CAFF
Conservation of Arctic Flora and Fauna

Supporting Publication to the
Circumpolar Biodiversity Monitoring Program
CAFF CBMP Report No. 15
September 2008

FRAMEWORK FOR A CIRCUMPOLAR ARCTIC SEABIRD MONITORING NETWORK

CAFFs CIRCUMPOLAR SEABIRD GROUP

Acknowledgements

CAFF Designated Agencies:

- Environment Canada, Ottawa, Canada
- Finnish Ministry of the Environment, Helsinki, Finland
- Ministry of the Environment and Nature, Greenland Homerule, Greenland (Kingdom of Denmark)
- Faroese Museum of Natural History, Tórshavn, Faroe Islands (Kingdom of Denmark)
- Icelandic Institute of Natural History, Reykjavik, Iceland
- Directorate for Nature Management, Trondheim, Norway
- Russian Federation Ministry of Natural Resources, Moscow, Russia
- Swedish Environmental Protection Agency, Stockholm, Sweden
- United States Department of the Interior, Fish and Wildlife Service, Anchorage, Alaska

This publication should be cited as: Aevar Petersen, David Irons, Tycho Anker-Nilssen, Yuri Artukhin, Robert Barrett, David Boertmann, Carsten Egevang, Maria V. Gavrilo, Grant Gilchrist, Martti Hario, Mark Mallory, Anders Mosbech, Bergur Olsen, Henrik Osterblom, Greg Robertson, and Hallvard Strøm (2008): *Framework for a Circumpolar Arctic Seabird Monitoring Network*. CAFF CBMP Report No.15 . CAFF International Secretariat, Akureyri, Iceland.

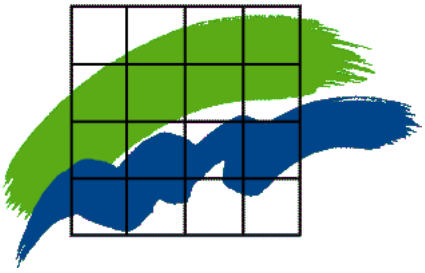
Cover photo: *Recording Arctic Tern growth parameters at Kitsissunnguit* West Greenland 2004. Photo by Carsten Egevang/ARC-PIC.COM.

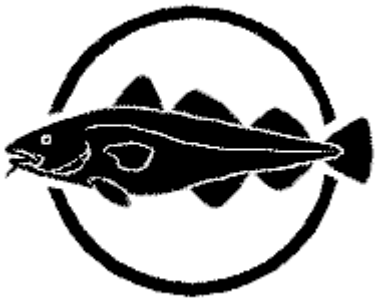
For more information please contact:
CAFF International Secretariat
Borgir, Nordurslod
600 Akureyri, Iceland
Phone: +354 462-3350
Fax: +354 462-3390
Email: caff@caff.is
Internet: http://www.caff.is

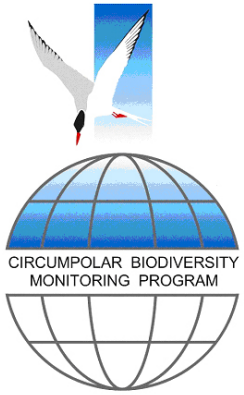
CAFF Designated Area

Editor: Aevar Petersen
Design & Layout: Tom Barry

Institutional Logos







CAFFs Circumpolar Biodiversity Monitoring Program: Framework for a Circumpolar Arctic Seabird Monitoring Network

Aevar Petersen, David Irons, Tycho Anker-Nilssen, Yuri Artukhin, Robert Barrett, David Boertmann, Carsten Egevang, Maria V. Gavrilo, Grant Gilchrist, Martti Hario, Mark Mallory, Anders Mosbech, Bergur Olsen, Henrik Osterblom, Greg Robertson, and Hallvard Strøm

on behalf of the

CIRCUMPOLAR SEABIRD GROUP (CBird)

CAFF CBMP Report No. 15
August 2008

List of Contributors

Aevar Petersen, Icelandic Institute of Natural History, Hlemmur 3, P.O. Box 5320, 125 Reykjavik, Iceland. aevar@ni.is

Anders Mosbech, Dept. of Arctic Environment, National Environ. Research Institute, Frederiksborgvej 399, Box 358, DK-4000 Roskilde, Denmark. amo@dmu.dk

Bergur Olsen, Faroese Fisheries Laboratory, Nóatún, FO-100 Tórshavn, Faroes. berguro@frs.fo

Carsten Egevang, Greenland Institute of Natural Resources, P.O. Box 570, 3900 Nuuk, Greenland, E.gevang@natur.gl

David Boertmann, Dept. of Arctic Environment, National Environ. Research Institute, Frederiksborgvej 399, Box 358, DK-4000 Roskilde, Denmark. dmb@dmu.dk

David Irons, U.S. Fish and Wildlife Service, 1011 E. Tudor Rd., Anchorage, Alaska AK99503, USA. david.irons@fws.gov

Grant Gilchrist, Science and Technology Branch, Environment Canada, N.W.R.C., 1125 Colonel By Drive, Raven Rd., Carleton Univ., Ottawa, Ont. K1A 0H3, Canada. grant.gilchrist@ec.gc.ca

Greg Robertson, Science and Technology Branch, Environment Canada, 6 Bruce Str., Mount Pearl, Newfoundland A1N 4T3, Canada. greg.robertson@ec.gc.cad

Hallvard Strøm, Norwegian Polar Institute, Polar Environmental Centre, N-9296 Tromsø, Norway. hallvardþstrom@npolar.no

Henrik Osterblom, Museum of Natural History, Dept. Systems Ecol., Box 50007, SE-10691, Sweden. henroste@nrm.se

Maria V. Gavrilo, Dept Polar Geography, AARI, 38 Bering St., Saint-Petersburg, 199397 Russia. mþgravrilo@mail.ru

Martti Hario, Finnish Game and Fisheries Research Institute, P.O. Box 2, FIN-00791 Helsinki, Finland. martti.hario@rktl.fi

Mark Mallory, Canadian Wildlife Service, Environment Canada, Box 1714, Qimugjuk Bldg 969, Iqaluit, Nunavut X0A 0H0, Canada. mark.mallory@ec.ga.ca

Robert Barrett, Tromso Museum, Zoology Dept, University of Tromso, N-9037 Tromso, Norway. robb@tmu.uit.no

Tycho Anker-Nilssen, NINA-NIKU, Tungasletta 2, N-7485, Trondheim, Norway. tycho@nina.no

Yuri Artukhin, Kamchatka Br. Pacific Inst. of Geography, Rybakov pr., 19-a, Petropavlovsk-Kamchatsky, 683024, Russia. artukhin@mail.kamchatka.ru

Table of Contents

Introduction

During recent years a Circumpolar Biodiversity Monitoring Program (CBMP) has been developed by the CAFF (Conservation of Arctic Flora and Fauna) Working Group of the Arctic Council (AC). The third AC ministerial meeting in Finland, October 2002, endorsed the framework of activities, which included biodiversity monitoring, for the CAFF Working Group for years to come. The CBMP Framework document was published in 2004 (Petersen, Zöckler & Gunnarsdóttir 2004). At the fourth AC ministerial in Iceland in November 2004 the Circumpolar Biodiversity Monitoring Program was finally endorsed as a cornerstone program of CAFF for the future. The CBMP was launched at a meeting in Cambridge, England, in September 2005 and since then the infrastructure of the program has been developed, including indicators and implementation plan, while networking to dozens of different programs has been made (CAFF 2008a). An important development was the publication of the ACIA report, which called for various biological information in relation to climate change (Arctic Climate Impact Assessment 2004). CAFF has identified the CBMP as the main response to this call by the Arctic Council.

Monitoring[1] was identified early on in CAFF´s work as an important conservation tool. In the Arctic Flora and Fauna. Recommendations for Conservation (CAFF 2002) monitoring was one of the five objectives that were selected to guide future CAFF work. Therein monitoring is addressed under the heading "Assessing and Monitoring Arctic Biodiversity" and more specifically, the development of the CBMP falls under the following recommendation:

> *"Build on national and international work to implement a program to monitor biodiversity at the circumpolar level that will allow for regional assessments, integration with other environmental monitoring programs, and comparison of the Arctic with other regions of the globe" (CAFF 2002, p. 10).*

As initial components of the CBMP seven monitoring networks were identified in order to start the process of developing and executing such a program, of which networks seabirds were considered one (CAFF 2000). The Circumpolar Seabird Group (CBird), with Iceland and USA as leads, were charged with the task of putting together a framework for an integrated monitoring program for seabirds, initially mentioned in the CAFF Work Plan for 2002-2004 (CAFF 2000).

Clearly not all seabird species can be included in a circumpolar monitoring program at all stages of their life cycle, for that seabird species are too many. Hence the challenge is to cover Arctic seabirds in as representative yet pragmatic way possible, at the same time taking into account on-going monitoring activities. This task involves, *inter alia*, (a) identifying the types of monitoring needs, (b) suggesting what monitoring parameters are important for individual

[1]Many definitions exist for monitoring, but in the present context this is in essence defined as regular, standardized observations of elements of the environment, creating long-term series of information. Hence trends, which otherwise may go unnoticed until too late, are realized at an earlier stage, early enough to counteract them with the appropriate mitigation measures, if needed or feasible.

Greg Robertson: *Preparing to photograph a murre colony in Witless Bay*, Canada 2005.

elements of the program, and (c) selecting the most appropriate species for monitoring. The important issue of this exercise is to recognize the circumpolar aspect, while individual national programs may also have other, more domestic, objectives or emphases.
The first steps in developing a circumpolar seabird monitoring network were taken at the eighth meeting of the Circumpolar Seabird Group in Alaska 2002 (CAFF 2002). This was further elaborated at later annual meetings (CAFF 2003, 2004, 2005, 2006, 2007, 2008b). The present document outlines the findings of the CBird expert group in the development of a Circumpolar Seabird Monitoring Network.

