian Institute for Nature Research, Tungasletta 2, N-7005 Trondheim, Norway.

Adult mortality, colony fidelity, and age of recruitment in important seabird populations

Project start: 1991

Planned conclusion: 1994

Project aims: Estimate adult mortality, colony fidelity, and age of recruitment in important seabird populations.

Project description: Investigations are carried out on the following colonies: Hornøy (East Finnmark), Common Guillemot, Brünnich's Guillemot, puffin and kittiwake; Grindøya (Tromsø), Common Eider.

A significant number of adults and chicks have been ringed with colored rings since 1990. The work has concentrated on sightings of ringed birds and the development of methods for estimating survival rates from capture-recapture results.

Controlled experiments on the manipulation of breeding investment have been conducted on the Common Eider (length

of incubation time), kittiwake (number of eggs), and puffin (length of chick period). The project has been performed in cooperation with the project described below, "Seabirds as top predator in the marine environment."

Published results: Contact person below for publication list.

Contact person: Kjell Einar Erikstad, Norwegian Institute for Nature Research, Tromsø Museum, University of Tromsø, N-9000 Tromsø, Norway.

Seabirds as top predator in the marine environment

Project start: 1990

Planned conclusion: 1994

Project aims: Study aspects of the feeding ecology and energetics to explain trophic interactions of the populations and population dynamics, as a basis for modelling.

This project focuses on five questions: 1) Is prey availability in the breeding period a regulating factor for breeding success, population size and demography? 2) Is it possible that seabirds can have an influence locally on the population size and recruitment of key species as herring and capelin? 3) With studies of energetics, is it possible to quantify the consumption of prey? 4) What influence do Common Eiders have on recruitment of sea urchins and the feeding on kelp forests? and 5) Is it possible that a limitation of prey availability will change the feeding habits and interactions among seabird species?

Project description: The project is divided into four parts:

1. Relations of predators/prey in a marine environment: effects and adaptations to variable occurrence of prey (Kjell Einar Erikstad). See also separate description of this project.
2. Energy consumption in seabirds (Geir Wing Gabrielsen). See also project "Energy turnover in seabirds."
3. Prey availability as a regulating factor in reproduction and population dynamics (Rob Barrett). See also project "Population status and breeding success of northern Norwegian seabirds in relation to fish stocks."
4. Flock dynamics and interactions of prey relations to Common Eider/sea urchins in an ecosystem in northern Norway (Jan Ove Bustnes). See also project "Marine ducks as predators of benthic communities."

The field work has been done on Hornøya (East-Finnmark), southern part of the Barents Sea, and Kvalsundet (Tromsø).

Published results: Contact persons below for publications list.

Contact persons: Kjell Einar Erikstad, Geir Wing Gabrielsen, Jan Ove Bustnes, Norwegian Institute for Nature Research, Tromsø Museum, University of Tromsø, N-9000 Tromsø, Norway. Rob Barrett, Zoological Department., Tromsø Museum, N-9006 Tromsø, Norway.

Relations of predators/prey in a marine environment: effects and adaptations to variable occurrence of prey

Project start: 1986

Planned conclusion: 1994

Project aims: Discover how different feeding conditions affect the distribution of pelagic seabird populations. Estimate prediction indexes for occurrence of seabirds from one year to another.

Project description: The investigation has been carried out in cooperation with the Institute of Marine Research (Bergen). Seabirds, oceanographic features, and distribution and occurrence of important fish species have been registered along the same transect line each year since 1986.

Published results:

Erikstad, K. E., J. O. Bustnes, and O. Jacobsen. 1988. Duration of ship-following by Kittiwake (*Rissa tridactyla*) in the Barents Sea. Polar Research 6: 191-194

Erikstad, K. E. and W. Vader. 1989. Capelin selection by Common and Brünnich's guillemots during the prelaying season. Ornis Scand. 20: 151-155.

Erikstad, K. E., R. T. Barrett, and F. Mehlum. 1990. What determines the distribution of seabirds at sea. Polar Research 8: 1-97.

Erikstad, K. E., T. Moum, and W. Vader. 1990. Correlations between pelagic distribution of Common and Brünnich's guillemots and their prey. Polar Research 8: 77-87.

Contact person: Kjell Einar Erikstad, Norwegian Institute for Nature Research, Tromsø Museum, University of Tromsø, N-9000 Tromsø, Norway.

Energy turnover in seabirds

Project start: 1990

Planned conclusion: 1995

Project aims: 1) Determine the energy expenditure and food consumption of seabirds breeding in northern Norway, and 2) construct energy budgets of adults and chicks in order to determine how food availability influences parental investment, and hence growth and survival of chicks.

Project description: Daily energy expenditure and food consumption has been determined for the most abundant seabird species by the use of the doubled labelled water (DLW) method. Based on studies of behavior, measurement of growth, carcass analysis, studies of assimilation efficiency, metabolic and DLW studies, it has been possible to construct energy budgets of seabird chicks.

Published results: Contact person below for publication list.

Contact person: Geir Wing Gabrielsen, Norwegian Institute for Nature Research, Tromsø Museum, University of Tromsø, N-9000 Tromsø, Norway.

Population status and breeding success of northern Norwegian seabirds in relation to prey fish stocks

Project start: 1972

Planned conclusion: Long-term study

Project aims: Study the effects of changes in Barents Sea capelin and Norwegian spring-spawning herring on breeding success and breeding populations of seabirds in northern Norway.

Project description: Detailed annual monitoring of breed-

ing populations of seabirds on Hornøy, East Finnmark are being carried out. Periodic total counts are made of seabirds breeding in other colonies in northern Norway. Studies are made of chick food and breeding success of selected species on Hornøy, and changes in community structure in response to population changes.

Published results: Contact person below for publication list.

Contact person: Rob Barrett, Zool. Dep., Tromsø Museum, N-9006 Tromsø, Norway.

Marine ducks as predators of benthic communities

Project start: 1991

Planned conclusion: 1994

Project aims: Study factors influencing the flocking behavior of sea ducks and the possible effects of their predation on community stability.

Project description: The study occurs in the Tromsø area, northern Norway. The study area, Kvalsundet, is a sound with varying current, substrate and depth. During winter, 1,000 Common Eiders, 1,000 King Eiders and 200 Long-tailed Ducks stay there. We have studied the habitat use of the different species, their diet, and their flocking behavior. In addition, we have monitored prey availability at the bottom of the sound, filming transects with a video camera throughout the winter and taking bottom samples.

Contact person: Jan Ove Bustnes, Norwegian Institute for Nature Research, Tromsø Museum, University of Tromsø, N-9000 Tromsø, Norway.

Environmental contaminants in arctic seabirds

Project start: 1992

Planned conclusion: 1995

Project aims: Determine the status of environmental contaminants at different trophic levels in the marine ecosystem in the Arctic. Additional purposes include 1) monitoring the levels of contaminants (organochlorines, heavy metals, and radio nuclides) in different seabird species breeding in the Barents Sea area and 2) investigating the tolerance and ability of seabirds to metabolize, redistribute and excrete persistent chlorinated hydrocarbons.

Project description: Tissue samples (brain, muscles, and liver) have been collected and analyzed for contaminants in different seabird species breeding in northern Norway, Bear Island, Svalbard, Frans Josef Land, Novaya Zemlya, and the Murmansk coast during the summers of 1991 and 1992. The collection, analysis, and quality assurance of samples have been performed according to recommendations made by the Arctic Monitoring and Assessment Program. Effect studies of contaminants on seabirds are performed on kittiwakes at the Hornøya colony.

Published results: Contact Geir Gabrielsen for publication list (see below).

Contact persons: Geir Wing Gabrielsen, Norwegian Institute for Nature Research, Tromsø Museum, University of Tromsø, N-9000 Tromsø, Norway. Tatiana Savinova, Murmansk Marine Biological Institute, Murmansk, Russia.

Steller's Eider in Varangerfjord northern Norway

Project start: 1992

Planned conclusion: 1996

Project aims: Assemble a basis for Steller's Eider management in the most important wintering area in Western Europe.

Project description: Total and limited counts are carried out along the southern coastline of the Varanger Peninsula. Limited counts are performed weekly and total counts four times yearly. A small number of individuals are captured. Some of these are equipped with radio transmitters and others only with foot-rings.

Published results:

Frantzen, B. and G. Henriksen. 1992. The Steller's Eider (*Polysticta stelleri*) in Finnmark 1985-1992. Fauna 45: 100-107.

Contact persons: Gunnar Henriksen/Erik Lund, Office of the Finnmark County Governor, Department of Environmental Affairs, N-9800 Vadsø, Norway.

Status of Seabird Populations in Lower Cook Inlet, Alaska

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Lower Cook Inlet, located in southcentral Alaska, is an important area for many marine and coastal birds. Previous surveys, conducted prior to petroleum development in the mid-1970s, have shown that many birds inhabit the inlet during spring and summer (Erikson 1977, Arneson 1980, Gould et al. 1982). The lower portion of the Inlet, near the Barren Islands, an area affected by the *Exxon Valdez* oil spill, was surveyed in 1992 (Piatt 1993). Otherwise, no population estimates of marine and coastal birds have been calculated since 1978.

Continued oil development in Cook Inlet prompted the need for a new study to obtain population estimates of the marine birds present in the area. In June 1993, U. S. Fish and Wildlife Service, in conjunction with the Minerals Management Service, conducted a small-boat survey of Lower Cook Inlet using techniques developed in Prince William Sound (Klosiewski and Laing ms).

The major objectives of this study were to obtain population estimates with 95% confidence intervals of marine bird

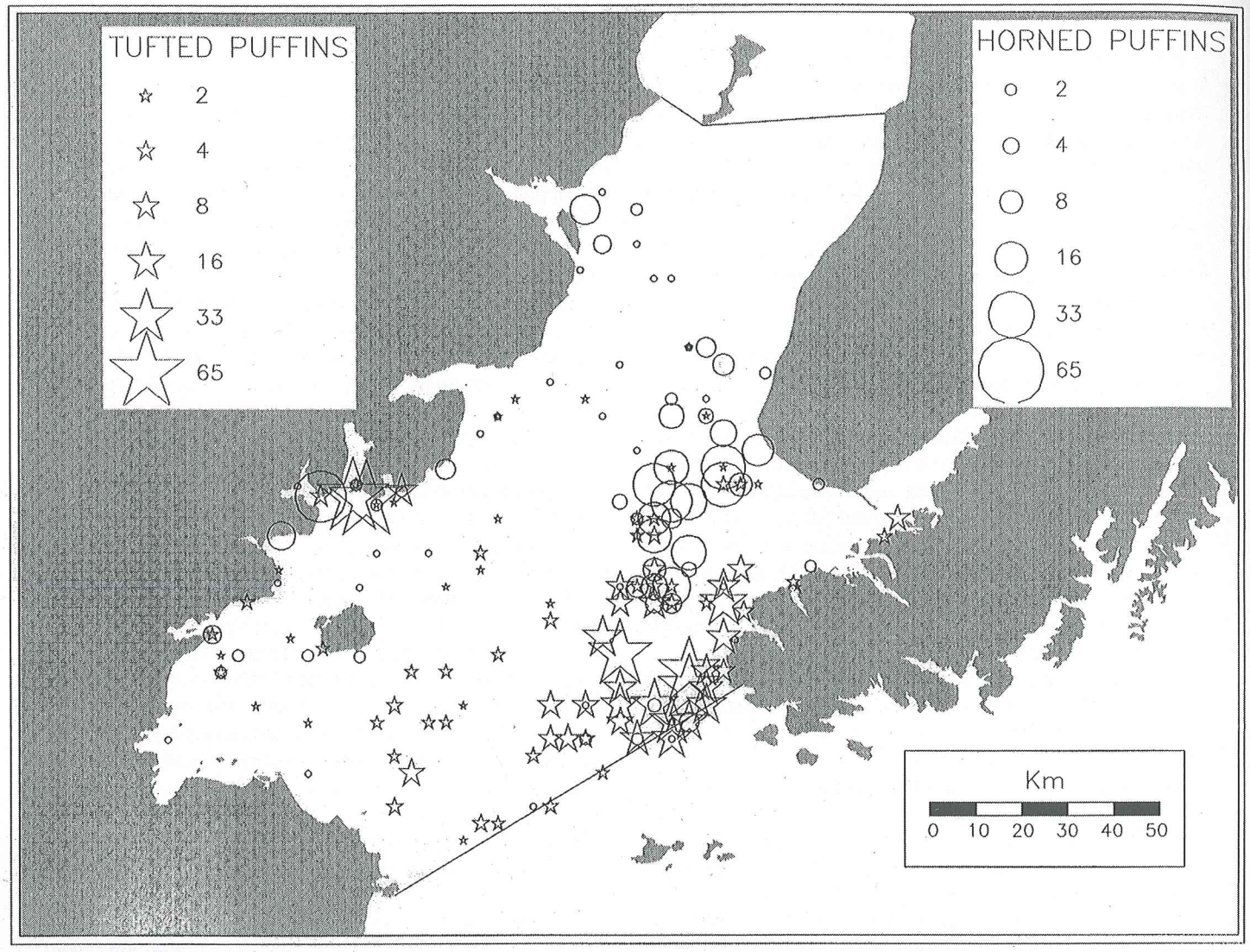

Figure 1. Distribution of Horned and Tufted puffins from a June 1993 small boat survey of Lower Cook Inlet. Each circle represents one transect, and the size of each circle is dependent upon the population estimate for that transect.

populations present in lower Cook Inlet before a possible environmental perturbation, such as the oil spill that occurred in Prince William Sound in 1989. We also examined the distributions of marine birds using a geographical information system and determined the relative abundance of the major species groups within the Inlet during June 1993.

Lower Cook Inlet is physiographically more diverse than many regions in Alaska and contains a wide variety of avian habitats. The southeast portion is made up of sheltered rocky bays and fjords, while the northeastern coastline consists of sand beaches with steep cliffs. Two major rivers enter the Inlet along the eastern shore, causing the Inlet to be turbid in the upper region. The west side of the Inlet is broken up by several large bays, which are relatively shallow and have extensive mudflats, including Kamishak Bay, in the southwestern portion of the study area. Marine waters within Lower Cook Inlet range from high salinity, low turbidity waters in the southeastern portion of the Inlet, correlated with an influx of water from the Alaska Coastal Current, to relatively low salinity, turbid waters in the northern and western portions of the study area.

To provide starting points for our transects, we placed a 2-degree latitude by 4-degree longitude grid over the study area, then randomly chose 30% of the blocks. We used the

northeast corner of each block as the beginning point for each transect. Most transects were oriented north to south, but a few that intersected land were oriented west to east, perpendicular to shore. Transects were approximately 2 nm long, and no transect was less than 1/2 nm.