Vision

The primary vision of a network program is to maintain current biodiversity of Arctic seabird populations, or enhance if these have declined through controlable causes. Coordination of Arctic monitoring activities, and the appropriate associated research to explain causal effects, allows for synthesis of information to determine the impacts of global environmental processes at a regional Arctic scale, not usually feasible to countries working individually. Monitoring information could be made available to, and are needed by, a number of different stakeholders, including researchers, local communities, educators, managers, policy makers, and the general public at large.

Rationale

Seabirds constitute important components of the Arctic ecosystems. They are primarily marine but form a link between the marine and terrestrial ecosystems as they come on land, particularly during the breeding season. Some seabird species are harvested in large numbers thus sometimes constituting a significant source of food for local people.

Seabirds travel long distances between their Arctic breeding sites and the wintering ranges. Most other parts of the globe receive Arctic seabirds, dependent on the species, sometime during their annual cycle. Seabirds can be used as indicators of fish stocks, or health of the marine ecosystem at large. Countries need to work together for responsible conservation of this important Arctic biological resource, not just the Arctic countries but beyond as well.

Assessing populations through internationally recognized methodologies gives an overview of the status of seabirds. Monitoring projects, of the

Flemming Merkel: *Monitoring the Innaq/Ritenbenk colony*, West Greenland 2006.

appropriate design, are important in assessing the trends in populations, creating long-term series of standardized observations, which are comparable.

Objectives

The main objectives of a Circumpolar Seabird Monitoring Network as are follows:

- To monitor populations of selected Arctic seabird species, in one or more Arctic countries
- Primarily, and preferably, species which are found in all the Arctic countries should be selected. Monitoring of populations in only one or few countries, as part of the circumpolar effort, is warranted if the species involved are very local and considered an Arctic responsibility.
- To monitor, as appropriate, survival, diets, phenology, and productivity of seabirds in a manner to allow significant changes to be detected. These data may be essential to explain observed changes in populations but abiotic environmental factors also need to be taken into account, as appropriate.
- To provide circumpolar information on the status of seabirds to the management agencies in the Arctic countries, in order to broaden their knowledge beyond the boundaries of their country to allow management decisions to be made on the best available information.

Yuri Arktukin: ***Watching kittiwakes and murres,*** **The Commander islands.**

Which are the Arctic Seabirds?

A first step in developing an Arctic monitoring program for seabirds is to identify which bird species should be considered “Arctic Seabirds” in the present context as definitions vary. At the first meeting of the Circumpolar Seabird Group a list of Arctic seabirds was compiled (Wohl & Pagnan 1994). This was further elaborated upon by the CBird Group during the development of the present monitoring framework. The revised list is shown here in Appendix 1.

The list of Arctic seabirds contains 64 species; five of these are Tubinares, six cormorant species, four seaducks, four skuas and jaegers, 18 species of gulls, six tern species, 20 species of auks, besides the Gannet *Sula bassana*. Of these 64 species, about half (30) breed only within the boundaries of the CAFF countries. The other half (34) breed partly within these boundaries but also in more Temperate regions towards the south, in some cases the larger proportion of the population. The distribution of these species dictates to some extent the degree of responsibility placed on the Arctic countries for the continued survival of these seabird populations.

The national regions included in the present exercise need some explaining. The boundaries of the CAFF designated areas dictate the area included, with some exceptions. Thus, the total area of Sweden and Finland are included, since their only marine regions are in the Baltic towards south of the countries. Also, the whole of Alaska is included in the present exercise, although only partially designated as a CAFF area. Because of the sheer size of Russia, this is divided into a western and an eastern component, with the Eastern Taimyr as the separator. Only the CAFF-designated parts for Canada and Norway, and three countries are included in total, i.e. Faroe Islands, Greenland and Iceland, since their whole territory is included as the CAFF designated area.

The number of seabird species breeding varies between the Arctic countries as shown in the table.

Canada	25
Faroes	20
Finland	18
Greenland	23
Iceland	23
Norway	29
Russia western	30
Russia eastern	39
Sweden	19
USA (Alaska)	41

The differences in the number of species are understandable on account of size alone but a number of other factors also determine their distribution. The high species diversity in the Bering Strait region is obvious in the figures for Alaska and eastern Russia. As a national entity Russia has the highest number of breeding species, altogether 48 in both east and west parts of the country.

The distribution of the 64 Arctic seabird species is highly variable. These were divided into three groups, i.e. Pacific only, Atlantic only, or both. The numbers were 25, 19, and 20 respectively.

Only six of the 64 species are found breeding in all the Arctic countries; Common Eider, Parasitic Jaeger, Herring Gull, Arctic Tern, Common Murre, and Black Guillemot. Two species breed in all but one country; Mew Gull, Black-legged Kittiwake, and five in all but two countries; Northern Fulmar, Long-tailed Jaeger, Great Black-backed Gull, Black-headed Gull, and Razorbill. On the other end of the scale, nine species nest in one country (not the same) only; Brandt´s Cormorant, Double-crested Cormorant, Thayer´s Gull, Western Siberian Gull, Spectacled Guillemot, Marbled Murrelet, Long-billed Murrelet, Cassin´s Auklet, and Rhinoceros Auklet. And 21 species breed in two countries only.

Hallvard Strøm: *Northern Fulmars on Bjørnøya (Bear Island)*, Barents Sea.

Current Monitoring Activity

The present section provides overviews of the current status of monitoring programs in the circumpolar Arctic countries. A short description is provided for each country, including references to annual reports published in the countries as overviews of seabird monitoring, or other relevant bibliography.

The overall goals of the Canadian Arctic Seabird monitoring program are to undertake monitoring programs aimed at evaluating the status and trends of seabird populations in relation to anthropogenic and natural environmental factors. This includes general population monitoring programs at multi-species colonies, and more focused programs, which monitor priority species or suites of species.

Carsten Egevang/ARC-PIC.Com: *Monitoring Seabirds*, Greenland.

Canada

Grant Gilchrist, Mark Mallory and Greg Robertson

The Canadian Wildlife Service (CWS) has been systematically monitoring Arctic seabirds since 1971, with notable pioneering efforts by Les Tuck in the 1950s providing the first documentation and study of many colonies (Tuck 1961). The focal species has been the Thick-Billed murre, largely in response to observed losses of murres due to international fisheries (Tull *et al*. 1972, Chardine 1998), its susceptibility to oil pollution (Wiese & Robertson 2004), and the large harvest of murres that takes place off Newfoundland, Labrador, and Greenland (Kampp 1988, Elliot *et al*. 1991, Wiese *et al*. 2004). Seabirds are sensitive indicators of marine environmental conditions in the Arctic (Gaston *et al*. 2005ab) and murres have been particularly suitable for this task (Gaston *et al*. 2003). Standardized protocols have been developed for murre monitoring (Birkhead & Nettleship 1980, Gaston 2002) and other species (Nettleship 1976). Canada continues to monitor Arctic murre populations as part of national commitment to the International Murre Conservation Strategy (CAFF) and the Canadian Murre Conservation Plan (Chardine & Elliot 2000).

Traditionally, the CWS has monitored seabird populations at a few locations, principally Prince Leopold Island, Coats Island, Coburg Island, Digges Sound and the Gannet Islands (Birkhead & Nettleship 1981, Gaston & Nettleship 1981, Gaston *et al*. 1985, 1993, Gaston 2002, Robertson & Elliot 2002). However, additional monitoring sites are needed to determine whether all Arctic colonies respond in the same manner to annual climate and ice conditions, pressures from harvest or other forms of anthropogenic stress, and whether there are inherent differences in reproductive success, recruitment and survival of seabirds across the Arctic. Since 2000, the CWS has initiated population monitoring of additional pelagic seabirds, notable Northern Fulmars and Black-legged kittiwakes, and at selected locations, Glaucous Gulls (Gaston *et al*. 2006, Mallory *et al*. in press). This has generally been undertaken at colonies where there were baseline surveys from the 1970s, including

Prince Leopold Island, Browne Island, Cape Vera, and Baillie-Hamilton Island. We plan to establish long-term monitoring plots based on the models used at Coats and Prince Leopold Islands and following the standard monitoring approach where appropriate. For those colonies not listed (e.g. Buchan Gulf [Bastions and Mitres], Scott Inlet, Hantszch Island, Skruis

Grant Gilchrist: ***A research team heads out by zodiac to the massive murre colony on Coburg Island,*** **Nunavut 1998.**

Grant Gilchrist: *Banding and satellite telemetry of King Eiders on Southampton Island*, Nunavut 2000.

Point, Batty Bay, Cape Parry, Herring Islands and the Nain Archipelago; Mallory & Fontaine 2004), we will visit those sites opportunistically or when special circumstances require current information.

Common Eiders remain a priority monitoring species for Canada, especially the northern borealis subspecies, as it is harvested intensively in Greenland and Atlantic Canada (Merkel 2004). Of the Arctic seabirds, Common Eiders are most intensively exploited species by Inuit in Canada, and egging, down collection and hunting of eiders is prevalent in all communities with access to eiders. Continued monitoring will be conducted at the East Bay Migratory Bird Sanctuary and intermittent monitoring will be conducted at sites where time series are available (Ungava Bay, Hudson Strait, Nain and Hopedale archipelgoes; Falardeau *et al*. 2003, Chaulk *et al*. 2005). Winter survey protocols are being refined (Bordage *et al*. 1998), and estimates for 2003 and 2006 are now available for Atlantic Canada. Monitoring of the unique *sedentaria* subspecies, which is confined to Hudson Bay throughout the year and appears to be susceptible to large kills in winters with heavy ice (Robertson & Gilchrist 1998), will also continue in partnership with the local community of Sanikiluaq.