We divided Lower Cook Inlet into three strata: shoreline, coastal, and pelagic. The shoreline stratum was defined as all waters within 200 m of land and contained 2% of the total area. The coastal stratum consisted of a 3-mile buffer outside the 200 m shoreline stratum and contained 26% of the total area. The pelagic stratum contained 72% of the total area. We surveyed a total of 411 transects in a 13-day period during June 1993.

Survey methodology was similar to that used during small-boat surveys of Prince William Sound conducted by the U. S. Fish and Wildlife Service (Irons et al. 1988a, b; Klosiewski and Laing ms). Transects were surveyed concurrently by three 25-foot boats traveling at speeds of 5-10 knots. Two observers, one on each side of the boat, surveyed a sampling window of 100 m on either side, 100 m ahead, and 100 m overhead of the vessel. When surveying shoreline transects, observers also recorded sightings on land within 100 m of shore.

We used a ratio estimator to estimate population sizes and variances (Cochran 1977). Data from all three strata were treated as a simple random sample. We calculated total population estimates by adding the estimates for each stratum. The 95% confidence intervals were calculated from the sum of the variances by stratum for each species.

To examine the species composition of Lower Cook Inlet, we determined the total population abundance of marine birds in all three strata and calculated the relative abundance of each major species group.

During June 1993, 53 bird species were observed in lower Cook Inlet, and we estimated that 798,042 $\pm$ 195,555 marine birds were present. We estimated that 37,334 $\pm$ birds were present in the shoreline stratum, 254,976 $\pm$ 172,127 birds were present in the coastal stratum, and 505,733 $\pm$ 99,995 birds were present in the pelagic stratum.

We used the Atlas geographic information system program (GIS) to plot our sightings. Overall, marine birds were seen throughout the Inlet, with a large concentration on the southeastern side. The GIS allowed us to overlay two species such as Figure 1 of Tufted (*Fratercula cirrhata*) and Horned Puffin (*Fratercula corniculata*) distribution. The two species appear to utilize the area differently. Horned Puffins were seen further north, while Tufted Puffins were concentrated in the southeastern corner of the Inlet. Creating these maps allowed us to examine the distributions of several species. For example, storm-petrels (*Oceanodroma* sp.) were concentrated along a tide rip down the middle of the Inlet. Gulls (*Larus* sp. and *Rissa* sp.) were seen consistently throughout the Inlet, with largest numbers near the colonies. Murres (*Uria* sp.) were also scattered throughout the area, with a concentration at the mouth of Kachemak Bay and in the southeastern corner of the Inlet.

The most common bird group observed in lower Cook Inlet was alcids (38.1%), and the majority of these were murres (21.2% of the total). The second most common species group was tubenoses (35%), consisting of procellariiformes (20.7% of the total) and storm-petrels (14.3% of the total).

In conclusion, this technique allowed us to obtain reasonable population estimates of marine bird populations in Lower Cook Inlet. This baseline information can be vital for determining short- and long-term changes in marine bird populations as has been shown for Prince William Sound.

References

Arneson, P. D. 1980. Identification, documentation and delineation of coastal migratory bird habitat in Alaska. U. S. Dept. Commer., NOAA, OCSEAP Final Rep. 15 (1981):1-363.

Cochran, W. G. 1977. Sampling techniques. New York: John Wiley and Sons, Inc. 428 pp.

Erikson, D. 1977. Distribution, abundance, migration and breeding locations of marine birds - Lower Cook Inlet, Alaska, 1976. In: Environmental studies of Kachemak Bay and lower Cook Inlet. Vol. 8, L. L. Trasky, L. B. Flagg, and D. C. Burbank (eds.). Alaska Dept. of Fish and Game, Anchorage, AK. 182 pp.

Gould, P. J., D. J. Forsell, and C. J. Lensink. 1982. Pelagic distribution and abundance of seabirds in the Gulf of Alaska and eastern Bering Sea. U. S. Fish and Wildl. Serv., Biological Services Program, OBS 82/48. 294 pp.

Irons, D. B., D. R. Nysewander, and J. L. Trapp. 1988a. Prince William Sound sea otter distribution in relation to population growth and habitat type. Unpubl. Rep. U. S. Fish and Wildl. Serv., Anchorage, AK. 31 pp.

Irons, D. B., D. R. Nysewander, and J. L. Trapp. 1988b. Prince William Sound waterbird distribution in relation to habitat type. Unpubl. Rep. U. S. Fish Wildl. Serv., Anchorage, AK. 26 pp.

Klosiewski, S. P. and K. K. Laing. 1993. Marine bird populations of Prince William Sound, Alaska, before and after the *Exxon Valdez* oil spill. NRDA Bird Study Number 2. Unpubl. Rep. U. S. Fish and Wildl. Serv., Anchorage, AK. 85 pp.

Piatt, J. F. 1993. Oceanic, shelf and coastal seabird assemblages at the mouth of a tidally-mixed estuary (Cook Inlet, Alaska). National Biol. Survey, Final Rep. for Minerals Management Serv. (OCS Study MMS 92-0000), Anchorage, AK. 22 pp.

Status of Seabird Populations in Prince William Sound, Alaska

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Prince William Sound is home to large marine bird and sea otter (*Enhydra lutris*) populations throughout the year. In 1989, the area was greatly affected by the *Exxon Valdez* oil spill that spilled over 11 million gallons of crude oil into the Sound. After the spill, the U. S. Fish and Wildlife Service conducted small boat surveys of Prince William Sound from 1989-91 (Burn in prep., Klosiewski and Laing in prep.) to determine the abundance of marine birds and sea otters and compare these estimates with previous surveys (Dwyer et al. 1976, Irons et al. 1988a, b). These comparisons indicated that populations of sea otters (Burn in prep.) and several marine bird species (Klosiewski and Laing in prep.) declined after the oil spill.

The overall purpose of this study was to survey the marine bird and sea otter populations of Prince William Sound to determine whether species were recovering from the oil spill. Our primary objectives included estimating abundances of marine bird and sea otter populations in Prince William Sound during March and July 1993 and determining whether there were any trends in population abundance.

We used the same methods developed after the oil spill to conduct small boat surveys of Prince William Sound during March and July 1993 (Klosiewski and Laing in prep.). During the 1993 surveys, we recorded 65 bird and 13 mammal species in Prince William Sound. We used a ratio estimator and a two-stage cluster sample (Cochran 1977) to estimate population sizes and variances (Klosiewski and Laing in prep.). We estimated that 402,760 ± 167,697 marine birds were present in the Sound during March 1993, an increase of >200,000 birds over the 1990 and 1991 estimates. This was largely due to an unexplained influx and subsequent die-off of murres (*Uria* spp.) in Prince William Sound (Kendall et al. 1993, Piatt and van Pelt 1993). Prince William Sound was divided into two zones based upon the amount of oiling received after the *Exxon Valdez* oil spill (Klosiewski and Laing in prep.). For March 1993, we estimated that 83,172 ± 34,794 birds were present in the oiled zone and 319,589 ± 164,048 birds were present in the unoiled zone. During July 1993, an estimated 371,327 ± 58,189 marine birds were present in Prince William Sound, a decrease of 41% from July 1972. During July 1993, an estimated 116,219 ± 26,896 birds were present in the oiled zone, and 255,108 ± 51,600 were present in the unoiled zone.

We examined the population trends from 1989-93 in the oiled and unoiled zones and determined whether the populations in the two zones changed at the same rate (homogeneity of slope test, Freud and Littell 1981). From the March 1989-93 surveys, we found that the goldeneye (*Bucephala* spp.) and Black Oystercatcher (*Haematopus bachmani*) populations had a significant difference between the population estimates in the oiled and unoiled zones. The Surfbird (*Aphriza virgata*) population of Prince William Sound showed a significant difference in population abundance during July. The goldeneye and Surfbird populations increased slower in the oiled zone than in the unoiled zone, indicating a continuing oil spill effect, while the Black Oystercatcher population increased faster in the oiled zone. For Prince William Sound as a whole, we examined the population trends from 1989-93 using regression analyses. From the March data, we found significant positive trends for the goldeneye, gull (*Larus* and *Rissa* spp.), murre (*Uria* spp.), and waterfowl populations. No significant trend in overall abundance of any species or species group was found for Prince William Sound during July.

We also examined the relative abundance of the species groups seen in Prince William Sound from 1972-73 (Haddock et al. unpubl. data), 1989-91 (Klosiewski and Laing in prep.) and 1993. The most common species group observed during March was waterfowl (x = 47.7% of the total marine bird population), except for 1993, when murres made up 54.9% of the total. The most common species groups recorded during July were *Brachyramphus* murrelets (x = 38.3%) and gulls (x = 31.6%).

We had only three years of data from March and four years of data from July, thus it is possible that other marine bird populations may have a trend in their population estimates that we were unable to detect. With so few data points, the year to year variability between estimates made it difficult to detect trends (Taylor and Gerrodette 1993, Klosiewski and Laing in prep.). Until we conduct more surveys, we are limited in our ability to determine trends from these data (Taylor and Gerrodette 1993).

The only species shown to be injured by the oil spill that showed a recovery was Black Oystercatcher (Klosiewski and Laing in prep.). The Black Oystercatcher population increased during March in the oiled zone. However, the March Black Oystercatcher population estimate of Prince William Sound was <20, so these results should be interpreted cautiously.

This study was unique for several reasons. We know of no other studies that have persisted for such a long period of time (four years) after a large environmental perturbation, such as the *Exxon Valdez* oil spill. Thus, we had the rare opportunity to examine the effect of an oil spill on an area over time. Also, most data on the population trends of marine and coastal birds have been collected on a relatively short-term basis, usually only 1-2 years (Wooller et al. 1992), or opportunistically over a large area (Gould et al. 1982). Long-term studies have traditionally been on a single species, usually at a breeding location (Wooller et al. 1992), but this survey covered rather large, yet discrete, areas and collected data on several species.

References

Burn, D. M. In prep. Boat-based population surveys of sea

otters (*Enhydra lutris*) in Prince William Sound, in response to the *Exxon Valdez* oil spill. NRDA Marine Mammal Study Number 6. Fish and Wildl. Serv., Anchorage, AK. 38 pp.

Cochran, W. G. 1977. Sampling techniques. New York: John Wiley and Sons, Inc. 428 pp.

Dwyer, T. J., P. Isleib, D. A. Davenport, and J. L. Haddock. 1976. Marine bird populations in Prince William Sound, Alaska. Unpubl. Rep. U. S. Fish and Wildl. Serv., Anchorage, AK. 24 pp.

Freud, R. J. and R. C. Littell. 1981. SAS for linear models: a guide to the ANOVA and GLM procedures. SAS Institute Inc., Cary, N. C. 231 pp.

Gould, P. J., D. J. Forsell, and C. J. Lensink. 1982. Pelagic distribution and abundance of seabirds in the Gulf of Alaska and eastern Bering Sea. U. S. Fish and Wildl. Serv., Biol. Serv. Prog., OBS-82/48. 294 pp.

Irons, D. B., D. R. Nyeswander, and J. L. Trapp. 1988a. Prince William Sound sea otter distribution in relation to population growth and habitat type. Unpubl. Rep. U. S. Fish and Wildl. Serv., Anchorage, AK. 31 pp.

Irons, D. B., D. R. Nyeswander, and J. L. Trapp. 1988b. Prince William Sound waterbird distribution in relation to habitat type. Unpubl. Rep. U. S. Fish and Wildl. Serv., Anchorage, AK. 26 pp.

Kendall, S., P. Seiser, G. Esslinger, and D. Irons. 1993. Observations of dead murres on beaches in Prince William Sound during March 1993. Unpubl. Rep. U. S. Fish and Wildl. Serv., Anchorage, AK. 8 pp.

Klosiewski, S. P. and K. K. Laing. In prep. Marine bird populations of Prince William Sound, Alaska, before and after the *Exxon Valdez* oil spill. NRDA Bird Study Number 2. Unpubl. Rep. U. S. Fish and Wildl. Serv., Anchorage, AK. 85 pp.

Piatt, J. F. and T. van Pelt. 1993. Common murre die-off in Alaska. Pacific Seabird Group Bull. 20:61.

Taylor, B. L. and T. Gerrodette. 1993. The uses of statistical power in conservation biology: the vaquita and northern spotted owl. Cons. Biol. 7:489-500.

Wooller, R. D., J. S. Bradley, and J. P. Croxall. 1992. Long-term population studies of seabirds. TREE. 7:111-14.

Eradication of Introduced Foxes on Islands in the Alaska Maritime National Wildlife Refuge to Restore Natural Biodiversity

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Foxes originally were absent from most Alaskan islands in the North Pacific, but arctic foxes (*Alopex lagopus*) and red foxes (*Vulpes vulpes*) are indigenous on islands in the Bering Sea, where pack ice seasonally links them to the mainland. Red foxes are native to the Fox Islands in the eastern Aleutian Islands and on some islands off the Alaska Peninsula. The Russians began releasing foxes on Attu Island, the westernmost of the Aleutians, in 1750, and introductions quickly expanded eastward (Black 1984). In the 1880s American fur farmers began releasing foxes on numerous additional islands from southeast Alaska westward to the Aleutians and, by the 1930s, foxes had been introduced to more than 450 islands with devastating consequences for many species of nesting seabirds, waterfowl, ptarmigans, and other insular birds (Bailey 1993). Alien foxes persist on only 43 islands, mostly in the Aleutians and south of the Alaska Peninsula. The U. S. Fish and Wildlife Service began eradicating foxes in the Aleutians in 1949. Presently, foxes presumably have been removed from at least 19 islands, and eradication awaits confirmation on five others. Until 1972, toxicants, chiefly 1080 baits (sodium monofluoroacetate) and M-44 devices (cyanide projectiles), were used to remove arctic foxes from islands in the Aleutians. The last use of poisons under an emergency waiver to protect endangered geese was in 1986; since then only traps and firearms have been used, making eradication efforts more costly and much less efficient. Experimental use of sterile red foxes to eliminate arctic foxes on two small islands also proved successful but would be very expensive and would likely fail on big islands. The refuge is currently trying to reobtain special approval to use M-44s, but the registration of 1080, the most effective tool, has been cancelled, thus probably precluding the affordable elimination of foxes from extremely large islands.

Of the 28 refuge islands which still have alien foxes, they should be removed from at least 15. Spectacular recoveries of nesting seabirds, waterfowl, shorebirds, and other species are occurring on many islands where foxes have been annihilated (Bailey 1993). Restoration of insular habitat by extermination of alien predators is clearly the most beneficial activity this refuge can pursue on behalf of island nesting birds.

References

Bailey, E. P. 1993. Introduction of foxes to Alaskan islands—history, effects on avifauna, and eradication. U. S. Fish and Wildlife Service Resource Pub. 193: 1-54.

Black, L. T. 1984. Atka—an ethnohistory of the western Aleutians. Kingston, Ontario: Limestone Press. 219 pp.