Banding of murres has provided information on the effects of harvest on local populations, as well as information needed for population modeling (Tuck 1961, Donaldson *et al*. 1995, Wiese *et al*. 2004). We will continue to band murres at long-term study sites (notably at Coats Island) and colonies not previously banded. Our approach will be consistent with the CAFF murre banding plan. Harvest of murres will be tracked with special murre harvest surveys which will hopefully become part of the standard game bird harvest monitoring program in Canada. Work is complete on developing tools to differentiate ages and species of murres from wing characters (Wilhelm *et al*. 2008), and adjustments are being made the national harvest survey to accommodate murres (and improve seaduck estimates).

Although there is much to be gained by standardized monitoring protocols, in some cases novel approaches may prove valuable. In the near future, we expect that the use of remote recording technologies, such as video surveillance cameras, will become practical for seabird monitoring. We will work closely with other researchers in this field to adapt these approaches where appropriate.

Monitoring of seabirds at sea continues to be a priority under the Canadian Murre Conservation Plan. A protocol for onboard monitoring has been established and is commonly used in the north Atlantic. CWS will approach cruise ship companies working in the Arctic to have knowledgeable instructors, staff, or tourists on the ship to conduct at sea data collection and deliver this to the CWS to help assess the distribution of seabirds at sea (e.g., Mallory *et al*. 2006a). Oil and gas exploration is also increasing in the Labrador Sea and is likely to increase in the Davis Strait, work in underway to collaborate with the oil and gas industry to collect seabird at sea data from their vessels. Other vessels of opportunity, such as the Canadian Coast Guard fleet, are also being accessed for seabird at sea data collection.

Work on the CWS seabird colony registry, an archive of all locations and population information on seabirds in Nunavut and the Northwest Territories, was initiated in the 1990s. It is currently maintained by CWS-Atlantic Region. In 2002, the data for the Arctic was transferred to the northern offices of CWS. Some data maintenance is required, and then annual updates will be performed, with appropriate documentation and back up procedures. Currently, we plan to port this data set into the data management program established by the Nordic countries, to facilitate data sharing among the North Atlantic countries.

Relatively few seabirds in the Canadian Arctic carry contaminant loads at levels that affect reproduction or survival (Braune 2007a, Braune *et al*. 2002, Braune *et al*. 2007, Buckman *et al*. 2004). For many contaminants, levels have declined since the 1970s, but for other pollutants, concentrations in seabirds have increased (Braune 2007a, b, Braune *et al*. 2007, Butt *et al*. 2007). Environment Canada's National Wildlife Research Centre has a "Contaminants in Seabirds Monitoring Program", which is supported by field programs. New developments in contaminant studies may dictate that annual plans are adjusted to account for urgent sampling needs.

Contaminants represent one aspect of seabird health in the Arctic, and can potentially influence other, sublethal relationships in these birds. Investigations of seabird health and contaminants have been examined in eiders (e.g., Wayland *et al*. 2002) and to some extent in fulmars (Mallory *et al*. 2006bc, 2007), although further investigations are underway. Health monitoring of Arctic seabirds is being extended

to other species, particularly in light of concerns about avian disease transmission (notably avian influenza). Recent monitoring has also revealed that pelagic seabirds in the Canadian Arctic are ingesting particulate debris (garbage) and transporting it back to their colonies (Mallory *et al*. 2006d).

Grant Gilchrist: *An Ivory Gull near its nest on the Brodeur Peninsula, Baffin Island,* Nunavut 2004.

Harvest of seabirds and their eggs are Arctic colonies is generally considered low (Chardine 2001), but it remains another stressor on top of natural mortality, annual variability in environmental conditions during breeding, and other anthropogenic stress. However, Arctic seabirds are harvested on their wintering grounds, particularly Thick-billed and Common Murres (Elliot 1991, Chardine *et al*. 1999, Wiese *et al*. 2004). We plan to continue to work with communities to assess local harvest of seabirds, and collaborate in analyses of the data from the Nunavut Wildlife Harvest Study (Priest & Usher 2004). We also plan to provide advice on allocating TAH (total allowable harvest) and designing harvest surveys, to the Nunatsivut government (Labrador Inuit) now that their land claim is settled. The recent agreement on the offshore Makivik Land Claim (for marine areas in Hudson Strait and eastern Hudson Bay) will soon require our input for the large marine bird issues in this region, especially murres.

Ivory Gulls and Ross' Gull are two Arctic breeding seabirds considered Endangered, and Threatened, respectively by COSEWIC (the Committee on the Status of Endangered Wildlife in Canada). Recent surveys for Ivory Gulls have shown significant declines at Canadian breeding sites (Gilchrist & Mallory 2005, Robertson *et al*. 2007), leading to a recent uplisting in status change (COSEWIC 2006). We plan to undertake a program to further evaluate the trends in Ivory Gull populations and to assess possible causes for their declining populations. We will work with our international partners to assess the status of this species in all circumpolar countries. Survey work and research is also underway on Ross's Gulls (Mallory *et al*. 2006e), to determine their responses to disturbance near colonies, so that best practices guidelines can be developed for the very active mineral exploration activities in the High Arctic.

References

Birkhead, T.R. & D.N. Nettleship 1980. Census methods for murres, *Uria* species: a unified approach. Can. Wildl. Serv. Occas. Pap. No. 43. Ottawa, ON.

Birkhead, T.R. & D.N. Nettleship 1981. Reproductive biology of Thick-billed Murres (*Uria lomvia*): an inter-colony comparison. Auk 98: 258-269.

Bordage, D., N. Plante, A. Bourget & S. Paradis 1998: Use of ratio estimators to estimate the size of Common Eider populations in winter. Journal of Wildlife Management 62: 185-192.

Braune, B.M. 2007a. Temporal trends of organochlorines and mercury in seabird eggs from the Canadian Arctic, 1975 to 2003. Environmental Pollution 148: 599-613.

Braune, B. 2007b. Temporal trends of contaminants in arctic seabird eggs: inter-year variability. Pp. 89-97 *in*: S. Smith & J. Stow (eds). Synopsis of research conducted under the 2006-2007 Northern Contaminants Program. Indian and Northern Affairs Canada.

Braune, B.M., G.M. Donaldson & K.A. Hobson 2002. Contaminant residues in seabird eggs from the Canadian Arctic. II. Spatial trends and evidence from stable isotopes for intercolony differences. Environmental Pollution 117: 133-145.

Braune, B.M., M.L. Mallory, H.G. Gilchrist, R.J. Letcher & K.G. Drouillard 2007. Levels and trends of organochlorines and brominated flame retardants in Ivory Gull eggs from the Canadian Arctic, 1976 to 2004. Science of the Total Environment 378: 403-417.

Buckman, A.H., R.J. Norstrom, K.A. Hobson, N.J. Karnovsky, J. Duffe & A.T. Fisk 2004. Organochlorine contaminants in seven species of Arctic seabirds from northern Baffin Bay. Environmental Pollution 128: 327-338.

Butt, C.M., S.A. Mabury, D.C.G. Muir & B.M. Braune 2007. Prevalence of long-chained perfluorinated carboxylates in seabirds from the Canadian Arctic between 1975 and 2004. Environmental Science and Technology 41: 3521-3528.

Chardine, J.W. 1998. Review of the seabird bycatch problem in Arctic Canada. Pp. 9-14 *in*: V. Bakken & K. Falk (eds). Incidental take of seabird in commercial fisheries in Arctic countries. Circumpolar Seabirds Working Group Technical Report Number 1, Akureyri, Iceland.

Chardine, J.W. 2001. Seabird harvest in Canada. Pp. 11-16 *in*: L. Denlinger & K. Wohl (eds). Seabird harvest regimes in the circumpolar nations. Conservation of Arctic Flora and Fauna Technical Report Number 9, Akureyri, Iceland.

Chardine, J.W., B.T. Collins, R.D. Elliot, H. Lévesque & P.C. Ryan 1999. Trends in the annual harvest of murres in Newfoundland and Labrador. Bird Trends 7, Canadian Wildlife Service, Ottawa, Ontario, Canada.

Chardine, J.W. & R.D. Elliot 2000. Canadian murre conservation plan: 2000-2005. Canadian

Wildlilfe Service Seabird Technical Committee Report Number 2. Atlantic Region, Sackville, NB.

Chaulk, K.G., G.J. Robertson, B.T. Collins, W.A. Montevecchi & B. Turner 2005. Evidence of recent population increases in common eiders breeding in Labrador. Journal of Wildlife Management 69: 805-809.

Cooch, F.G. 1986. The numbers of nesting northern eiders on the West Foxe Islands, NWT, in 1956 and 1976. Pp. 114-118 *in*: A. Reed (ed.). Eider Ducks in Canada. Canadian Wildlife Service Report Series Number 47, Ottawa, ON.

COSEWIC 2006. COSEWIC assessment and update status report on the Ivory Gull *Pagophila eburnea* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Donaldson, G.M., A.J, Gaston, K. Kampp, J. Chardine, D.N. Nettleship & R.D. Elliot 1997. Winter distribution of Thick-billed Murres from the eastern Canadian Arctic and western Greenland in relation to age and time of year. Canadian Wildlife Service Occ. Paper Number 96, Ottawa, ON.

Elliot, R.D. 1991. The management of the Newfoundland turr hunt. Pp. 29-35 *in*: A.J. Gaston & R.D. Elliot (eds). Studies of high-latitude seabirds. 2. Conservation biology of Thick-billed Murres in the Northwest Atlantic. Canadian Wildlife Service Occ. Paper Number 69, Ottawa, Ontario, Canada.

Elliot, R.D., B.T. Collins, E.G. Hayakawa & L. Métras 1991. The harvest of murres in Newfoundland from 1977-79 to 1987-88. Pp. 36-44 *in*: A.J. Gaston & R.D. Elliot (eds). Studies of high-latitude seabirds. 2. Conservation biology of Thick-billed Murres in the Northwest Atlantic. Canadian Wildlife Service Occ. Paper Number 69, Ottawa, Ontario, Canada.

Falardeau, G., J.-F. Rail, S. Gilliland & J.P. Savard 2003. Breeding survey of Common Eiders along the west coast of Ungava Bay, in summer 2000, and supplement on other nesting birds. Canadian Wildlife Service, Quebec region, Sainte-Foy. Techn. Rep. Ser. No. 405, 67 pp.

Falk, K. & J. Durink 1992. Thick-billed Murre hunting in west Greenland, 1988-89. Arctic 45: 167-178.

Gaston, A.J. 2002. Results of monitoring Thick-billed Murre populations in the eastern Canadian Arctic, 1976-2000. Pp. 13-33 *in*: Studies of high-latitude seabirds. 5. Monitoring Thick-billed Murres in the eastern Canadian Arctic, 1976-2000. Canadian Wildlife Service Occ. Paper 106, Ottawa, Ontario, Canada.

Gaston, A.J. & D. N. Nettleship. 1981. The Thick-billed Murres of Prince Leopold Island. Canadian Wildlife Service Monograph Series Number 6, Ottawa, ON.

Gaston, A.J., D.K. Cairns, R.D. Elliot & D.G. Noble 1985. A natural history of Digges Sound. Canadian Wildlife Service Report Series Number 46. Ottawa, ON.

Gaston, A.J., L.N. de Forest, G. Gilchrist & D.N. Nettleship 1993. Monitoring Thick-billed Murre populations at colonies in northern Hudson Bay, 1972-92. Canadian Wildlife Service Occ. Paper Series Number 80, Ottawa, ON.

Gaston, A.J., K. Woo & M. Hipfner 2003. Trends in forage fish populations in northern Hudson Bay since 1981, as determined from the diet of nestling Thick-billed Murres *Uria lomvia*. Arctic 56: 227-233.

Gaston, A.J., H.G. Gilchrist & M. Hipfner 2005a. Climate change, ice conditions and reproduction in an Arctic nesting marine birds: Brunnich's Guillemot (*Uria lomvia*). Journal of Animal Ecology 74: 832-841.

Gaston, A.J., H.G. Gilchrist & M.L. Mallory 2005b. Variation in ice conditions has strong effects on the breeding of marine birds at Prince Leopold Island, Nunavut. Ecography 28: 332-344.

Gaston, A.J., M.L. Mallory, H.G. Gilchrist & K. O'Donovan 2006. Status, trends and attendance patterns of the Northern Fulmar *Fulmarus glacialis* in Nunavut, Canada. Arctic 59: 165-178.

Gilchrist, H.G. & M.L. Mallory 2005. Declines in abundance and distribution of the Ivory Gull (*Pagophila eburnea*) in Arctic Canada. Biological Conservation 121: 303-309.

Mallory, M.L. & A.J. Fontaine 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Canadian Wildlife Service Occ. Paper Number 109, Ottawa, ON.

Mallory, M.L., H.G. Gilchrist, B.M. Braune & A.J. Gaston 2006a. Marine birds as indicators of Arctic marine ecosystem health: linking the Northern Ecosystem Initiative to long-term studies. Environmental Monitoring and Assessment 113: 31-48.

Mallory, M.L., B.M. Braune & M.R. Forbes 2006b. Breeding and contaminant concentrations in Northern Fulmars (*Fulmarus glacialis* L.) from the Canadian high arctic. Chemosphere 64: 1541-1544.

Mallory, M.L., M.R. Forbes & T.D. Galloway 2006c. Ectoparasites of Northern Fulmars *Fulmarus glacialis* (Procellariformes: Procellariidae) from the Canadian Arctic. Polar Biology 29: 353-357.

Mallory, M.L., G.J. Robertson & A. Moenting 2006d. Marine plastic debris in Northern Fulmars from Davis Strait, Nunavut, Canada. Marine Pollution Bulletin 52: 813-815.

Mallory, M.L., H.G. Gilchrist & C.L. Mallory 2006e. Ross's Gull (*Rhodostethia rosea*) breeding in Penny Strait, Nunavut, Canada. Arctic 59: 319-321.

Mallory, M.L., J.D. McLaughlin & M.R. Forbes 2007. Breeding status, contaminant burden and endoparasites of Northern Fulmars (*Fulmarus glacialis*) from the Canadian high arctic. Ibis 149: 338-344.

Mallory, M.L., J.A. Akearok & A.J. Gaston *in press*. Status of Black-legged Kittiwake (*Rissa tridactyla*)

colonies in the Canadian High Arctic. Arctic.
Merkel, F.R. 2004. Impact of hunting and gillnet fishery on wintering eiders in Nuuk, Southwest Greenland. Waterbirds 27: 469-479.
Nettleship, D.N. 1976. Census techniques for seabirds of Arctic and eastern Canada. Can. Wildl. Serv. Occ. Pap. Ser. No 25. Ottawa, ON.
Petersen, A. & V. Bakken 2004. Distribution of murres outside the breeding season: Circumpolar murre banding program – North Atlantic Region. Conservation of Arctic Flora and Fauna Techn. Report Number 13, Akureyri, Iceland.
Piatt, J.F. & D.N. Nettleship 1987. Incidental catch of marine birds and mammals in fishing nets off Newfoundland, Canada. Mar. Poll. Bull. 68: 344-349.
Priest, H. & P. Usher 2004. The Nunavut wildlife harvest study. August 2004. Nunavut Wildlife Management Board, Iqaluit, Nunavut. 822 pp.
Robertson, G.J. & H.G. Gilchrist 1998. Evidence for population declines among Common Eiders breeding in the Belcher Islands, Northwest Territories. Arctic 51: 378-385.
Robertson, G.J. & H.G. Gilchrist 1998. Evidence for population declines among Common Eiders breeding in the Belcher Islands, Northwest Territories. Arctic 51: 378-385.
Robertson, G.J. & R.D. Elliot 2002. Population size and trends of seabirds breeding in the Gannet Islands, Labrador. Canadian Wildlife Service Technical. Report Series No. 393. Atlantic Region.
Robertson, G.J., H.G. Gilchrist & M.L. Mallory 2007. Colony dynamics and persistence of Ivory Gull breeding in Canada. Avian Conservation and Ecology - Écologie et conservation des oiseaux 2:8. [online] URL: http://www.ace-eco.org/vol2/iss2/art8/
Tuck, L.M. 1961. The murres: their distribution, populations and biology - a study of the genus *Uria*. Canadian Wildlife Service Monograph No. 1. Ottawa, ON.
Tull, C.E., P. Germain & A.W. May 1972. Mortality of Thick-billed Murres in the west Greenland salmon fishery. Nature 237: 42-44.
Wayland, M., J.E.G. Smits, H.G. Gilchrist, T. Marchant, & J. Keating 2002. Biomarker responses in nesting Common Eiders in the Canadian Arctic in relation to tissue cadmium, mercury and selenium concentrations. Ecotoxicology 12: 225-237.
Wiese, F.K. & G.J. Robertson 2004. Assessing seabird mortality from chronic oil discharges at sea. Journal of Wildlife Management 68: 627-638.
Wiese, F.K., G.J. Robertson & A.J. Gaston 2004. Impacts of chronic marine oil pollution and the murre hunt in Newfoundland on Thick-billed Murre *Uria lomvia* populations in the eastern Canadian Arctic. Biological Conservation 116: 205-216.
Wilhelm, S.I., S.G. Gilliland, G.J. Robertson, P.C. Ryan & R.D. Elliot 2008. Development and validation of a wing key to improve the harvest management of alcids in the Northwest Atlantic. Journal of Wildlife Management 72(4): 1026–1034.

Faroes

Bergur Olsen

Colony Monitoring: Monitoring of seabird colonies in the Faroe Islands has been concentrated on the Common Murre *Uria aalge* as this was the most important hunt and the fowlers mentioned a heavy decline in the population, starting late in the 1950s (Olsen 1982). The first total census and detailed registration of the Common Murre colonies was in 1972 (Dyck & Meltofte 1973, 1975), and it has been repeated in 1987 and 1997-99 (Olsen unpubl.). In connection with the Guillemot census in 1987 and 1997-99, also the Kittiwake *Rissa tridactyla* colonies were censused. It is planned to repeat the census of Common Murre and Kittiwakes at about 10 years intervals and some of the colonies were censused again in 2007.

In 1972 it was decided to count a Guillemot breeding cliff, Høvdin on Skúvoy, once a year as a control area, and this has been done each year except 1975 (Olsen 1992). Since 2001 the other seabirds on Høvdin; Fulmars *Fulmarus glacialis,* Kittiwakes and Razorbills *Alka torda* have been included in the program, so we now also monitor the number of Razorbills and the number and productivity of Kittiwakes and Fulmars on Høvdin (Olsen 2002). On Skúvoy all the seabirds breeding inland have been censused in 1961, 1981 and 2001 (Olsen 2003).

The only Gannet *Sula bassana* colony has been censused occasionally since 1937 with intervals of one to 13 years (Olsen & Permin 1974). The last two censuses have been conducted at 10 years intervals and it is planned to continue at this interval.