Introduced Rats on Alaskan Islands: History, Current Status, and Future Threats

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Commensal rats (*Rattus* spp.) have reached 82% of the world's major islands and insular groups with disastrous consequences for native birds (Atkinson 1985). Twenty-seven species of seabirds are known prey of rats. Rats are spreading to additional islands because of shipwrecks, moored vessels, and cargo (Atkinson 1985).

Norway rats (*R. norvegicus*) have become established on at least 22 islands in the Alaska Maritime National Wildlife Refuge, beginning with a shipwreck on Rat Island (Aleutian Islands) in 1780 (Bailey 1993). Norway rats also occur on many other islands in Alaska, chiefly in the Alexander Archipelago. In the Aleutians, rats undoubtedly prey heavily on fossorial and crevice-nesting seabirds, but clear examples of the extirpation of nesting seabirds by rats alone on specific islands are not evident because of more extensive depredations on seabirds by the introduction of arctic foxes (*Alopex lagopus*) or red foxes (*Vulpes vulpes*) to over 450 islands in Alaska (Bailey 1993). However, Langara Island, lying just south of Alaska in British Columbia, is an obvious case of the demise of once immense fossorial seabird colonies by rats (Taylor 1993). Five species of seabirds were extirpated within 40 years.

Unlike countries like New Zealand, which have contingency plans to deal with the grounding of vessels on rat-free islands, Alaska currently has no such protection. A grounding of a rat-infested ship on a key refuge island, such as Buldir, Chagulak, or Forrester, would prove locally catastrophic for many species of seabirds, and once established, rats would be impossible to remove.

An environmental assessment proposing the emergency use of two rodenticides (brodifacoum and bromethalin) on a grounded ship and ambient beaches has been completed by the U. S. Fish and Wildlife Service (1993). These toxicants should be stored at strategic statewide sites where they can quickly be deployed after the grounding of a ship on a rat-free refuge island. Prevention of the invasion of rats onto new islands must always be the main concern because later eradication efforts, even if possible, are far more costly after rats have become established. Rats have been removed only on islands up to 259 hectares in size.

References

Atkinson, I. A. E. 1985. The spread of commensal species of *Rattus* to oceanic islands and their effects on island avifauna. ICBP Tech. Publ. 3: 35-81.

Bailey, E. P. 1993. Introduction of foxes to Alaskan islands—history, effects on avifauna, and eradication. U. S. Fish and Wildlife Resource Publ. 193:1-54.

Taylor, R. H. 1993. The feasibility of rat eradication on Langara Island, British Columbia, Canada. Unpubl. Rep., Canadian Wildlife Service, Delta, B. C.

U. S. Fish and Wildlife Service. 1993. Proposed emergency use of toxicants to prevent accidental introductions of rats from shipwrecks on islands in the Alaska Maritime National Wildlife Refuge. Environmental Assessment. Alaska Maritime National Wildlife Refuge. Homer, AK.

The Alaska Maritime National Wildlife Refuge: Its Role in Conservation of Alaska's Seabirds

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The Alaska Maritime National Wildlife Refuge (Figure 1) was created in 1980 by the Alaska National Interest Lands Conservation Act. Nearly 2 million acres were added to 11 existing seabird refuges in Alaska, creating a new 4.9 million-acre refuge encompassing most of Alaska's seabird nesting habitat. Nowhere else in the world has a government set aside such an expansive land base to protect seabirds. The refuge is divided into five geographical units which span nearly the entire coastline of Alaska. At least 30 species of seabirds totalling approximately 40 million birds, about 80% of the total breeding population for Alaska, nest on the refuge. The most abundant seabirds are storm-petrels, kittiwakes, murres, auklets, and puffins.

Most of the refuge is composed of islands, but a few mainland cliffs are also included. About 75% of the land in the refuge is in the Aleutian Islands which have been designated an International Biosphere Reserve. Although most of the refuge is wilderness, seabirds have not been free from perturba-

tions. The Aleutian Islands have been a wildlife refuge since 1913, but there was a major occupation of this area during WWII accompanied by substantial local habitat destruction from construction, bombings, and oil spills. Furthermore, nuclear weapons were tested at one site in the late 1960s and early 1970s. Nevertheless, the most significant adverse impacts have been caused by the introduction of mammals (e.g., foxes, rats, ground squirrels, cattle, reindeer).

Active refuge management over the past 30 years has included removal of introduced foxes, reindeer, and cattle from selected islands. Seabirds and other native fauna are becoming reestablished and their populations are increasing as a result of these management actions. In addition, military commands remaining on the refuge work closely with the U. S. Fish and Wildlife Service to minimize effects of their activities on seabirds and other native wildlife. Recently, the military has produced natural resource management plans for areas they occupy on the refuge. These plans recognize the need to clean up contaminants, minimize further habitat damage, and monitor key wildlife species and habitats.

In order to identify problems in the marine food web, refuge biologists monitor selected species of seabirds, representing different feeding guilds to determine population trends, fluctuations in productivity, and variations in other parameters that help managers understand processes affecting populations. In addition, researchers from universities and other research institutes in the United States, Canada, and Russia, study various aspects of seabird ecology on the refuge. Transportation for the refuge staff and researchers is provided to remote areas by the Fish and Wildlife Service's 120-foot vessel *Tiglax*.

Refuge staff members are also involved in environmental education and visitor information activities in offices at Adak and Homer. Outreach programs include visits to schools in several villages and remote military installations, presentations by naturalists on board the Alaska ferries, and operating youth summer camps.

All these actions help the refuge meet it's purpose of protecting wildlife and habitat in its natural diversity, providing for continued subsistence use by local residents, fulfilling treaty obligations of the United States, protecting water quantity and quality, and providing for an international research program on marine resources.

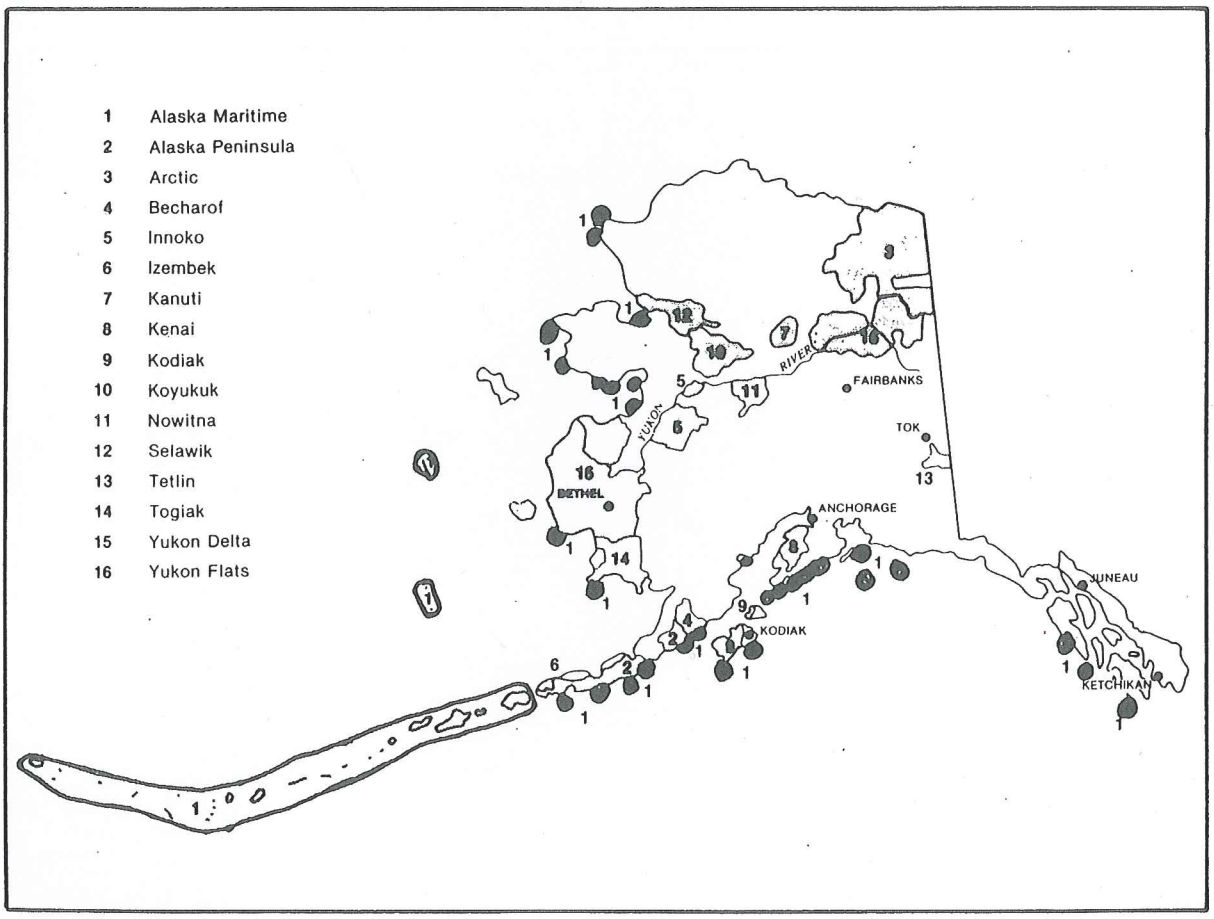

Figure 1. Alaska Maritime National Wildlife Refuge.

Threatened and Endangered Seabirds and Seaducks in Alaska

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The recent addition of two seabird species to the U. S. Fish and Wildlife Service's list of species that are candidates for threatened and endangered species classification has increased concern over biological conditions in the Bering Sea and North Pacific Ocean. In September 1993, the U. S. Fish and Wildlife Service (Service) added the Red-legged Kittiwake (*Rissa brevirostris*) and Kittlitz's Murrelet (*Brachyramphus brevirostris*) to the category 2 candidate species list. The Marbled Murrelet (*B. marmoratus*) has been a candidate species in Alaska since 1989. The population in Washington, Oregon, and California was classified as threatened in 1992. Another seabird that is found in Alaska, the Short-tailed Albatross (*Diomedea albatrus*), has been listed as an endangered species since the U. S. Endangered Species Act became law in 1973. Clues that the Bering Sea may be experiencing fundamental changes come from other animal populations, as well. Two Arctic sea duck populations have declined dramatically in Alaska. The Spectacled Eider (*Somateria fischeri*) was designated a threatened species in May, 1993, and the Alaska breeding population of Steller's Eiders (*Polysticta stelleri*) will soon be proposed for threatened species listing.

How the U. S. Endangered Species Act protects marine birds

Recognizing the importance of preserving wildlife diversity, the U. S. Congress passed the Endangered Species Act in 1973. The U. S. Fish and Wildlife Service (Service), along with the National Marine Fisheries Service for most marine mammals and fish, administer the provisions of the Act. These responsibilities include: 1) listing species as threatened or endangered; 2) enforcing prohibitions on take and disturbance; 3) conducting biological recovery programs; 4) protecting important habitat, 5) providing biological opinions to Federal agencies on their activities that may affect listed species, and 6) providing financial grants to States to assist with their endangered species conservation efforts.

Under the Act, species may be listed as threatened or endangered. The Service also maintains a list of species that are "candidates" for protection under the Act. Candidate species do not receive legal protection, but they often receive increased emphasis for biological study and conservation actions by government agencies and non-governmental organizations. The distinctions between the various listing and candidate species designations are discussed below.

Endangered: A species which is in danger of extinction throughout all or a significant portion of its range. Under the Act, a "species" is defined to include distinct vertebrate population segments. No standard, quantified guidelines are provided for determining when a species is in danger of extinction. Determination of endangerment is based solely on biological and take information.

Threatened: A species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Candidate, Category 1: A species for which the Service has sufficient information on biological vulnerability and threats to support listing. Formal listing is presently delayed due to listing work on higher priority species (e.g., species facing greater threats or facing more imminent extinction).

Candidate, Category 2:. A species for which the Service has information indicating that listing may be appropriate, but for which conclusive data on biological vulnerability and threats are not currently available. Additional research and field study are typically needed for these species and listing will not be proposed unless additional supportive data are obtained.

Alaska's endangered, threatened and candidate seabirds

Short-tailed Albatross (Endangered): Historically, this large, pelagic bird was the most abundant albatross in the North Pacific, numbering in the millions. Market hunting from the late 1800s to 1930s, combined with a volcanic eruption on Torishima Island in Japan where they nest, decimated the population. Following protection on their nesting grounds, the population has increased from less than 50 birds to more than 600 (Sherburne 1993). Short-tails range across the North Pacific Ocean feeding on surface aggregations of plankton and small fishes. They frequent Alaskan waters during the summer nonbreeding season. Incidental sightings in Alaska have increased in the last decade, including two birds accidentally caught in commercial fishing operations.

Spectacled Eider (Threatened): This large-bodied diving duck has declined precipitously on western Alaska breeding grounds from perhaps 50,000 pairs to less than 5,000 pairs (Stehn et al. 1993). Breeding numbers and trends on Alaska's Arctic coastal plain and in Russia are not clear. Causes for their decline are not known, but may include some combination of reduced food supply, contamination, overharvest, and predation (Stehn et al. 1993). Little is known about this species away from its coastal tundra nesting grounds. Its winter distribution is probably restricted to the northwestern Bering Sea and its diet is presumed to consist primarily of benthic mollusks.

Steller's Eider (Category 1 Candidate): A diving duck, Steller's Eiders frequent nearshore lagoons and bays to feed on mollusks. The wintering population on the Alaska Peninsula apparently has stabilized after declining by 50% or more in the 1970s-80s (Quakenbush and Cochrane 1993). Steller's

Eiders nest most abundantly in Russia. The North American breeding range has diminished and nesting is now restricted to the western portion of Alaska's Arctic coastal plain (Kertell 1991). The North American breeding population may number only a few thousand birds, while 150,000-200,000 may nest in Russia (Quakenbush and Cochrane 1993).

Red-legged Kittiwake (Category 2 Candidate): This small gull is found only in the Bering Sea. It nests on the Pribilof Islands and Buldir and Bogoslof islands in the Aleutian Islands in western Alaska and on Russia's Komandorskiye Islands. Little is known about their post-breeding distribution and ecology. Red-legged Kittiwakes feed primarily on small fishes and marine invertebrates, especially myctophids, taken from surface waters. Since the mid-1970s, the nesting population on St. George Island, where >75% of the known population nests, declined by roughly 50% (Byrd and Williams 1993). Although reasons for the decline are unclear, biologists attribute the decline to low productivity and irregular food supplies. Despite speculation, data are lacking that might link Red-legged Kittiwake food supplies to extensive commercial fish harvests. Since 1985, the Pribilof Islands' population appears to be stable (V. Byrd, pers. comm.).

Marbled Murrelet (Category 2 Candidate): This small alcid breeds primarily in old-growth coniferous rain forests from California to Alaska. Marbled Murrelets are listed as a threatened species in Washington, Oregon, and California, and in British Columbia, Canada, primarily due to loss of nesting habitat in old-growth coastal forests. Their status in Alaska is not clear, although their population size is estimated to be at least 160,000 birds (Piatt and Ford 1993). Most Marbled Murrelets are found in Prince William Sound, the Kodiak Archipelago, and Southeast Alaska, parts of which are undergoing extensive logging.