In 1981 there was a census of all the inland birds (Bloch 1981, Bloch & Sørensen 1984). From this year we have census of Parasitic Jaeger *Stercorarius parasiticus*, Great Skua *Stercorarius skua*, Black-headed Gull *Larus ridibundus*, Mew Gull *Larus canus*, Lesser Black-backed Gull *Larus fuscus*, Great Black-backed Gull *Larus marinus*, Herring Gull *Larus argentatus* and Arctic Tern *Sterna paradisaea*. The Arctic Tern colonies were registrated and censused again in 2003 and have since been monitored annually. There are occasional census of Great Skua and Parasitic Jaeger (Hamer 2001, Bengtson & Bloch 2003), but skuas are not yet included in the monitoring program.

At-Sea Surveys: Surveys have been conducted in the waters around the Faroe Islands between 1979 and 1999, yielding information on the distribution and abundance of seabirds (Taylor & Reid 2001, Skov *et al*. 2002). Most oft the surveys were carried out from 1997-1999 as a result of the planned oil exploration in the Faroe-Shetland Channel east of the Faroes. A total of 37 seabirds were recorded and areas of international importance to seabirds were identified.

Bergur Olsen: *Seabird Cliff on Sandoy,* The Faroe Islands 2007.

Such surveys are, however, very expensive, so they will not be used in the regular monitoring of Faroese seabirds.

Harvest Statistics: There is no official harvest statistic for the Faroes. However, information exist on the number of birds hunted in some of the colonies for certain years. Seabirds are the only birds that are allowed to hunt and Common Murre and Puffins have been the most important for generations. The former export of feathers give an indication on the total number hunted and also shows both short time and long time fluctuations (Nørrevang 1977). In the last decades Fulmars have been the most important with a yearly hunt of about 50,000 to 100,000 birds, most newly fledged young. On a voluntary base we have got the number of hunted Gannet chicks during the last 13 years and we also get the number of Puffins taken by fleyg in some areas. It is only allowed to take the eggs of Common Murre after permission from the Faroese Museum of Natural History and the result for each cliff is recorded. In total 1,000 to 2,000 Common Murre eggs are taken each year.

Banding: Bird ringing was initiated in the Faroes in 1923 (Jensen & Olsen 1999). In 13 seabird species more than 500 individuals have been ringed and about 61,000 seabirds have been ringed in total (see table). The results have been partly analyzed for Storm Petrels *Hydrobates pelagicus* (Jensen & Fritze 1991), Common Murres (Olsen *et al.* 2000), and Gannets (Danielsen & Jensen 2004).

Storm Petrel	28430
Arctic Tern	9378
Common Murre	6057
Atlantic Puffin	3997
Leach's Petrel	3921
Lesser Black-backed Gull	2932
Fulmar	1726
Great Skua	1086
Manx Shearwater	732
Gannet	728
Kittiwake	700
Parasitic Jaeger	634
Black-headed Gull	541

Numbers of seabirds ringed in the Faroe Islands up to 1998. Only those species with more than 500 ringed individuals (Jensen & Olsen 1999)

References

Bloch, D. 1981. Fugletælling på Færøerne sommeren 1981 – foreløbig rapport. Dansk Orn. Foren. Tidsskr. 75: 1-6.

Bloch, D & S. Sørensen 1984. Checklist of Faroese birds. Føroya Fróðskaparfelag and Føroya Skúlabókagrunnur, Tórshavn. 84 pp. (In Danish and English).

Bengtson, S-A. & D. Bloch 2003. The Arctic Skua *Stercorarius parasiticus* on the Faeroe Islands: abundance and plumage polymorphism. Dansk Orn. Foren. Tidsskr. 97: 201-220.

Danielsen, J. & J.-K. Jensen 2004. Recoveries of Gannets (*Morus bassanus*) ringed in the Faroe Islands. Fróðskaparrit 51: 264-269.

Dyck, J. & H. Meltofte 1973. Lomvieoptællingen på Færøerne 1972. Report issued by Dansk ornithologisk Forening (Copenhagen), The Fisheries Laboratory (Tórshavn) and Institute of Comparative anatomy (University of Copenhagen). 97 pp.

Dyck, J. & H. Meltofte 1975. The Guillemot *Uria aalge* population of the Faeroes 1972. Dansk Orn. Foren. Tidsskr. 69: 55-64.

Hamer, K.C. 2001. *Catharacta skua* Great Skua. BWP Update 3: 91-110.

Jensen, J-K. & E. Fritze 1991. Ringmærkning af Lille Stormsvale (Havsvale) *Hydrobates pelagicus* på Nólsoy, Færøerne. Ringmerkaren 3: 149-150.

Jensen, J-K. & B. Olsen 1999. Ringmærkningens historie på Færøerne. Dansk Orn. Foren. Tidsskr. 93: 206-210. (With a summary in English: Bird ringing in the Faeroes).

Nørrevang, A. 1977. Fuglefangsten på Færøerne. Rhodos, København. 275 pp.

Olsen, B. 1982. Nogle årsager til nedgangen i den færøske lomviebestand vurderet ud fra mønsteret i tilbagegangen og ringmærkningsresultater. Viltrapport 21: 24-30.

Olsen. B. 1992. Teljingar av lomviga í Høvdanum á Skúvoynni 1973 til 1991. *Fiskirannsóknir* 7: 6-15.

Olsen, B. 2002. Fuglakanningar. Ársfrágreiðing 2001. Fiskirannsóknarstovan, Tórshavn 2002:14-16.

Olsen, B & M. Permin 1974. Bestanden af Sule *Sula bassana* på Mykineshólmur 1972 Dansk orn. Foren. Tidsskr. 68: 39-42. (With an English summary: The population of Gannet *Sula bassana on* Mykineshólmur, 1972).

Olsen, B., J.-K. Jensen & A. Reinert 2000. Populations of Guillemots, Razorbills and Puffins in Faroese Waters as documented by ringed birds. GEM Report, No. C22-161-1.

Olsen, I. 2003. Bestandsudviklingen af ynglefuglene på Skúvoy, Færøerne, 1961-2001. Dansk Orn. Foren. Tidsskr. 97: 199-209. (With a summary in English: Population development of breeding birds on Skúvoy, Faeroe Islands, 1961-2001).

Taylor, S.J. & J.B. Reid 2001. The distribution of seabirds and cetaceans around the Faroe Islands. Joint Nature Conservation Committee, Peterborough. 68 pp.

Skov, H., A.J. Upton, J.B. Reid, A. Webb, S.J. Taylor & J. Durinck 2002. Dispersion and vulnerability of marine birds and cetaceans in Faroese waters. Joint Nature Conservation Committee. 106 pp.

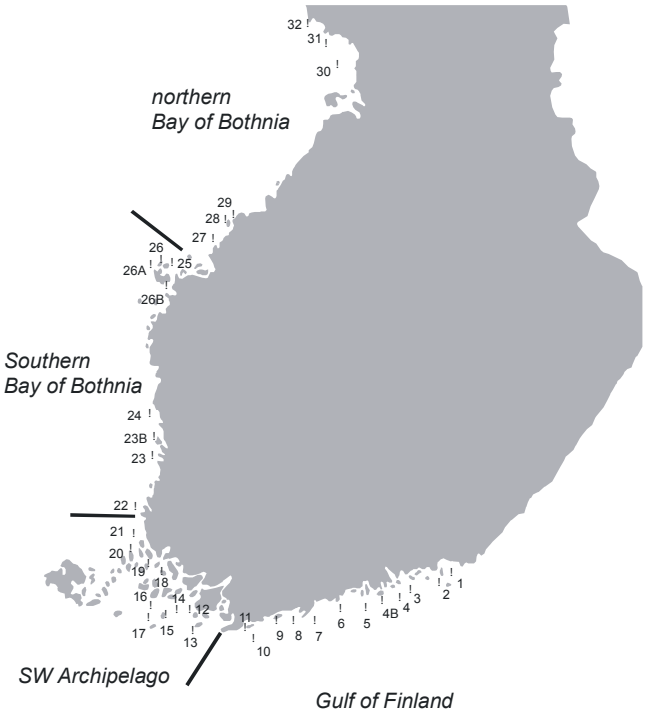
Finland

Martii Hario

Unlike conspecifics in the oceanic environment, seabirds in the northern Baltic Sea do not aggregate in huge disjunct breeding colonies. In Finland, they are distributed more or less evenly over the 73,000 islets and islands of the coasts. A "colony" is equivalent to an "island". There is no better way to delineate a "colony" because there is a continuum of islets throughout the coast with no apparent bordering, and there are seabirds on nearly every islet.

However, there is a prominent zonation within the archipelago (inner, middle, outer). In the outer zone, most genuine seabirds dwell (like alcids). There, the number of islets is smaller. The "colonies" are rather well known and form the base of the monitoring effort. In contrast, the most abundant and common seabirds, such as Mew Gull *Larus canus* and Eider Duck *Somateria mollissima* occur throughout the entire zonation, breeding in the inner parts as well as in the outer parts. Their colony size is mainly small, ranging from 3 to 100 pairs in the middle zone of the SW Archipelago.

Finnish Seabird Monitoring Program, called the *Archipelago Bird Census*, focus on monitoring breeding bird populations in selected archipelago areas, each consisting of tens to hundreds of islands. Present monitoring scheme is based on 36 census areas comprising 1700 islands (see map). This program is built on a preceding program of six core areas that started already in late 1940s (e.g., Grenquist 1965). The current program is a joint effort the the Finnish Game and Fisheries Research Institute and the Finnish Museum of Natural History.



The location of the seabird census sites along the Finnish coast. The borders of the four sea districts used as covariates in the TRIM procedure are also shown.

The census program aims at monitoring changes in the breeding populations by counting nests and broods or parent birds on selected areas, converted into number of pairs. Three counts are recommended on each site during the breeding season. If only a few species are monitored, 1-2 visits may suffice. Basic goal in data interpretation is the separation of human-caused changes from natural changes.

Martti Hario: *Seabird Archipelago in the Northern Baltic*, Finland 2007.

Population trends are analyzed with a computer program (TRIM) applying log-linear modeling on count data. The method allows for estimating significance of short and long term trends as well as, when covariates are implemented in the models, their comparison among different geographical regions. Confidence intervals can be estimated for the indices illustrating the magnitude of the population changes. As covariates, we use 4 sea districts within the Finnish coast (e.g., Hario & Rintala 2007). Thus, instead of creating a *colony registry*, we monitor larger *sample areas* consisting of several smaller colonies.

There are no *at-sea surveys* during the breeding period, so far. These could be developed, especially in Herring spawning areas in the outer zone, frequented by gulls and alcids in the summer. However, as fish reach the sea surface mainly during the night, surface feeders need to be monitored nocturnally (Hario 1990).

Distribution of *non-breeding seabirds* in Finland has been surveyed by ship mainly in connection of national waterbird counts under the auspices of Wetlands International. These winter counts use permanent transects at sea on the Åland Islands, depending on the ice situation. Counts by airplane have been carried out only during two pan-Baltic surveys of waterbirds in 1992 and 2007 (e.g., Durinck *et al*. 1994). The non-breeding counts are organized by the Finnish Environment Institute and the Museum of Natural History.

National *hunting statistics* concern only game species, i.e. the Eider Duck. As a monitoring tool, it is of poor value unless related to hunting effort. Eider numbers bagged by hunters have been decreasing since mid-1990s concurrently with declining Eider population in Finland. In contrast, at Danish over-wintering sites of the Finnish Eiders, the annual Eider bag is mainly affected by the number of hunters. The Danish bag is ten-fold compared to that of Finland. Employing bag statistics requires good knowledge of the hunting effort at both ends of the migration journey of a migratory seabird (Tiainen *et al*. 2001).

Martti Hario: *Creching Eiders*, Finland 2007.

Specific programs for *endangered and scarce species* are currently conducted on Caspian Tern *Sterna caspia*, Parasitic Jaeger *Stercorarius parasiticus*, Great Cormorant *Phalacrocorax carbo* (Lehikoinen 2006), and Lesser Black-backed Gull *L. f. fuscus* (the nominate race). They are monitored annually throughout the entire coast. Smaller, restricted programs carried out on Little Tern *S. albifrons* and Common Murre *Uria aalge* at selected areas. Caspian Tern is the only species in the Baltic with a permanent pan-Baltic survey program, i.e. in Finland, Sweden and Estonia (Hario *et al*. 1987).

Status and trends of Finnish birds are known from the two nation-wide bird atlas surveys (in 1974-79 and in 1986-89, the so-called Euro-Atlas) and from several on-going monitoring programs. Nearly all of the 250 breeding species are covered by some of the 17 different monitoring projects, run by 3000-4000 birdwatchers and 4000 hunters (Koskimies & Väisänen 1991).

References

Durinck, J., H. Skov, F.P. Jensen & S. Pihl 1994. Important marine areas for wintering birds in the Baltic Sea. EU DG XI research contract no. 2242/90-09-01. Ornis Consult report 1994, 110 pp.

Grenquist, P. 1965. Changes in abundance of some duck and sea-bird populations off the coast of Finland 1949-1963. Finnish Game Res. 27. 114 pp.

Hario, M. 1990. Breeding failure and feeding conditions of Lesser Black-backed Gulls *Larus f. fuscus* in the Gulf of Finland. Ornis Fennica 67: 113-129.

Hario, M., T. Kastepöld, M. Kilpi, R. Staav & T. Stjernberg 1987. Status of the Caspian Tern *Sterna caspia* in the Baltic. Ornis Fennica 64: 154-157.

Hario, M. & J. Rintala 2007. Population trends of sea terns, the *Aythya* ducks, the Black-headed Gull and the Common Eider on Finnish coasts in 1986-2006. Linnut-yearbook 2006: 36-42.

Koskimies, P. & R.A. Väisänen 1991. Monitoring Bird Populations. Zoological Museum, Finnish Museum of Natural History. 144 pp.

Lehikoinen, A. 2006. Cormorants in the Finnish archipelago. Ornis Fennica 83: 34-46.

Tiainen, J., J. Rintala & J. Stigzelius 2001. Distribution and abundance of sea duck species huntable in spring in southern and southwestern archipelagoes of Finland in autumn 2000. Suomen Riista 47: 30-51 (Finnish, Engl, summ,).

Greenland

David Boertmann, Anders Mosbech, and Carsten Egevang

Current monitoring programmes for seabirds in Greenland include only Thick-billed Murre *Uria lomvia* and Common Eider *Somateria mollissima* (Falk & Kampp 1997, 1998, 2001, Merkel 2002, Merkel & Nielsen 2002, Nyeland 2007, Merkel *et al.* 2007). Programmes for monitoring Kittiwakes *Rissa tridactyla* have been discussed but not yet initiated (Nyeland 2004), but almost all colonies in West Greenland has been surveyed since 1998 (Labansen *et al.* in prep.). A monitoring program for Arctic Terns *Sterna paradisaea* (Egevang & Boertmann 2003, Egevang *et al.* 2005) is under preparation. Further, due to the large size of the country and the high number of seabird colonies, a future priority will be to develop a realistic monitoring plan for the most important seabird species such that the limited time and economical resources will be taken into account.

Database: In 1992, a database over the breeding colonies of Greenland seabirds was developed (Boertmann *et al.* 1996). This was developed mainly as a tool for ready access to background data on breeding seabird in areas exposed to potential oil spills. However, this database can also be viewed upon as the first step in the development of a general monitoring program for seabirds breeding in Greenland. The database contains both historical information obtained from the available literature and unpublished field notes from researchers working in Greenland.

Censuses: Several surveys of breeding seabirds were carried out in order to augment and control the historical information. These surveys were carried out along the coasts likely to be affected by potential oil spills (Boertmann *et al.* 1996, Boertmann 2004, 2006), and much new information has also been obtained on an opportunistic basis, during other ornithological field work (e.g., Burnham *et al.* 2005). Some surveys were aimed mainly at species of concern, such as Thick-billed Murre (Evans & Kampp 1991, 1997, Kampp 1990, Kampp & Falk 1994, Kampp *et al.* 1994), Little Auk *Alle alle* (Kampp *et al.* 1987, Boertmann & Mosbech 1998, Egevang *et al.* 2003), Common Eider (Christensen & Falk 2001, Merkel 2002), Ivory Gull *Pagophila eburnea* Gilg *et al*. 2004), and Arctic Tern (Egevang & Boertmann 2003, Egevang *et al.* 2005).

All these activities combined means that most of West Greenland (inclusive the Qaanaaq region) have been surveyed for seabird breeding colonies within the past 10 years. However, there are some regions, mainly some of the large fjord-systems (e.g. Fiskefjord) that have never been. Thus, apart for these

Carsten Egevang/*ARC-PIC.COM*: *Studying colony attendance of Thick-billed Murres at Kap Brewster,* Northeast Greenland 2004.

few exceptions, the general knowledge on distribution of colonial seabirds in West Greenland is therefore good.

A few monographs on abundance, distribution and population trends of Greenland seabirds have been published over the recent decades. For example Great Cormorant *Phalacrocorax carbo* based on information from the database (Boertmann & Mosbech 1997), Sabine´s Gull *Larus sabini* (Forchhammer & Maagaard 1990), and Kittiwake (Nyeland 2004). Burnham *et al.* (2005) surveyed the Uummannaq district to compare with surveys from the 1920s.

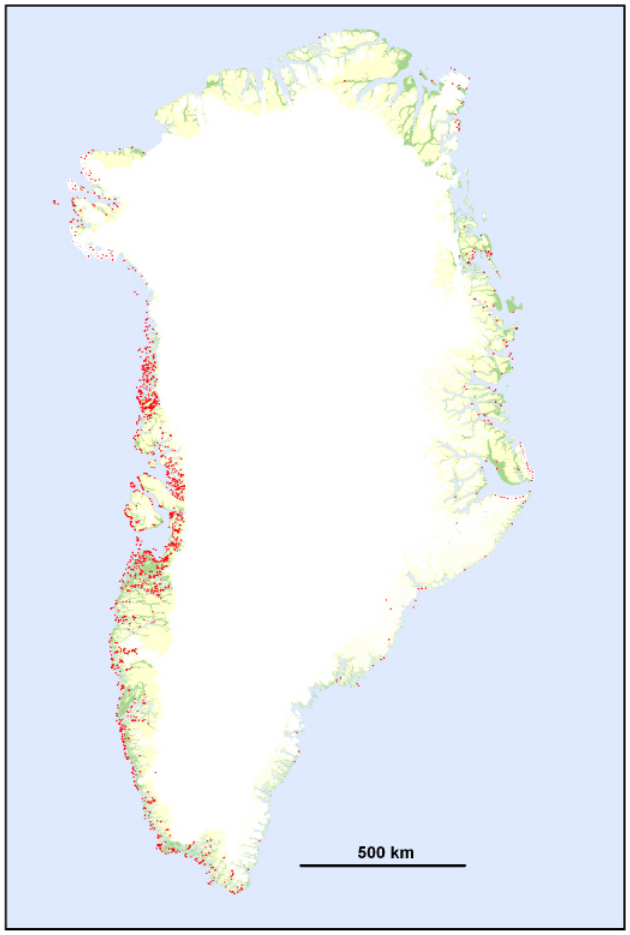


Fig 1: Distribution of seabird breeding colonies (red dots) in Greenland

The information from the other two major regions of Greenland (North and East Greenland) is by all means inadequate. Access to these regions is difficult, and sea ice blocks the coast in summer over large stretches. Most information is opportunistic observation made during other fieldwork and expeditions (e.g., Stemmerik 1990). A few censuses have recently been carried out locally at some of the polynyas, such as the Northeast Water (Falk & Møller 1995, Falk *et al.* 1997) or Dove Bugt (Forchhammer 1990). A major step forward was carried out by Gilg *et al.* (2003, 2005), who surveyed extensive region of Northeast Greenland from boat in 2003 and 2004 locating numerous new breeding colonies and controlling old information. But extensive areas, for example entire Southeast Greenland are still unsurveyed.