Kittlitz's Murrelet (Category 2 Candidate): Because they are difficult to distinguish from Marbled Murrelets in the field, little is known about Kittlitz's, Murrelets. They nest on the ground. Their breeding range extends from Southeast Alaska to the Chukchi Sea in Northwest Alaska and Russia. Based on surveys in Alaska's Prince William Sound, they are much less numerous than Marbled Murrelets (K. Kuletz, pers. comm.). Both Kittlitz's and Marbled Murrelets forage close to shore, feeding on zooplankton and small fish.

Current projects in Alaska

In recent years the National Marine Fisheries Service, in cooperation with the Service, has been collecting data on incidental take of seabirds in offshore and selected nearshore commercial fisheries in the North Pacific and Bering Sea. In 1995, this observer program will be expanded to the winter Bering Sea commercial crab fishery due to anecdotal reports that large numbers of eiders occasionally collide with lighted vessels near the ice pack.

The Service will continue monitoring Red-legged Kittiwake nesting populations in Alaska to determine current population and productivity trends. Studies of productivity and food habits are continuing at St. George Island. Summer and winter murrelet populations have been monitored in Alaska's Prince William Sound between 1989-93 (see Agler, this issue). Seabird population surveys will be conducted in Southeast Alaska for the first time, in part, to obtain a population estimate for murrelets in that region.

A Spectacled Eider Recovery Team was appointed in 1993 and will produce a draft recovery plan by June 1994. Nesting ground studies and surveys are underway for both the Spectacled and Steller's Eiders to assess reproductive success and population trends in Alaska and Russia. Adult and juvenile survivorship will be addressed through banding studies. The winter distribution of Spectacled Eiders is being investigated by implanting satellite transmitters in breeding birds occurring in western Alaska.

This study will be expanded to Alaska's North Slope, and hopefully to Russia, in the near future.

In response to concerns about these birds and other marine resources, the Service has formed a Bering Sea Ecosystem Team to provide integrated direction for future research and management actions. This effort will complement related Bering Sea initiatives by other agencies and nongovernmental organizations.

References

Byrd, G. V. and J. C. Williams. 1993. Red-legged Kittiwake (*Rissa brevirostris*). In: The Birds of North America, No. 60. A. Poole and F. Gill (eds.). Philadelphia: The Academy of Natural Sciences; Washington, D. C.: The American Ornithologists Union.

Kertell, K. 1991. Disappearance of the Steller's Eider from the Yukon-Kuskokwim Delta, Alaska. Arctic 44: 177-218.

Piatt, J. F. and R. G. Ford. 1993. Distribution and abundance of Marbled Murrelets in Alaska. Condor 95: 662-69.

Quakenbush, L. and J. F. Cochrane. 1993. Report on the conservation status of the Steller's Eider (*Polysticta stelleri*), a candidate threatened and endangered species. Unpubl. rep., U. S. Fish and Wildlife Service, Anchorage, Alaska. 26 pp.

Sherburne, J. 1993. Status report on the Short-tailed Albatross (*Diomedea albatrus*). Unpubl. rep., U. S. Fish and Wildlife Service, Anchorage, Alaska. 33 pp.

Stehn, R. S., C. P. Dau, B. Conant, and W. I. Butler. 1993. Decline of Spectacled Eiders nesting in western Alaska. Arctic 46: 264-277.

Diet and Reproduction in Red-legged and Black-legged Kittiwakes

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Red-legged and Black-legged kittiwakes (*Rissa brevirostris* and *R. tridactyla*) are sympatric congeners breeding on the Pribilof Islands, Alaska. Red-legged Kittiwakes currently pose the most serious bird conservation and management problem in Alaska. This seabird, virtually endemic to the Bering Sea, has exhibited population declines of 50% in the last 15 years (Byrd 1989) and is currently under consideration for listing as threatened or endangered. The population decline has resulted from chronically poor reproductive success and all evidence points to failure of the food supply (Dragoo 1991, Springer 1992, Hatch et al. 1993).

Red-legged Kittiwakes primarily utilize oceanic prey, particularly northern lampfish (*Stenobrachius leucoparus*: Myctophidae) during the breeding season, while Black-legged Kittiwakes feed on a diverse array of forage fish (primarily juvenile pollock, *Theragra chalcogramma*) and zooplankton found in shallower waters closer to the breeding colony (Dragoo 1991, Flint et al. 1990). Lampfish are extremely high in lipids (mostly wax esters, A. R. Place unpubl. data), while juvenile pollock are relatively low in lipids (J. Wejak, NMFS unpubl. data). Consequently, lampfish have more than twice the energy density of juvenile pollock and Red-legged Kittiwake chicks can meet their energy requirements on much lower daily food intakes than Black-legged Kittiwake chicks (Figure 1).

Dietary differences between the two species of kittiwakes are associated with differences in reproductive traits. Red-legged Kittiwakes have a smaller clutch size, longer incubation period, and lower growth rate compared with Black-legged Kittiwakes (Byrd and Williams 1993). Red-legged Kittiwakes apparently deliver chick meals less frequently, but field metabolic rates during chick-rearing are not different in the two species (Flint et al. 1990).

Field research was conducted on St. George Island, Alaska, during the 1993 breeding season. Chicks of the two species were interspecifically cross-fostered to test the hypothesis that interspecific differences in chick diets are responsible for observed differences in growth rate and fledging success. Data were collected on chick growth rates, chick meal size, chick feeding rate, and composition of the diet for the two species. Chicks were collected at 30 days of age for body composition analysis.

Survival rates of interspecifically cross-fostered chicks were similar to those of control chicks. There were no intraspe-

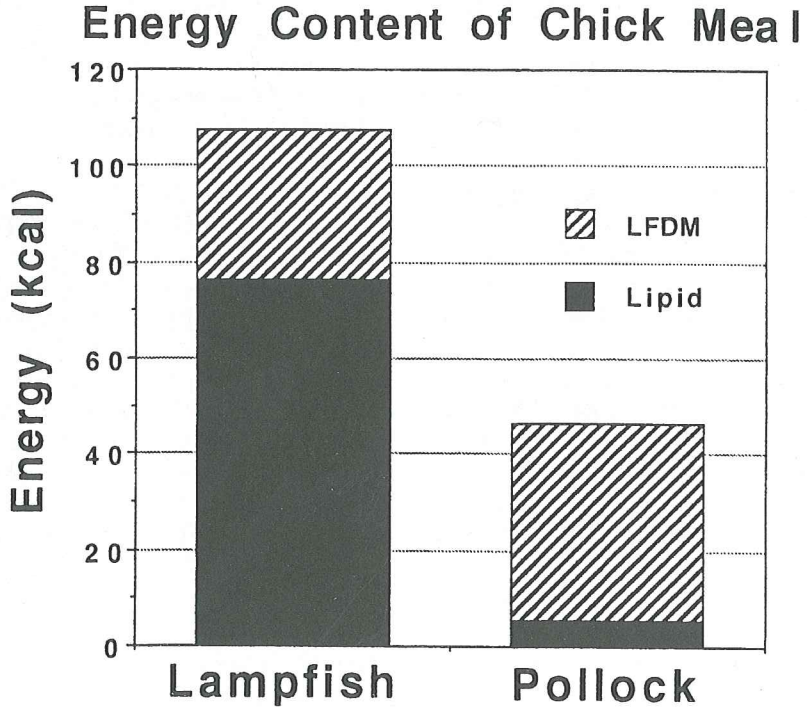

Figure 1. Energy density of northern lampfish (*Stenobrachis leucopsarus*) and walleye pollock (*Theragra chalcogramma*).

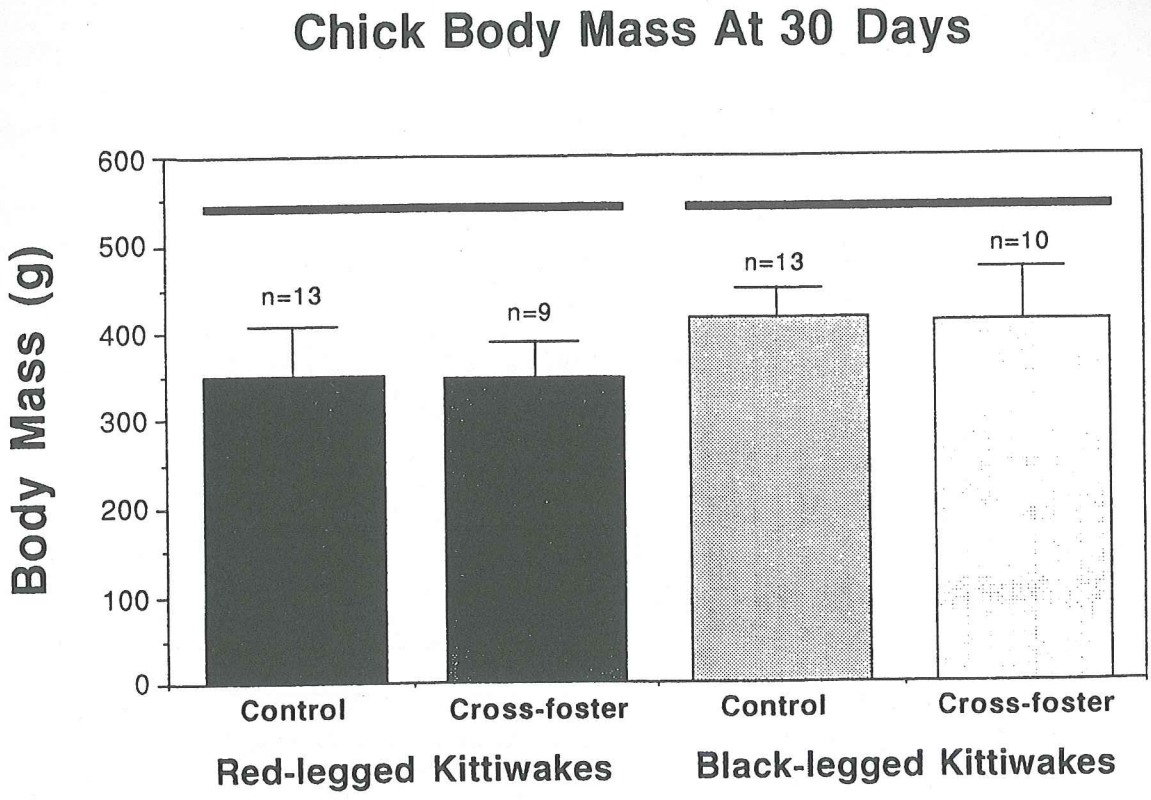

Figure 2. Peak masses of Red-legged and Black-legged kittiwakes chicks (control and cross-fostered), St. George Island, Alaska.

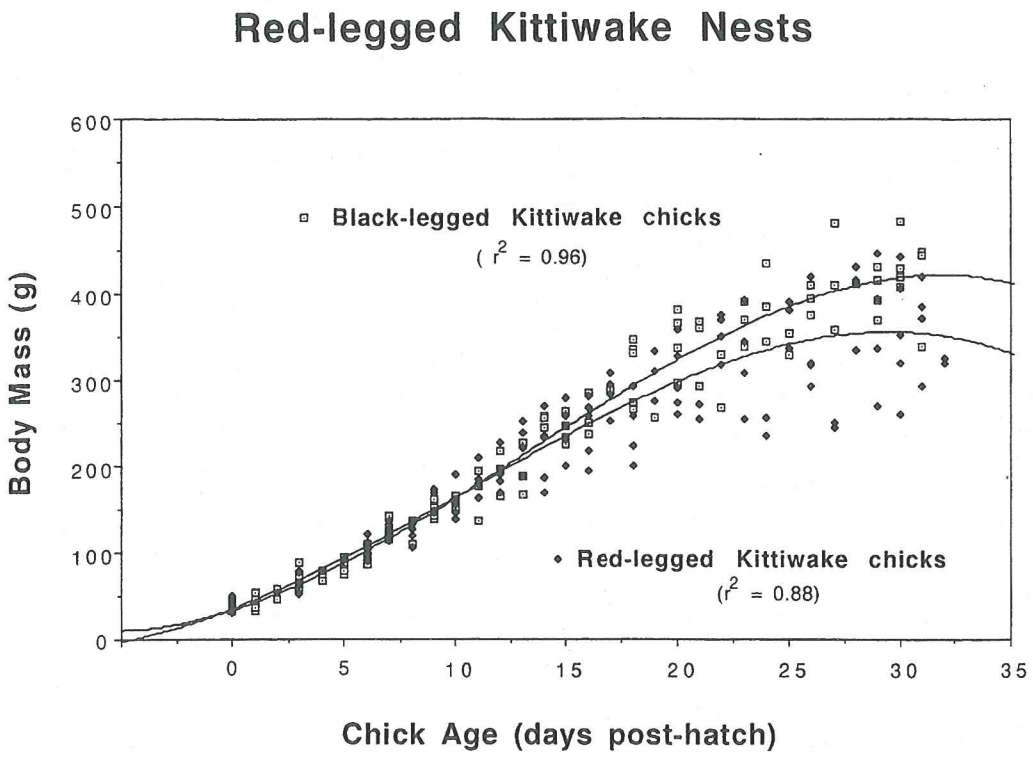

Figure 3. Growth rates of Red-legged and Black-legged kittiwake chicks in Red-legged Kittiwake nests, St. George Island, Alaska.