The database and the surveys have focused on colonial seabirds, leaving out the dispersed breeders such as Parasitic Jaeger *Stercorarius parasiticus*, Red-breasted Merganser *Mergus serrator* and a large part of the Great Black-backed Gull *Larus marimus* population. Distribution of these species is well known in West Greenland, but knowledge on their numbers is missing.

All the colony surveys have been carried out on an *ad hoc* basis, and only some of the Thick-billed Murre colonies have been surveyed at regular intervals (as part of the monitoring programme). However, regular surveys of many colonies are needed, for example in order to elucidate natural variation compared to oil spill induced mortality.

Non-breeding seabirds: Non-breeding seabirds in West Greenland have been surveyed by the National Environmental Research Institute, Greenland Institute of Natural Resources and others. Very few surveys of non-breeding seabirds cover other Greenland areas. Moulting seaducks was surveyed in late summer in entire western Greenland from aircraft 1993-1998, resulting in valuable information on species moulting in high concentrations, mainly Harlequin Ducks *Histrionicus histrionicus* and King Eiders *Somateria spectabilis* (Mosbech & Boertmann 1999, Boertmann & Mosbech 2001a, 2002). Offshore abundance and distribution of seabirds in West Greenland has been surveyed by ship mainly in late summer and autumn (Glahder 1993, Durinck & Falk 1996, Mosbech *et al.* 1998, Boertmann & Mosbech 2001b). Surveys in West Greenland in the winter period have been performed mainly by airplane in the Open Water Area (Mosbech & Johnson 1999, Merkel *et al.* 2002, summary in Boertmann *et al.* 2004).

References

Boertmann, D. 2004. Seabird colonies and moulting Harlequin Ducks in South Greenland. Research Notes from NERI, No. 191. 33 pp.

Boertmann, D. 2006. Optælling af ridekolonier i Disko Bugt, Arfersiorfik Fjord og Nordre Strømfjord i 2005. Arbejdsrapport fra DMU nr. 225. 60pp.

Boertmann, D. & A. Mosbech 1997. Breeding distribution and abundance of the Great Cormorant *Phalacrocorax carbo carbo* in Greenland. Polar Research 16: 93-100.

Boertmann, D. & A. Mosbech 1998. Distribution of Little Auk (*Alle alle)* breeding colonies in Thule District, northwest Greenland. Polar Biology 19: 206-210.

Boertmann, D. & A. Mosbech 2001a. Important summer concentrations of seaducks in West Greenland. An input to oil spill sensitivity mapping.

National Environmental Research Institute, Denmark, NERI Technical Report no. 345: 1-48.

Boertmann, D. & A. Mosbech 2001b. Offshore seabird distributions during summer and autumn at West Greenland. Ship based surveys 1977 and 1992-2000. National Environmental Research Institute, Denmark. Technical Report no. 370.

Boertmann, D. & A. Mosbech 2002. Moulting Harlequin Ducks in Greenland. Waterbirds 25: 326-332.

Boertmann, D., A: Mosbech, K. Falk & K. Kampp 1996. Seabird colonies in western Greenland. NERI Technical Report 170. 148 pp.

Boertmann, D., P. Lyngs, F. Merkel & A. Mosbech 2004. The significance of Southwest Greenland as winter quarters for seabirds. Bird Conservation International 14: 87-112.

Burnham, W., Burnham, K. K. & Cade, T. J. 2005. Past and present assessments of bird life in Uummannaq District, West Greenland. Dansk Ornitologisk Forenings Tidsskrift 99: 196-208.

Christensen, K.D. & K. Falk 2001. Status of the Common Eider breeding in the municipality of Avanersuaq (Thule), north-west Greenland. Polar Research 20: 109–114.

Durinck, J. & K. Falk 1996. The distribution and abundance of seabirds off south-western Greenland in autumn and winter 1988–1989. Polar Research 15: 23–42.

Egevang, C. & D. Boertmann 2003. Havternen i Grønland. Danmarks Miljøundersøgelser, Faglig Rapport nr. 438, 69 pp.

Egevang, C., D. Boertmann & O. Stenderup 2005. Monitering af havternebestanden på Kitsissunguit (Grønne Ejland) og den sydlige del af Disko Bugt 2002-2004. Pinngortitaleriffik, Grønlands Naturinstitut, teknisk rapport 62, 41 pp.

Evans, P.G.H. & K. Kampp 1991. Recent changes in Thick-billed Murre populations in West Greenland. Pp. 7-14 *in*: A.J. Gaston & R.D. Elliot (eds). Studies of high-latitude seabirds. 2. Conservation biology of Thick-billed Murres in the Northwest Atlantic. Can. Wildl. Serv., Occ. paper No. 69.

Falk, K. & K. Kampp 1997. A manual for monitoring Thick-billed Murre populations in Greenland. Pinngortitaleriffik, Grønlands Naturinstitut, teknisk rapport 7.

Falk, K. & K. Kampp 1998. Langsigtet moniteringsplan for lomvier i Grønland. Pinngortitaleriffik, Grønlands Naturinstitut, teknisk rapport 18.

Falk, K. & K. Kampp 2001. Lomvie i Grønland: mulige effekter af forskellige bestandspåvirkende faktorer, og parktiske grænser for ressourceudnyttelse. Pinngortitaleriffik, Grønlands Naturinstitut, Teknisk Rapport 38.

Falk, K. & S. Møller 1995. Colonies of Northern Fulmars and Black-legged Kittiwakes associated with the Northeast Water polynya, Northeast Greenland. Arctic 48: 186-195.

Falk, K, C. Hjort, C. Andreasen, K.D. Christensen, M. Elander, M. Ericson, K. Kampp, R.M. Kristensen, N. Møbjerg, S. Møller & J.M. Weslawski 1997. Seabirds utilizing the Northeast Water polynya. Journal of Marine Systems 10: 47-65.

Forchhammer, M. 1990. Ornithological observations in Germania Land and Dove Bugt, Northeast Greenland, 1986-1988. Greenland Home Rule, Dpt. Wildl. Mgmt., Technical report no. 12: 29 pp.

Forchhammer, M. & L. Maagaard 1990. Distribution of breeding Sabine's Gulls in Greenland. Dansk. Orn. Foren. Tidsskr. 84: 162-164. (Danish, Engl. summ.).

Gilg, O. (ed.). 2005. Ecopolaris – Tara 5 expedition to NE Greenland 2004. – Groupe de Recherches en Ecologie Arctique.

Glahder, C. 1993. Havfugle langs Syd- og Sydøstgrønland, august 1990. Dansk Orn Foren. Tidsskr. 87: 252-255.

Gilg, O., B. Sabard, B. Sittler, F. Mariaux, P. Leguesdron & V. Gilg 2004. Ecopolaris 2003. Ecological expedition to North Greenland & Dove Bugt: North-East Greenland National Park. Field report, Groupe de Recherches en Ecologie Arctique.

Kampp, K. 1990. The Thick-billed Murre population of the Thule district, Greenland. Arctic 43: 115-120.

Kampp, K. & K. Falk 1994. The birds of Ydre Kitsissut (Kitsissut Avalliit), Southwest Greenland. Meddr Grønland, Bioscience 42: 25 pp.

Kampp, K., H. Meltofte & C.E. Mortensen 1987. Population size of the Little Auk *Alle alle* in East Greenland. Dansk Orn. Foren. Tidsskr. 81: 129-136.

Kampp, K., D.N. Nettleship & P.G.H. Evans 1994. Thick-billed Murres of Greenland: status and prospects. Pp. 133-154 *in*: D.N. Nettleship, J. Burger & M. Gochfeld (eds). Seabirds on Islands, Threats, case-studies and action plans. BirdLife International, Conservation series no. 1.

Labansen, A.L., F.R. Merkel, D. Boertmann & J. Nyeland *in prep*. Status of the Black-legged Kittiwake population breeding in West Greenland, 2007.

Merkel, F.R. 2002. Ederfugleoptællinger i Ilulissat, Ummannaq og Upernavik Kommuner, 1998–2001. Pinngortitaleriffik, Grønlands Naturinstitut, teknisk rapport nr. 43.

Merkel, F.R. & S.S. Nielsen 2002. Langsigtet overvågningsprogram for ederfuglen i Ilulissat, Uummannaq og Upernavik Kommuner, vejledning og baggrund. Pinngortitaleriffik, Grønlands Naturinstitut, teknisk rapport 44.

Merkel, F.R., A.L. Labansen & L. Witting 2007. Monitering af lomvier or rider i Qaanaaq kommune, 2006. Pinngortitaleriffik, Grønlands Naturinstitut, teknisk rapport 69. 82 pp.

Mosbech, A. & S.R. Johnson 1999. Late Winter Distribution and Abundance of Sea-Associated Birds in South-Western Greenland, the Davis Strait and Southern Baffin Bay. Polar Research 18: 1-17.