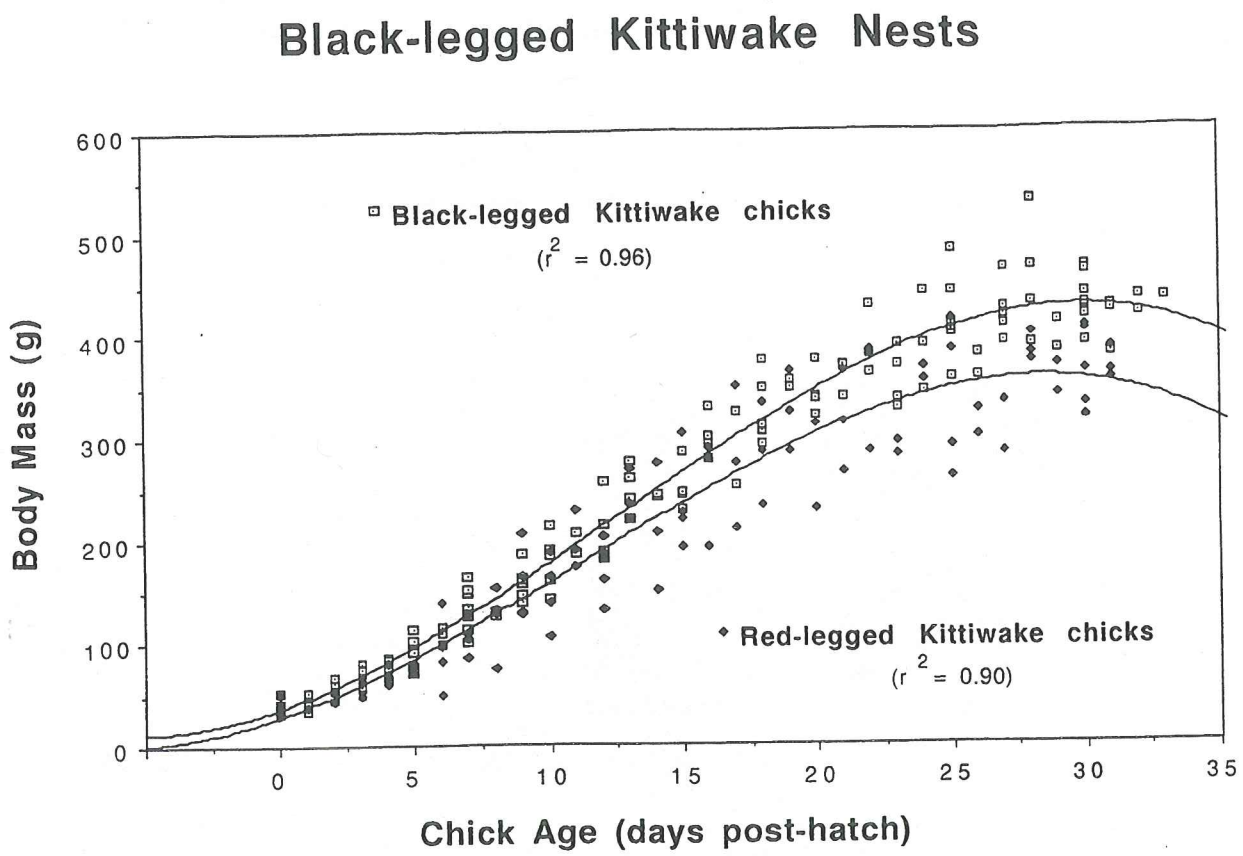

Figure 4. Growth rates of Red-legged and Black-legged kittiwake chicks in Black-legged Kittiwake nests, St. George Island, Alaska.

cific differences in growth rates or peak mass between control and cross-fostered chicks, but Black-legged Kittiwake chicks had higher growth rates and peak masses than Red-legged Kittiwake chicks regardless of the treatment (Figures 2, 3, and 4). Thus, diet and feeding frequency were not the proximate factors causing differences in chick growth rate and peak mass between the two kittiwake species. Instead, interspecific differences in chick growth rates are due to species-specific physiological constraints. The reliance of Red-legged Kittiwakes on more oceanic prey, and the resultant lower frequency of chick feeding and higher energy density of chick meals, has selected for a suite of reproductive traits characteristic of offshore-foraging seabirds.

Our continuing research will compare the diet, growth, body composition, and reproductive energetics of Red-legged and Black-legged kittiwakes. The research will also compare the gastrointestinal anatomy of the two species and examine how this relates to dietary differences. In addition, an energetics model will be developed to investigate the relationship of diet to productivity in Red-legged and Black-legged kittiwakes and how this relates to differences in foraging ecology between the two species. An understanding of dietary requirements, foraging niche, and reproductive constraints of Red-legged Kittiwakes will be essential in formulating management strategies to enhance populations of this declining species.

References

Byrd, G. V. and J. C. Williams. 1993. Red-legged Kittiwake. In: The birds of North America, No. 60. A. Poole and F. Gill (eds.) The Academy of Natural Sciences Philadelphia.

Byrd, G. V. 1989. Seabirds of the Pribilof Islands, Alaska: trends and monitoring methods. Unpubl. M.S. thesis, University of Alaska, Fairbanks. 96 pp.

Dragoo, D. E. 1991. Food habits and productivity of kittiwakes and murres at St. George Island, Alaska. Unpubl. M.S. thesis, University of Alaska, Fairbanks. 104 pp.

Flint, E. N., G. L. Hunt, Jr., and M. A. Rubega. 1990. Time allocation and field metabolic rate in two sympatric kittiwake species. Acta XX Congressus Internationalis Ornithologici, Supplement.

Hatch, S. A., G. V. Byrd, D. B. Irons, and G. L. Hunt, Jr. 1993. Status and ecology of kittiwakes (*Rissa tridactyla* and *R. brevirostris*) in the North Pacific. In: The status, ecology and conservation of marine birds of the North Pacific, K. Vermeer, K. T. Briggs, K. H. Morgan, and D. Siegel-Causey (eds.). Can. Wildl. Serv. Spec. Pub., Ottawa.

Springer, A. M. 1992. A review: walleye pollock in the North Pacific—how much difference do they really make? Fish. Oceanogr. 1:80-96.

Learn About Alaskan Seabirds: An Educational Curriculum

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The U. S. Fish and Wildlife Service (Service) believes education plays an important role in preparing young Alaskans to make informed decisions about natural resource issues. The Service in Alaska has developed several educational curricula including "Teach about Geese," "Wetlands and Wildlife," and "The Role of Fire in Alaska." The goal of these curricula is to introduce students to, and provide information about, local natural resource topics.

Over 60 species of seabirds are found in Alaska. About 50 million breeding seabirds or about 86% of the total U. S. population of seabirds occur in Alaska. This important resource plays a significant socioeconomic role in Alaska. They are vulnerable to natural and human-caused impacts.

The Service would like young Alaskans to learn more about seabirds so they will be aware of their status in Alaska, their worldwide significance, and their vulnerability to impacts. The Service will soon have available a seabird education packet, "Learn About Alaskan Seabirds," designed to reach students in grades 4-6. The packet will include an education curriculum, a teacher information manual, a poster, seabird identification slides, and reference books. The curriculum will contain 11 interdisciplinary, hands-on activities. Topics that are covered include seabird identification, food webs, population dynamics, predator/prey relationships, adaptations of seabirds to their habitats, traditional uses by people, and adverse impacts to seabirds and their habitats. For example, in one activity called "Create a Cliff" the class builds a seabird colony in their classroom.

The 18" X 24" color poster will highlight impacts to Alaska's seabirds. These impacts are shown on one side of the poster with further explanation of each given on the back. Some of the impacts depicted include oil pollution, disturbance by animals such as rats and dogs, entanglement in fishing nets, and ingestion of plastics and other litter.

As the packet was developed we solicited ideas and information from seabird biologists, land managers, and school districts in coastal areas across Alaska. They were invited to participate in the development of the packet so the materials would accurately portray local seabird resources and issues. Draft materials were tested in a variety of schools and suggestions were incorporated in the final version.

We hope the packet will be widely used by Alaskan educators once it is completed and that its use will benefit young Alaskans and our seabird populations for many years to come. In addition, we hope that it will serve as a model for use in communities near seabird resources in the Northeast and Northwest regions of the U. S. and in other circumpolar countries.

Restoration Activities Following the *Exxon Valdez* Oil Spill: Murre Population Counts and Productivity in the Barren Islands, Alaska

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We studied productivity and population size of murres on East Amatuli and Nord islands in the Barren Islands, Alaska, during the 1993 nesting season (Figure 1). These islands contained the largest breeding concentrations of seabirds in the path of the 1989 *Exxon Valdez* oil spill; murres appeared to suffer the highest mortality (Piatt et al. 1989). Since the oil spill, annual surveys have been conducted in the Barrens to try to assess the impacts of the oil spill and recovery rates of murre populations.

Before the oil spill, cliff-nesting seabirds at the Barren Islands were not consistently monitored because it is a difficult place to work on them. Most of the cliffs are accessible on a routine basis only by boat, and frequent storms in the area make boating difficult. From 1989-1992 studies focused on counts of murres and increasingly on timing of nesting events and rates of productivity. Data were gathered during regular trips on a ship. In 1993, two summer-long field camps were established in the islands to allow more intensive study of the colonies.

The entire islands of Nord, East Amatuli, and East Amatuli Light Rock were counted from boats at least once annually during 1989-1993, and replicate counts were also made on a series of plots. Only whole-island counts could be compared with pre-spill estimates (plots were not established during the early estimates); the replicate-count plots were used to look for seasonal trends in attendance and to provide statistical power in interannual post-spill comparisons. We also used time-lapse video cameras to record hourly attendance of murres.

In addition to the population counts, nests on cliff segments that could be viewed from above were observed through-

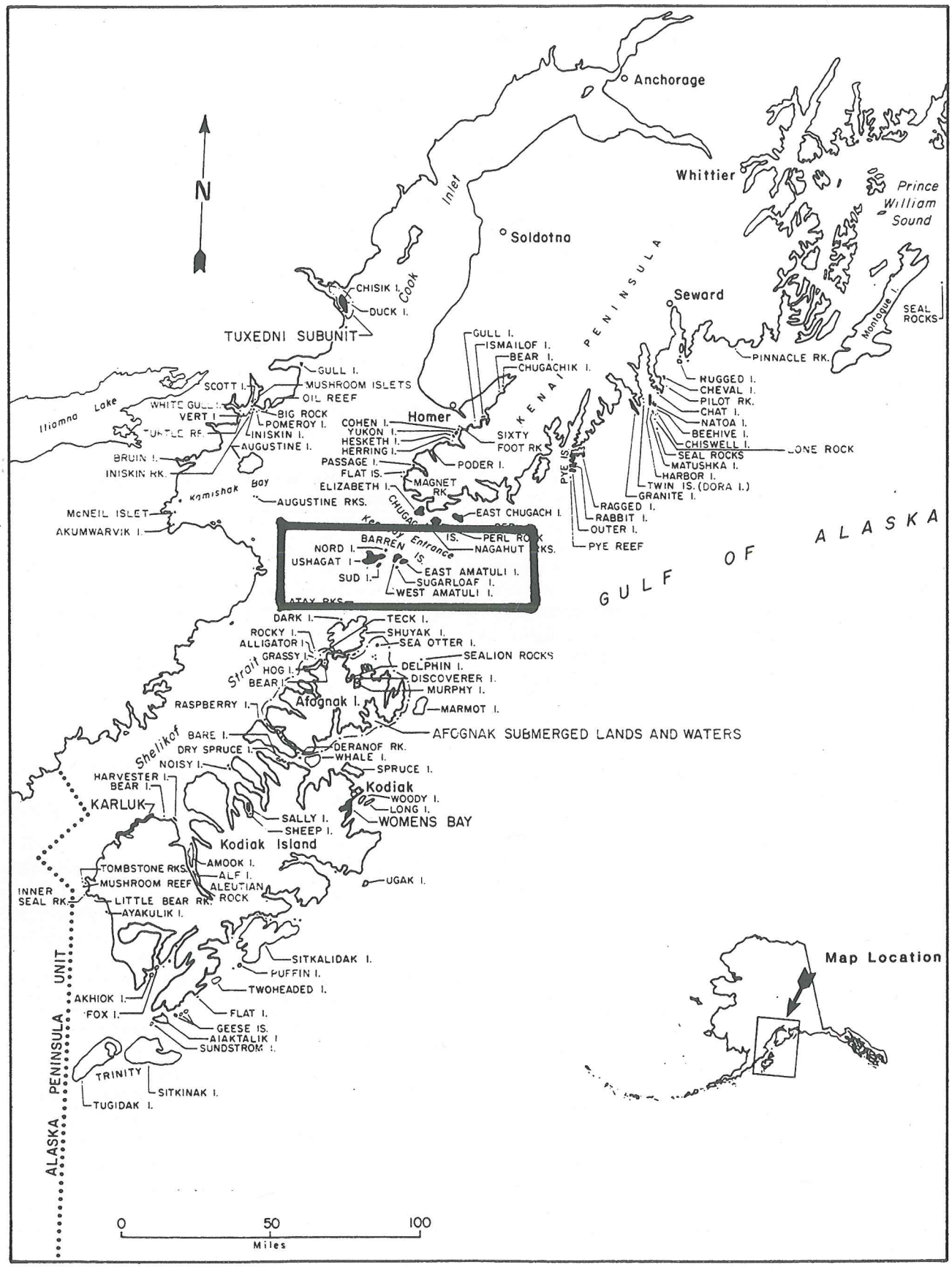

Figure 1. Study area in the Barren Islands, Alaska.

out the summer of 1993 to estimate the timing of nesting events and rates of productivity. Less complete information on these parameters was obtained from 1989-1992. Because of the need to assess impacts of the *Exxon Valdez* oil spill, it has been necessary to try to make comparisons with data of differing quality. We have become acutely aware of the need to have baseline data for which confidence may be specified and with which rigorous comparisons may be made.

References

Piatt, J. F., H. R. Carter, W. Butler, M. Kendriorek, and D. R. Nysewander. 1990. Immediate impacts of the *Exxon Valdez* oil spill on marine birds. Auk 107:387-397.

Survey of Pigeon Guillemot Colonies in Prince William Sound, Alaska

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Pigeon Guillemot (*Cepphus columba* Pallas) populations in Prince William Sound (PWS) have been declining since the early 1970s (U. S. Fish and Wildlife Service 1993; Oakley and Kuletz ms). This phenomenon was intensified along shorelines affected by the 1989 oil spill of the *Exxon Valdez* (Klosiewski and Laing ms). Thus, we surveyed PWS for Pigeon Guillemot breeding colonies to provide resource managers with current data to use in post-oil spill efforts to restore guillemot populations.

We surveyed 98% of PWS's 5,000 km shoreline in May and June 1993, and found 184 Pigeon Guillemot colonies, most of which were previously unknown (Figure 1). There were no

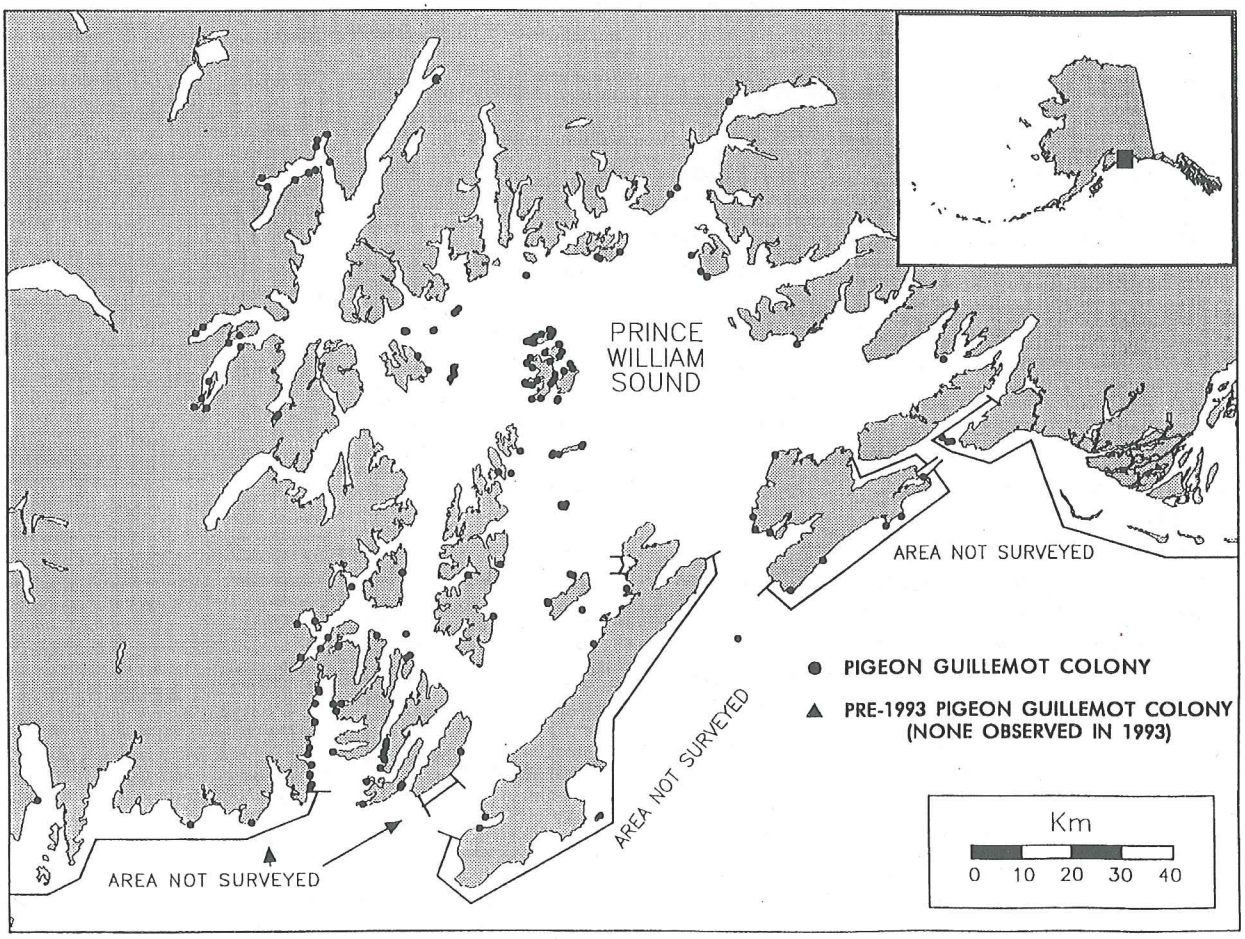

Figure 1. Pigeon Guillemot colonies in Prince William Sound, 1993.

guillemots at 14 former colony sites, but we found new colonies within a few km of eight of these sites. The southwestern Sound, with 41% of the shoreline surveyed, had 62% of the guillemots while the eastern Sound, with 24% of the shoreline surveyed, had 10% of the guillemots, and the Naked Island area, with only 2.5% of the shoreline, had 27% of all guillemots. We found concentrations of colonies in the Naked Island group, and on Jackpot, Fool, Pleiades, Seal, Evans and Bligh islands, and in Passage Canal, Port Bainbridge, Harriman Fjord, and Blackstone Bay. In general, half of all guillemots were at 22 major clusters of colonies.

We counted a total of 3,028 Pigeon Guillemots, including 1,012 that were unassociated with colonies. Our count is at the low end of a Sound-wide estimate of 3,000 to 4,900 Pigeon Guillemots from pelagic and shoreline surveys by another project in July 1993. The PWS guillemot population remains depressed compared with a high of 15,000 in the 1970s. Counts at oiled Naked Island have declined steadily since the spill, but numbers are also depressed in unoiled areas of PWS compared with the 1970s. Reasons for the Sound-wide decline are unclear, but besides the oil spill killing birds outright, reduced food availability and increased predation are implicated. Most PWS guillemots nest on National Forest land. Protection of important colonies may enhance population restoration. Studies on predation prey usage and are needed, and non-lethal predator control may be warranted.

References

Klosiewski, S. P. and K. K. Laing. In prep. Marine bird populations of Prince William Sound, Alaska, before and after the *Exxon Valdez* oil spill. Bird Study Number 2. Fin. Rep. U. S. Fish and Wildlife Service, Anchorage, Alaska.

Oakley, K. and K. Kuletz. In prep. Population, reproduction and foraging ecology of Pigeon Guillemots at Naked Island, Prince William Sound, Alaska, before and after the *Exxon Valdez* oil spill. Bird Study Number 9. Fin. Rep. U. S. Fish and Wildlife Service, Anchorage, Alaska.

U. S. Fish and Wildlife Service. 1993. Alaska seabird colony catalog: computer database and colony data archives. U. S. Fish and Wildlife Service, Anchorage, Alaska.

Seabird Biodiversity in the Arctic

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Our research team is investigating the patterns and processes relating to the species diversity, distribution, and abundances of circumpolar arctic seabirds. In recent years, we have initiated multidisciplinary studies designed to investigate the historical patterns of species distribution in Beringia. This work comprises three main areas of research focused on the genetic structure of Aleutian populations of cormorants, kittiwakes, and alcids; on the historical patterns of species distributions during the past 15,000 years; and on the historical evolutionary changes in North Pacific cormorants. All three lines of research are ongoing, and the results so far are beginning to provide a broad-based understanding of the dynamics of species change in Beringian seabirds.

Since 1990, we have been collecting specimens of seabirds breeding in the Aleutian Islands for molecular analysis of their genetic structure of populations. Laboratory and field studies have concentrated on cormorants, particularly North Pacific shags (Red-faced Shag *Stictocarbo urile*, Pelagic Shag *S. pelagicus*, and Kenyon's Shag *S. kenyoni*). Morphometric analysis of skins and skeletons revealed that several populations of these species exist in Beringia, and that population limits are geographically similar among species. Molecular analysis of mitochondrial DNA obtained from specimens collected along the Aleutian and Alaskan coastlines now enables us to determine the present patterns of gene flow among populations.

In conjunction with archeologists from U. S. Fish and Wildlife Service, Smithsonian Institution, France, and Russia, we are investigating the historical patterns of species distributions and relative abundances of marine birds utilized as food by early indigenous Aleut and Eskimo hunters. Bones (and other material like feathers and eggshells) are being excavated from past occupation sites, identified to species, and analyzed for clues to age of collection, past numbers, and breeding status. Bird bones from about 100 sites throughout Beringia have been processed and initial results presage a chronological atlas of species distributions throughout the Holocene. Given enough sites and specimens, clues to the changing patterns of species diversity and distribution throughout the Bering Sea basin may allow assessment of how global change during the past 15,000 years has affected seabirds in the Arctic.

We have had recent success in extracting and analyzing DNA from these seabird bones obtained from Aleut and Eskimo middens described above. We are now able to quantify changes in the genetic makeup of several species through the past 9,000 years. For practical reasons related to difficulties in obtaining viable DNA from bones buried for thousands of years, we have focused on several 300-400 bp segments of the 12S and ATPase mitochondrial genes. We have been able to detect both significant divergences between Siberian and Alaskan populations of some species (e.g., Pelagic Shag, Fulmar) and strong evidence of genetic introgression among others (Tufted Puffin, Least Auklet). These analyses are being done at the population level, which should allow us to quan-

tify even local genetic changes in study species through time. We anticipate that this line of research will allow a much more detailed view of the dynamics of change of Beringian seabird diversity and distributions.

Beringian International Seabird Working Group: Summary of the 1994 Meeting

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In 1972, the President of the United States and General Secretary of the Soviet Union signed the agreement "Cooperation in the Field of Environmental Conservation." In 1992, the Beringian International Seabird Working Group (BISWG) was created under the auspices of that agreement. BISWG will ensure that Americans and Russians interested in seabird resources of Beringia will have a recognized forum to promote and coordinate activities for the research, management, and conservation of seabirds.

The first meeting of BISWG occurred in December 1992 at the Institute of Biological Problems of the North, (IBPN), Magadan, Russia. Alexander Kondratyev of IBPN's Laboratory of Coastal Ecology and Resources (LCER) and Peter Vyatkin, Kamchatka Institute of Ecology and Nature Management (KIENM), Petropavlovsk-Kamchatsky, represented Russia. Vivian Mendenhall and Kenton Wohl, U. S. Fish and Wildlife Service (FWS), Anchorage, Alaska, represented the U. S. The first meeting focused on developing cooperative seabird projects including the Alaska-Russian Far East Seabird Colony Catalog Database and the Beringian Seabird Bulletin.

The second meeting was held January 17-19, 1994, in Anchorage, Alaska. Two of the three U. S. representatives attended: Kenton Wohl, and Edward Murphy (University of Alaska, Fairbanks). David Cline (National Audubon Society, Anchorage) was unable to attend but sent Mary Core in his place. Two Russian representatives, Alexander Kondratyev and Peter Vyatkin, attended. Although in Anchorage during the meeting, the third Russian representative, Alexander Golovkin (Institute for Nature Protection and Reserves, Laboratory for Rare and Endangered Vertebrates, Moscow) was unable to attend. The meeting was co-chaired by Alexander Kondratyev and Kenton Wohl. The meeting focused on Beringian seabird management issues, Beringian species of special management concern, existing cooperative seabird projects, seabird information needs and opportunities for cooperative studies in Beringia, and recommendations for future cooperation under Area V of the U. S.- Russia Environmental Agreement. In addition, the Red-legged Kittiwake was the subject of an intensive day-long workshop.

The representatives agreed on some changes in the Russian delegation; specialists who have been prevented by other work from attending the meetings were replaced by others. Nicolai Gerasimov was replaced by Peter Vyatkin, and Alexander Ya. Kondratyev became the Co-chairperson for Russia, replacing Alexander Golovkin. The BISWG Charter was amended. The group decided that the next meeting of the BISWG will be in the Russian Far East, perhaps in Petropavlovsk-Kamchatsky or Vladivostok early in 1995.

The representatives recommended that their nations take the following actions in 1994-95, under the auspices of the U. S.- Russia Environmental Agreement. The activities will strengthen bilateral research, management, and conservation efforts for seabird resources of Beringia.

Joint Red-legged Kittiwake Project: IBPN/LCER (Larisa Zelenskaya), KIENM (Peter Vyatkin), and Alaska Maritime National Wildlife Refuge (G. Vernon Byrd) agreed to prepare a joint paper on the status of Red-legged Kittiwakes in the Bering Sea for publication in a U. S. journal in 1994.

Beringian Seabird Bulletin (BSB): FWS and IBPN/LCER agreed to collaborate in preparing the second Beringian Seabird Bulletin in 1994. The Bulletin will continue to include research, management, and conservation articles about seabirds of the North Pacific, emphasizing the Beringian Region. The articles will be abstracts of published papers and summaries of original work. Kondratyev and Wohl agreed to co-edit the 1994 issue.

Pribilof Island Seabird Program: Although Alexander Golovkin was not present, it was agreed in concept that he and FWS (Alaska Maritime National Wildlife Refuge) will continue to coordinate their Red-legged Kittiwake projects in the Pribilof Islands, and cooperate in the field, share data, and jointly publish data as appropriate.

Talan Island Seabird Project: Scott Hatch, Alaska Science Center, National Biological Survey (ASC/NBS) and A. Ya. Kondratyev (IBPN/LCER) agreed to continue their joint study of seabird populations on Talan Island, Magadan, Russia. ASC/NBS will send at least one biologist to Talan Island to work with A. Ya. Kondratyev and his staff in 1994. This project will continue during 1995.

Joint Beringian Seabird Colony Catalog: Alexander Ya. Kondratyev and Lubov Kondratyev (IBPN/LCER) and Vivian Mendenhall and Shawn Stephensen (FWS) will collaborate on a database of seabird colony census data for Alaska and the Russian Far East. This joint project is a continuation of work initiated in 1992.

Conservation of Arctic Flora and Fauna: Circumpolar Seabird Working Group Amended Meeting Report - 1994

Kenton Wohl, U. S. Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, Alaska and Jeanne Pagnan, CAFF Secretariat, Ottawa, Ontario

Background

During the second meeting of nations for the Conservation of Arctic Flora and Fauna (CAFF) in May 1993, the USA presented a proposal to create a Circumpolar Seabird Group (CSG). The proposal was approved during that meeting by the CAFF delegates.

The goal of the CSG is to promote, facilitate, and coordinate seabird research, management, and conservation activities among the circumpolar countries by improving the communication between scientists and managers concerned with northern seabirds. In accordance with the CAFF work plan for 1993-94, the CSG has three assigned functions: 1) facilitate completion of the Murre Conservation Strategy, 2) facilitate publication of the Circumpolar Seabird Bulletin, and 3) facilitate evaluation of a circumpolar seabird colony catalog database system.

The inaugural meeting of the CSG occurred on January 23-25, 1994, in Sacramento, California. Nine representatives from seven of eight countries (Sweden was not present) signatory to the Declaration on the Protection of the Arctic Environment attended. Ms. Jeanne Pagnan, Program Coordinator, CAFF, and several observers also attended (see attachment 1). The representatives approved a name change at the meeting. The group henceforth will be called the Circumpolar Seabird Working Group (CSWG).

Introduction

K. Wohl (USA), facilitator for the first meeting, welcomed the representatives and observers, summarized the background of the CSWG's formation, and reviewed the meeting's agenda.

Wohl clarified that the CSWG is an officially approved arm of CAFF and that the official CSWG representatives are responsible for decisions and recommendations dealing with CAFF circumpolar seabird issues. He also emphasized that the meetings were open to observers and that their attendance and participation were encouraged.

For the next three days, the participants addressed five main topics (see attachment 2): 1) Overview of seabird resources of CAFF countries, 2) murre conservation strategy, 3) seabird colony catalog databases, 4) circumpolar seabird bulletin and 5) new seabird initiatives for the CSWG. In addition, Jeanne Pagnan presented an overview of CAFF and its linkages to the Arctic Environmental Protection Strategy and its sister programs.

Agenda Item 1: Overview of Seabird Resources

Norway - V. Bakken

Estimates for most seabird populations in Norway are good. An extensive monitoring scheme has been established. The main concerns for seabirds in Norway are declining forage fish populations (mainly capelin) and mortality in gillnets. Attachment 3 summarizes additional information about seabird resources of Norway.

Gannet	- increasing population; 5 colonies with approximately 3500 breeding pairs
Cormorant	- most populations increasing since 1988
Lesser Black-backed Gull	- severe population decline due to crash in capelin stock; only a few birds remain in northern Norway
Black-legged Kittiwake	- stable population in eastern-Finnmark; 50% decrease in southern Norway
Razorbill and Little Auk	- population counts uncertain; probably in millions
Fulmar	- increasing population
Common Eider	- population size and trends unknown
Puffin	- some colonies increasing while other decreasing; crash in one population due to decline in herring stocks
Common and Brunnich's	- significant population decrease Guillemots possibly due to collapse of capelin stocks; approximately 20,000 pairs remain

Iceland - Æ. Petersen

Estimates for seabird populations in Iceland are now much lower than previous estimates, but this is probably due to a change in censusing methods rather than actual declines in populations. Census data vary greatly by species. The location of colonies makes their censusing very difficult.

Presently, there are no major concerns for seabirds in Iceland; however, the populations of some species (e.g., Common and Brunnich's guillemots) are highly concentrated in a few colonies and are susceptible to human disturbance. Attachments 4, 5, and 6 summarize additional information about seabird resources of Iceland.

Manx Shearwater	- stable population
Gannet	- small population increase
Cormorant	- large population decline; reasons uncertain
Shag	- small population increase
Arctic Skua	- populations healthy; viewed as a pest
Lesser Black-backed Gull	- large population increase
Greater Black-backed Gull	- declining population for unknown reasons
Herring gull	- increasing population
Black-legged Kittiwake	- numerous but census data not available; small population increase but this may be due to movement between colonies
Arctic Tern	- stable population
Common Guillemot	- stable population
Razorbill	- small population increase may be due to a change in censusing methods
Black Guillemot	- stable population, predation by introduced mink may be a problem
Little Auk	- one pair remains
Puffin	- probably increasing population; heavily hunted
Eiders	- stable or increasing population; economically important for down collection until recently

Greenland - P. Nielsen

Until recently, estimates of seabird populations varied widely and often were based on observations of people untrained in seabird censusing. This is being remedied thanks to the work of Danish ornithologists. Greenland has a colony catalog database which now includes about 1,000 colonies (a colony is defined as more than 10 pairs). During winter, seabird populations increase due to visiting migrants.

Greenland is a subsistence-based society and seabirds have value both as a food resource and as an economic commodity. The primary concern for seabirds in Greenland is the high level of harvest. Although estimates of harvest are based on anecdotal information and may not be reliable, harvest levels appear to be very high and may not be sustainable. The seabird harvest in Greenland may increase in the future because of a ban on caribou hunting and the crash of the cod population. Both of these resources have been very important traditional sources of protein in Greenland. Attachment 7 summarizes additional information about seabird resources in Greenland.

Thick-billed Murre	- stable population; 25%-50% of winter population is harvested annually
King and Black Eiders	- serious population decline; nesting may have nearly ceased in southwest Greenland; important food resource
Black-legged Kittiwake	- stable population; heavy hunting pressure
Little Auk/Dovekie	- stable population; important food resource
Arctic Tern	- stable population; eggs are collected

Russia - A. Ya. Kondratyev

Estimates for populations of seabirds in the Russian Far East are not particularly good for some areas but a rough overall estimate is approximately 25,000,000 birds. The most numerous populations of seabirds in the Russian Far East are auks, murres and kittiwakes. Many seabird colonies are protected by reserve status.

Primary problems confronting seabirds and their nesting colonies in Russia are 1) lack of funding for research and monitoring, 2) impacts to seabird colonies from economic developments along the coast, and 3) interest in developing socioeconomic uses of seabirds including increased harvest of birds and eggs which, at the moment, is minimal.

Priority seabird projects for Russia are to improve population estimates and information on the status of nesting colonies and to establish a monitoring plan for seabird population, productivity, survivorship and demographic parameters. Currently, scientists are concentrating on monitoring only at a few important sites; (e.g., Wrangel Island).

Finland - M. Hario

The Baltic Sea is one of the most contaminated marine environments in the world. Nevertheless, seabird populations appear to be increasing in the Baltic. Along the Finnish coast, seabirds dwell in the outermost zone. Common Murre, Razorbill and Arctic Tern populations in that region crashed in 1992 due to paralytic shellfish poisoning and have not recovered. Regular monitoring takes place throughout the coast of Finland.

Concerns for seabirds in Finland are high fledgling mortality, outbreaks of shellfish poisoning and oil spills. Attachment 8 summarizes additional information about seabirds in Finland.

Common Murre	- Baltic Sea populations increasing; Finnish coast populations down to 35 pairs
Razorbill	- Finnish coast population increasing
Black Guillemot	- Finnish coast population increasing

Canada - A. Gaston/J. Chardine

Existing seabird information and a description of issues and priorities for Canada's seabirds are summarized by the Canadian Wildlife Service in its 1991 document, "Conservation Issues and Canadian Wildlife Service Priorities for Marine Birds" (attachment 9). Attachment 10 summarizes additional information about seabirds of Labrador and Newfoundland.

For many seabirds, little is known of their population size

and distribution. Populations of Common Eiders, Razorbills, Thick-billed Murres, Leach's Storm Petrels and Red-necked Phalaropes appear to be declining. With the exception of the Ross's Gull, all other censused gull species appear to be increasing.

Concerns for seabirds in Canada are numerous and include 1) high levels of murre and seaduck harvests, 2) interaction between seabirds and declining fish stocks, 3) oil spills, 4) introduced predators, and 5) human disturbance at colonies.

United States - D. Irons

Information on the issues and status of Alaska's seabirds is summarized in the U. S. Fish and Wildlife Service's 1992 document, "Alaska Seabird Management Plan" (attachment 11).

Alaska has approximately 50 million breeding seabirds at over 1,360 colonies. This is over 95% of all breeding seabirds in the continental USA. Alaska also supports upwards of 50 million southern hemisphere migrants during summer. Most important colonies are protected by the National Wildlife Refuge System. Population counts at selected colonies have been conducted for several years and are summarized in the Alaska Seabird Colony Catalog database.

Trend data are available for kittiwakes and murres. A population and productivity monitoring program has been established at some colonies, but the program needs to be expanded into a statewide effort.

The most abundant breeding seabirds in Alaska are auks, petrels, murres, puffins, and kittiwakes. Some populations (e.g., kittiwakes, murres, and some seaducks) are showing declines, particularly in the Bering Sea. Reasons for declines are uncertain but may be related to declines in forage fish abundance or availability. In the Aleutians, some seabird populations appear to be increasing.

Management concerns for seabirds in Alaska are 1) oil spills, 2) declines in forage fish, 3) incidental mortality in fishing operations, 4) seabird-fishery food web interactions, and 5) introduced predators. Attachment 12 summarizes additional information about seabirds in Alaska.

Agenda Item 2: Charter of the Circumpolar Seabird Working Group (K. Wohl)

The representatives discussed the merits of the CSWG and reviewed the Charter proposed by the USA.

There was general agreement that the goals and objectives of the CSWG were appropriate and not duplicative with any other governmental or nongovernmental organization. The representatives agreed it was in the best interest of circumpolar seabirds to continue the CSWG and adopt a working charter. Representatives were requested to provide comments to Wohl as quickly as possible in order to finalize the document by meeting's end. The charter was revised (see attachment 13) in accordance with comments received, including changing the group's name to the Circumpolar Seabird Working Group. [Editor's note: a copy of the charter is included in this issue of the *Bulletin*.]

It was recommended that the revised Charter be presented to the CAFF delegates for their approval at the third CAFF meeting in Reykjavik.

Lead: Wohl (USA)
Product: Revised CSWG Charter
Schedule: January 1994

Agenda Item 3: International Murre Conservation Strategy (A. Gaston)

A. Gaston facilitated discussion of the Murre Conservation Strategy beginning with a brief historical review of the strategy and an overview of the draft outline. Basically, the group agreed on a four chapter and two appendix outline. Gaston will develop Chapter 1, global overview, based on descriptions of murres provided by each country. Each country's description will appear individually in Appendix A of the strategy. Contents and concepts of other chapters were discussed and agreements on assignments were concluded.

Discussions of the mission, goal, and objectives of the strategy resulted in agreement that the strategy should be aimed at maintaining and restoring murre populations irrespective of their potential uses by people. The mission statement was deleted and the goal was revised as follows: "To provide international leadership to conserve, protect and restore populations of murres, and their habitats, in the Arctic."

The four existing objectives were revised and three more were added. The seven objectives now are 1) protecting habitats, both on land and at sea, 2) increasing public awareness of murres, 3) maintaining opportunities for harvests of adults and eggs, 4) using murres as indicators of the marine environment, 5) facilitating research and monitoring, 6) maintaining or restoring breeding populations and patterns of distribution, and 7) mitigating adverse human impacts to murres.

The group reviewed legal mechanisms currently available to protect murres and their habitats. Legislation in the form of laws creating parks, refuges and sanctuaries generally is adequate to protect murre breeding habitat. Many important murre colonies in the circumpolar region are protected. Legislation to protect habitat at sea is less adequate, although legislation for controlling pollution exists in all member countries. Laws to mitigate the effects of net-drowning and food web disruption caused by fishing are inadequate or nonexistent. Mechanisms by which hunting regulations are set and the regulations themselves need to be improved in those countries where hunting occurs.

The group reviewed current threats to murre populations and ranked them in priority order. Hunting (Canada and Greenland), mortality in commercial fishing operations (Canada, Finland, USA, Norway), oil pollution (Canada, USA, Norway), and introduced predators (USA, Finland, Russia) were the highest ranking management issues for murres.

The issues listed below were considered sufficiently important to be pursued in the immediate future. It was agreed that discussions of these issues should be included in the strategy.

- Review hunting regulations: assigned to Chardine (Canada) and Nielsen (Greenland)
- Identify important colonies and marine habitats: assigned to Senner (USA)
- Review programs to mitigate the impacts of oil pollution: assigned to Chardine (Canada)
- Review/develop guidelines for human activities at or near colonies: assigned to Mendenhall (USA)
- Develop a circumpolar murre colony monitoring network: assigned to Gaston (Canada)
- Coordinate a circumpolar murre banding program: assigned to Petersen (Iceland)
- Identify role of murres in food webs: assigned to Irons (USA)

Lead: Gaston (Canada)
Product: International Murre Conservation Strategy
Schedule: Country contributions by April 1; assigned issues by March 1995; draft strategy by May 1995.

Agenda Item 4: Circumpolar Seabird Colony Catalog (J. Chardine)

J. Chardine initiated this session with a brief introduction of the project followed by general discussions of national catalog databases and the functions and uses of a Circumpolar Seabird Colony Catalog. Mapping colony locations on a global basis and having the ability to answer global seabird questions via queries of a circumpolar database were highlighted. There was agreement that a circumpolar colony database was a worthwhile project to pursue.

A country-by-country description of existing seabird colony catalog databases revealed that Finland, Norway, Greenland, and Canada have existing national catalog databases. The USA does not have a national catalog system, although individual systems exist for Alaska, the Great Lakes, and the west coast. Iceland will be evaluating database systems in 1994 with the intent to create a system in 1995. Finland's database contains results from a program that monitors only a subset of colonies and thus is not complete for most species. Canada's database is not yet complete, while those of Norway and Greenland are complete. Russia is cooperating with the USA to create a joint Alaska-Russian Far East catalog database and with Norway to create a joint catalog database for the northwestern Russian region. Neither database is complete yet. All existing colony catalog databases run on microcomputers using either standard or proprietary softwares. Most of the database systems have the capability of producing map products.

A brief discussion ensued on how best to develop and manage a circumpolar seabird colony catalog database. The idea of approaching Birdlife International (BI) was considered. It was reported that BI was planning to hire a seabird officer whose main task will be to compile a global seabird database. This project may overlap the concept of a circumpolar colony catalog database. When recently approached informally, BI expressed interest in being involved in the development of a circumpolar colony catalog database. Some reservations for this approach were expressed because of the predicted long-term demand for funds by BI. Another approach would be for a governmental agency to develop the database.

Chardine will correspond with BI by February 1994 on behalf of CSWG to explore the concept of BI developing and managing the circumpolar colony catalog database and to inquire about BI funding requirements. Wohl will ask the U. S. Department of Interior, National Biological Survey, about its interest in developing the database. A decision on who will take the lead in developing the circumpolar database will be made by the end of 1994.

The geographic and species limits of a circumpolar database were discussed. It was agreed that only those seabirds having a substantial portion of their breeding distribution in the Arctic should be included in the database. So far this is 43 species (see attachment 14). Colonies in regions outside the Arctic would not be included initially but could be added in the future if they contained species of concern to the CSWG. It was agreed that the geographic range of the database could extend beyond the Arctic for species of concern such as murres.

The USA produced a list of candidate fields to be considered for the circumpolar database (see attachment 15). Discussion of the list focused on questions regarding what "measure of colony size "should be used (e.g., counts of individuals, nests, pairs, etc.) and whether there should be a limit on the size of colonies included in the database. It was agreed that populations in the circumpolar database would be represented by the estimated "number of pairs," but that original counts also would be included if quantities other than pairs were censused. It was also agreed that only colonies of 10 pairs or more would be included in the database.

Lead: Chardine (Canada)
Product: Circumpolar Seabird Colony Catalog Database
Schedule: Decide by December 1994 who/what country will develop and manage the database; submit contributions and develop database by 1995/96.

Agenda Item 5: Circumpolar Seabird Bulletin (K. Wohl)

During the second CAFF meeting in May 1993 the USA presented a proposal to create and publish a Circumpolar Seabird Bulletin in 1994; the proposal was approved by the CAFF delegates. Wohl initiated discussion of this project with a brief introduction to the USA's original proposal (attachment 16). This was followed by a discussion of the purposes and merits of a bulletin. It was agreed, as originally proposed, that the bulletin should serve as a quick and inexpensive method of exchanging seabird information and publishing the results of the CSWG meetings. The bulletin should not compete with or replace established ornithological publications.

There was agreement to proceed with the bulletin and publish one issue in 1994. The USA (Wohl) will coordinate the completion of the first issue. Guidelines for articles for the first issue are as follows:

1) Articles should be one to three pages (about 500 words).
2) Articles will be published in English only.
3) Any size paper may be used.
4) One-and-a-half-inch margins should be used.
5) Use of figures and tables will be acceptable.

Based on reports from the representatives, there might be between 30 and 50 articles in the first issue. One camera ready copy will be made available to each country by April 15, 1994. Each CSWG representative will be responsible for reproducing and distributing the Bulletin within their country.

Lead: Wohl (USA)
Product: Circumpolar Seabird Bulletin 1994
Schedule: Submit materials to Wohl by March 1994; camera-ready copy to each country by April 1994.

Agenda Item 6: New Seabird Initiatives for the Circumpolar Seabird Working Group (S. Senner)

S. Senner (USA) facilitated a productive and enthusiastic discussion about new seabird issues that concerned one or more CAFF representatives. New seabird issues identified and discussed were 1) the need to select indicator seabird species, 2) development of circumpolar seabird colony monitoring network, 3) review of seabird hunting regulations/incidental take, 4) coordination of seabird banding programs, 5) development of a directory of Arctic seabird experts, 6) management of endangered seabird species, 7) guidelines to minimize human disturbance at seabird colonies, 8) management of incidental take of seabirds in commercial fisheries, 9) development of a program for exchanging of seabird experts, and 10) cooperative programs for Native education. The CSWG agreed to pursue actions on 8 of the 10 initiatives. Actions on the exchange of seabird experts and Native education were postponed until the second annual meeting in 1995.

1) List of indicator seabird species

The representatives agreed there was a need to recommend species of seabirds to be monitored by Arctic Monitoring and Assessment Program (AMAP) and by CAFF countries at sites included in the circumpolar seabird monitoring network.

The group reviewed the criteria advanced by the AMAP group and discussed the list of indicator species identified by AMAP. There was a desire to suggest changes for several species and perhaps shorten the overall list.

A subcommittee of Byrd, Chardine, Gaston, and Petersen agreed to meet before the close of the Pacific Seabird Group meeting and develop a list of proposed indicator species.

The plan is for this subcommittee to review the AMAP list and then fax the list to all CSWG representatives and the CAFF Program Coordinator. The list will be finalized after CSWG representatives have had an opportunity to comment on the draft list. It will then be sent to the CAFF Program Coordinator for coordination with AMAP.

Lead: Gaston (Canada)
Product: List of circumpolar seabird indicator species
Schedule: New list - January 1994; recommended list to CAFF Secretariat - June.

2) Circumpolar seabird colony monitoring network

This new project involves establishing a network of seabird colony sites in the Arctic at which trends in productivity, population (plots), survivorship, and other demographic parameters would be measured in a manner that produces comparable data. An annual monitoring report would be included in the Circumpolar Seabird Bulletin. This project also would involve the development of a monitoring database.

Several issues were identified that must be addressed to advance this proposal. These include criteria for site selection, parameters to be recorded, format and other characteristics of the database, and the process of compiling and sharing data and results.

A main purpose of the circumpolar monitoring program would be to monitor Arctic-wide population trends for a few selected species. The system needs to be compatible with other seabird monitoring programs (e.g., Pacific and NW European regions) and linked to the circumpolar colony catalog database.

Petersen, Gaston, Bakken, Irons, and Byrd agreed to develop this proposal in greater detail.

There was discussion about taking advantage of and not duplicating efforts already advanced by the Monitoring Committee of the Pacific Seabird Group (PSG) for the Pacific coast and the Seabird Group for NW Europe. Scott Hatch and Mark Tasker are key participants in these two programs, respectively. The CSWG group agreed to meet for lunch and then participate in the PSG Monitoring Committee meeting. The group was to meet again following the PSG committee meeting.

The subcommittee's near-term objective is to prepare a draft action plan summarizing the purpose of the network, selected species and sites, methods to be used, an organization and process to implement the project, and parameters to be measured. A draft will be circulated to CSWG representatives and the Secretariat.

Lead: Gaston (Canada)
Product: Circumpolar Seabird Colony Monitoring Network Action Plan
Schedule: March 1995 (second CSWS meeting)

3) Seabird hunting regimes

Many seabirds of several species are harvested or taken incidentally in the circumpolar region. Each of the CAFF countries has its own regulatory and management approaches to the hunting or taking of seabirds. These approaches vary from allowing little or no hunting to allowing largely unregulated hunting. The CSWG agreed it would be useful to compile information on hunting regimes of seabirds in CAFF countries. One benefit of this action would be to encourage more consistent efforts to ensure that seabird harvests occur on a sustain-

able basis.

Nielsen and Senner agreed to collect and summarize hunting regulations and harvest information and to develop a list of people by country that are knowledgeable about this issue. CSWG representatives will be requested by letter to submit basic information on nature and significance of seabird harvests in their respective countries, and to provide information on existing regulations and management approaches. Nielsen and Senner will summarize this information in a report in a future issue of the CSWG Circumpolar Seabird Bulletin.

Lead: Nielsen (Greenland) and Senner (USA)
Product: Report summarizing the management and regulation of seabird hunting and harvests
Schedule: Request for information by May 1994; response from representatives by April 1994; final report by March 1995 (second CSWG meeting)

4) Coordination of seabird banding programs

Discussion focused on opportunities to improve circumpolar coordination in the application of bands (e.g., color-marking schemes) and in the analysis of returns. It was agreed that there is a need to improve cooperation in these activities and that several prior attempts to coordinate a project like this have not been successful. Representatives agreed that sharing and combining murre band recovery data would be an especially useful first step in establishing a collaborative circumpolar banding program. Chardine, Bakken, and Petersen agreed to develop a plan for a coordinated murre banding project. Chardine agreed to establish a murre band database and a protocol for combining data.

Lead: Bakken (Norway), Petersen (Iceland) and Chardine (Canada)
Product: Circumpolar Murre Banding Plan and Database
Schedule: March 1995 (second CSWG meeting)

5) Directory of arctic seabird experts

Consistent with the CSWG Charter's goal of improving communications between circumpolar seabird scientists and managers, the CSWG acknowledged it would be useful to have a directory of experts specifically interested in Arctic seabirds. The concept was adopted.

Wohl provided a draft database format to the group which was approved. He requested that each representative distribute requests for information to appropriate seabird experts in their country. Completed forms should be returned to Wohl by May 1994. He will create a directory and provide a copy to each representative.

Lead: Wohl (USA)
Product: Directory of Seabird Experts of the Circumpolar Region
Schedule: Database distributed by March 1995 (second CSWG meeting)

6) Endangered seabird species

It was suggested that the topic of vulnerable, threatened, and endangered seabird species and seabird species of concern should be on the agenda of the next CSWG meeting. There appears to be confusion regarding criteria for designation of "species of concern" and the meaning of the designation. The CAFF Program Coordinator agreed to coordinate with the CAFF Endangered Species Fauna Group which is developing the two lists of species for CAFF.

Lead: None
Product: List of seabird species of concern
Schedule: (March 1995 second CSWG meeting)

7) Guidelines to minimize human disturbances at seabird colonies

The group discussed the issue of human disturbance to seabirds at their colonies due to activities such as tourism, commercial fishing, research, and aircraft overflights. Types of disturbances and their management vary widely by region, season, and other circumstances. The group agreed it would be very useful to develop guidelines regarding disturbance at colonies that would assist the ongoing efforts of individual countries/agencies to reduce the adverse impacts of human disturbances to seabirds.

It was agreed that Mendenhall and Chardine would solicit and assemble existing guidelines, authorities and educational materials from member countries. Mendenhall will also compile technical references from each country that give scientific justification for authorities or guidelines. Mendenhall will contact CSWG representatives with specific requests for needed information.

Lead: Mendenhall (USA) and Chardine (Canada)
Product: Draft report on existing authorities and guidelines concerning human disturbances to seabirds
Schedule: March 1995 (second CSWG meeting)

8) Incidental take of seabirds in commercial fisheries

This problem was discussed at great length and appears to be a priority that several CAFF countries are examining. It was agreed it should be a priority issue for the CSWG to address. Norway is currently surveying the extent of incidental take in their fisheries, especially in the capelin and cod fisheries. The USA has studied the incidental take of seabirds in high-seas driftnets in Alaska, and in trawl, long-line, and gillnet fisheries in Alaska and the US west coast for several years. Canada (British Columbia) also has been involved in documenting the incidental take of seabirds in high-seas driftnets and in nearshore fisheries.

Bakken and Wohl agreed to request and compile existing incidental take information for each CAFF country. Information to be solicited includes: incidental take legal regimes, extent and significance of seabird mortality by fishery and season, study results that have or will document fishery-seabird mortality, and methods to mitigate or eliminate inciden-

tal take. The CSWG believes it can play an important role by recommending alternative methods to mitigate incidental take. It was agreed that incidental take of seabirds in marine fisheries will be a major topic for discussion at the next CSWG meeting.

Lead: Bakken (Norway) and Wohl (USA)
Product: Report on incidental take of seabirds in fisher operations.
Schedule: Report by March 1995 (second CSWG meeting)

9) Exchange of seabird experts

It was generally acknowledged that the exchange of seabird scientists and managers among circumpolar countries is a good idea; however, no decision was made as to specific actions or recommendations that should be taken. This will be discussed again at the next CSWG meeting.

Lead: None
Product: None
Schedule: March 1995

10) Native education

There was a discussion about native peoples and their interests related to seabirds and the work of the CSWG. It was noted that a workshop in Iceland will address how the knowledge of indigenous peoples can best be used. It was generally concluded that the need to share information with indigenous people should be addressed at greater length before groups like the CSWG can determine an appropriate role to play.

Pagnan will alert the CAFF Indigenous Peoples Group of the CSWG's interest in involving them in CSWG activities.

Agenda Item 7: Overview of CAFF/AEPS

J. Pagnan, Program Coordinator, CAFF Secretariat, presented an informative briefing about the Arctic Environmental Protection Strategy and its four programs: CAFF, Arctic Monitoring and Assessment Program (AMAP), Protection of the Marine Environment (PAME) and Emergency Prevention, Preparedness and Response (EPPR). She also requested that copies of all CSWG correspondence be provided to the Secretariat so that appropriate linkages can be made and maintained with the other programs.

(Attachments referred to in the meeting report have not been included in this bulletin.)

Circumpolar Seabird Working Group

Colonial nesting seabirds having breeding distributions that are substantially arctic or subarctic:

Northern Fulmar
Manx Shearwater
Fort-tailed Storm Petrel
Leach's Storm Petrel
Northern Gannet
Great Cormorant
Shag
Pelagic Cormorant
Red-faced Cormorant
Common Eider
Great Skua
Glaucous Gull
Iceland Gull
Glaucous-winged Gull
Great black-backed Gull
Herring Gull
Lesser Black-backed Gull
Slaty-backed Gull
Ross's Gull
Ivory Gull
Black-legged Kittiwake
Little Auk/Dovekie
Sabine's Gull
Ross' Gull
Arctic Tern
Aleutian Tern
Razorbill
Guillemot/Common Murre
Brunnich's Guillemot/Thick-billed Murre
Spectacled Guillemot
Black Guillemot
Pigeon Guillemot
Ancient Murrelet
Cassin's Auklet
Rhinoceros Auklet
Least Auklet
Crested Auklet
Parakeet Auklet
Whiskered Auklet
Atlantic Puffin
Horned Puffin
Tufted Puffin
Red-legged Kittiwake

Agenda Item 8: Second meeting of the CSWG

After a short discussion of the advantages and disadvantages of alternative locations and timing for the next meeting of the CSWG, it was concluded that Norway will host the next meeting in Oslo in about March 1995. The timing and location of the next CSWG meeting will allow representatives to attend The Seabird Group's conference on Threats to Seabirds at the University of Glasgow, Scotland. Bakken will host and facilitate the next meeting and Wohl will develop the meeting's program.

(This report was prepared by K. Wohl, Coordinator of the inaugural meeting of the CSWG, and J. Pagnan, Program Coordinator, CAFF Secretariat)

Circumpolar Seabird Colony Catalog Database: Proposed Core Data Fields

Variable	Field type	Description
1. Colony name	A50	Official or assigned name
2. Database site number	S	Unique number in database (map no. + site no.)
3. Latitude, longitude	N, N	Degrees, minutes (nn.nn')
4. Country	A4	Country Code (e.g., Russia - RU)
5. State	A30	State, province, oblast', Region, etc.
6. Species name	A50	Latin name (genus, species)
7. Date of census	D	Day, month, year
8. Census method	A1	Census platform (boat, land, etc.)
9. Population	N	Estimate of breeding population in pairs
10. What was counted	A1	Units of original data (individuals, pairs, etc.)
11. Adjustment type	A1	Method of adjusting from original data to pairs (e.g., K-factor, nests x 2, midpoint of range, etc.)
12. Data quality	A1	Reliability of estimate
13. Plot data	A3	Population trend by species based on plot counts
14. Location of raw data	A50	Position title, address, telephone no., fax no., etc. of data base manager

Conservation of Arctic Flora and Fauna: Circumpolar Seabird Working Group Charter

I. Introduction

Marine and coastal ecosystems are socioeconomically and biologically important features in circumpolar regions. Populations of seabirds in the circumpolar region are large and diverse. About 16 species of seabirds have circumpolar distributions while several other species are shared between two or more countries.

Traditionally, conservation, management, and research activities for seabirds in the Arctic have been poorly coordinated in terms of common direction, concerns, field methods, reporting and information exchange. Existing governmental and non-governmental regional seabird groups are organized in a north-south or latitudinal manner and not in an east-west or longitudinal manner. Therefore, seabird activities have been poorly coordinated in a circumpolar context. Creating the Circumpolar Seabird Working Group (CSWG) within the organizational structure of the Conservation of Arctic Flora and Fauna Working Group, a component of the Arctic Environmental Protection Strategy, will ensure that scientists and managers interested in northern seabirds will have a common forum to promote, facilitate and coordinate conservation, management, and research activities of mutual concern.

II. Goals and Objectives

Goal

To promote, facilitate, and coordinate seabird conservation, management and research activities among circumpolar countries, and to improve communication between scientists and managers concerned with seabirds of the Arctic.

Objectives

1. To identify current and emerging seabird conservation, management and research problems affecting the Arctic and corresponding information needs.

2. To facilitate and coordinate publishing seabird information of mutual interest to scientists and managers of the circumpolar countries.

3. To facilitate exchanging published information and unpublished data concerning seabirds of the Arctic.

4. To facilitate using standard objectives, methods and data analyses for similar studies of seabirds in the Arctic.

5. To facilitate developing cooperative research and management projects and plans for circumpolar seabird problems of mutual concern.

6. To develop an integrated package of cooperative seabird activities or initiatives for the Conservation of Arctic Flora and Fauna annual work plan.

III. Description

The CSWG complements global and other regional seabird committees of governmental and nongovernmental organizations.

The CSWG is comprised of up to 16 representatives; i.e., up to two representatives from each of the eight countries signatory to the Declaration on the Protection of the Arctic Environment. The representatives represent the range of organizations and geographical areas important to seabird research, management and conservation in the Arctic. Participation in the CSWG meetings, however, is open to seabird experts of all governmental and nongovernmental organizations interested in Arctic seabirds. Decision-making within the CSWG is by majority agreement of the representatives.

The CSWG is administered by a chairperson. The chairperson is one of the representatives from the host country in which the annual meeting is conducted. The chairperson facilitates and coordinates the work of the CSWG between annual meetings and facilitates the annual meeting. The meeting agenda is developed by the chairperson in cooperation with the other representatives.

The CSWG conducts meetings when its necessary to fulfill its goals and objectives. The meetings will be conducted in each country on a rotational basis.

Appropriate materials and records of each meeting are provided to each representative and other attendees of each CSWG meeting as soon as possible following a meeting. The chairperson is responsible for preparing and distributing the materials unless other arrangements are concluded during the meeting.

Unless there is prior agreement for logistic arrangements, the host-country is responsible for all in-country meeting expenses and arrangements for the CSWG representatives. Expenses for lodging, meals, and transportation are the responsibility of each representative, unless prior agreement is concluded.