Mosbech, A., D. Boertmann, J. Nymand, F. Riget & M. Acquarone 1998. The Marine Environment in Southwest Greenland. Biological Resources,

Nyeland, J. 2004. Apparent trends in the Black-legged Kittiwake in Greenland. Waterbirds 27: 342-349.
Nyeland, J. 2007 Monitering af lomviekolonierne Kippaku og Apparsuit i det nordlige Upernavik 2002. – Pinngortitaleriffik, Grønlands Naturinstitut, teknisk rapport 65, 21 pp.
Stemmerik, L. 1990. Hvalrosø - a new breeding site for Fulmar *Fulmarus glacialis* and possibly for Little Auk *Alle alle* in East Greenland. Dansk Orn. Foren. Tidsskr. 84: 161. (Danish, Engl. summ.).

David Boertmann: *Seabird census work*, Greenland.

Iceland

Aevar Petersen

A recent overview of the status of seabirds monitoring in Iceland was completed in 2003 (Petersen 2003). Only a couple of Icelandic seabird species are monitored in a fully representative way; the Cormorant *Phalacrocorax carbo* (Garðarsson 1996a, 1999) and the Gannet *Sula bassana* (Garðarsson 1995a, 2005). Other seabird species breeding in Iceland are: Fulmar *Fulmarus glacialis*, Shag *Phalacrocorax aristotelis*, Leach's Petrel *Oceanodroma leuocorrhoa*, Storm Petrel *Hydrobates pelagicus*, Manx Shearwater *Puffinus puffinus*, Common Eider *Somateria mollissima*, Great Skua *Stercorarius skua*, Parasitic Jaeger *S. parasiticus*, Arctic Tern *Sterna paradisaea*, Black-headed Gull *Larus ridibundus*, Mew Gull *L. canus*, Lesser Black-backed Gull *L. fuscus*, Great Black-backed Gull *L. marinus*, Glaucous Gull *L. hyperboreus*, Herring Gull *L. argentatus*, Kittiwake *Rissa tridactyla*, Puffin *Fratercula arctica*, Razorbill *Alca torda*, Common Murre *Uria aalge*, Thick-billed Murre *U. lomvia*, and Black Guillemot *Cepphus grylle*. The Dovekie *Alle alle* has recently stopped breeding in the country.

The breeding distribution of Icelandic seabirds is known in general terms through irregular data-collecting, and more recently some organized breeding bird atlas work, environmental impact assessments, and colony censuses (see, e.g. Skarphéðinsson *et al*. 1994, Jóhannsson & Guðjónsdóttir 1995, Petersen 1998, 2000, Petersen & Egilsson 1998). Detailed colony registration and total population estimates have been carried out for Shag (Garðarsson 1979, Petersen & Ingvarsson 1995), Great Skua (Lund-Hansen & Lange 1991), Kittiwake (Petersen 1993, Garðarsson 1996b, Bornaechea & Garðarsson 2006), Razorbill, Common Guillemot, and Thick-billed Murre (Garðarsson 1995b). The Shag population has been fully censused several times and analysis is underway (Garðarsson & Petersen 2007), and for Cormorant (Garðarsson 1979 and *in prep*.).

Several seabird species, Fulmar, Kittiwake, Thick-billed Murre, Common Murre, and Razorbill, have been monitored at colony in several regions of Iceland (Garðarsson 2006a, 2006b). All colonies have been

Mark Mallory: *In the Field*, Iceland 2007.

monitored in one region in W-Iceland (Bornaechea & Garðarsson 2006). In another region the Breiðafjörður Bay and islands around Flatey, NW-Iceland, Fulmar, Shag, Cormorant, Kittiwake and Arctic Tern have been monitored (Petersen 1979). More extensive monitoring of Black Guillemots has taken place on about twenty little islands in Breiðafjörður for nearly 35 years (Petersen 1979, 1981, 2001a, Frederiksen & Petersen 1999a, b, 2000). Black-headed and Mew Gulls are censused every fifth year in the Eyjafjörður region, N-Iceland (Petersen & Thorstensen 1990, 1993, 2001, 2004, 2005). Census work is presently underway by Gardarsson and coworkers repeating a census of bird-cliff seabird species done in the 1980´s (Garðarsson 1995b).

Work is progressing to further the monitoring of seabirds in Iceland in general. A Seabird Colony Registry has been developed for several years, collating as much information as possible on the whereabouts of seabird colonies and their sizes at various times (cf. Petersen 2000, 2006). Incidental information from various times has been collected into a database giving an overview of the trend at many colonies, although the area coverage is mostly not representative of the respective Icelandic populations, nor is the full suite of species at some of these colonies monitored.

Wintering seabirds are monitored within the annual Christmas Bird Counts (Petersen 1983, Petersen & Hjartarson 1989, 1991, 1993). Best coverage is of the Common Eider, Shag, Cormorant, 5–6 gull species and Black Guillemot, as well as the Iceland Gull *Larus glaucoides*, which is a regular and common winter visitor. Razorbill, Common Murre, and Thick-billed Murre are poorly represented on account of their more pelagic habits as the census areas are either along the coast or inland. The only estimates for size of wintering populations in Iceland are found in Asbirk *et al.* (1997) and Petersen (1998), and more specifically for Common Eider (A. Petersen *in* Laursen 1989, Skarphéðinsson 1994). The Eider holds a very special role in Iceland being economically the most important wild bird species (Petersen 1997, 2001b,c). The size of the majority of the Icelandic Eider colonies is known, and in many cases also colony trends going back as far as a century. A monitoring program was organized in 2001 to collect at regular intervals data for a representative sample of Icelandic colonies, as part of the Circumpolar Eider Conservation Strategy (CAFF 1997).

Many areas, large or small, have been censused for seabirds as part of general surveys of breeding birds of these areas. Certain small areas that have been visited on two or more occasions, for instance the recently-formed island of Surtsey (S-Iceland), lake Tjörnin in mid Reykjavík, lake Ástjörn and Seltjarnarnes peninsula (SW-Iceland), many Breiðafjörður islands (W-Iceland), the nature reserve Skógar in Skagafjörður, the island of Hrísey, and the delta area of Eyjafjarðará (N-Iceland).

As part of continued work to fill gaps in regions with little or non-existent colony data, censuses have been carried out over such larger areas as the Reykjanes peninsula, islands off Reykjavík (SW-Iceland), many of the islands off Mýrar and those in the Breiðafjörður bay (W-Iceland), the regions of Jökulfirðir and Hornstrandir, Strandir and Ísafjarðardjúp (NW-Iceland), Vatnsnes, Látraströnd and Keflavík, Tjörnes peninsula and nearby islands, and Þistilfjörður (N-Iceland), Hérað and Víkur (E-Iceland), Dyrhólaey peninsula (S-Iceland), etc. Some of this work has been carried out as part of environmental impact assessments, other as part of general breeding bird surveys, or work on individual seabird species. Some species, lacking detailed distribution overviews, let alone breeding numbers, have also been targeted over larger areas. These poorly covered species are also among the most common and highly dispersed seabird species in Iceland, such as Fulmar, Arctic Tern, the gulls, Puffin, and Black Guillemot.

Aevar Petersen: *Censusing Puffin burrows*, Iceland 1995.

The hunting intensity on seabirds is monitored by the wildlife management unit of the Environment Agency, which annually compiles reports from hunters, in accordance with the hunting legislation (Act no. 64/1994). Preliminary analysis of the effects of hunting on seabird populations has been undertaken (Petersen *in prep*.).

References

Act on conservation, protection and hunting of wild birds and wild [terrestrial] mammals [in Iceland.] No. 64/1994. (Icel.).

Asbirk, S., L. Berg, G. Hardeng, P. Koskimies & Ævar Petersen 1997. Population sizes and recent trends

in the Nordic countries 1978-1994. TemaNord 1997:614. Nordisk Ministerråd. 88 pp.
Bornaechea, P.G. & A. Garðarsson 2006. [A survey of the bird cliffs of Snæfellsnes, W-Iceland, in 2005.] Bliki 27: 51-54. (Icel., Engl. summ.).
CAFF 1997. Circumpolar Eider Conservation Strategy and Action Plan. 16 pp.
Frederiksen, M. & A. Petersen 1999a. Adult survival of the Black Guillemot in Iceland. Condor 101(4): 589–597.
Frederiksen, M. & A. Petersen 1999b. Philopatry and dispersal within a Black Guillemot colony. Waterbirds 22(2): 274–281.
Frederiksen, M. & A. Petersen 2000. The importance of natal dispersal in a colonial seabird, the Black Guillemot *Cepphus grylle*. Ibis 142(1): 48–57.
Garðarsson, A. 1979. [A census of Cormorants (*Phalacrocorax carbo*) and Shags (*Phalacrocorax aristotelis*) in Iceland in 1975.] Natturufraedingurinn 49(2–3): 126–154. (Icel., Engl. summ.).
Garðarsson, A. 1995a. [Numbers of Gannet (*Sula bassana*) Iceland 1989–94.] Natturufraedingurinn 64(3): 203–208. (Icel., Engl. summ.).
Garðarsson, A. 1995b. [Numbers and distribution of Common Murre *Uria aalge*, Thick-billed Murre *U. lomvia* and Razorbill *Alca torda* in Iceland.] Bliki 16: 47–65. (Icel., Engl. summ.).
Garðarsson, A. 1996a. [Numbers of breeding Cormorants *Phalacrocorax carbo* in Iceland in 1975–1994.] Bliki 17: 35–42. (Icel., Engl. summ.).
Garðarsson, A. 1996b. [Numbers and distribution of breeding Kittiwake *Rissa tridactyla* in Iceland.] Bliki 17: 1–16. (Icel., Engl. summ.).
Garðarsson, A. 1999. [Numbers and recruitment of Cormorants.] Veiðistjóraembættið. Veiðidagbók 1999: 10–12. (Icel.).
Garðarsson, A. 2005. [Numbers of Northern Gannet *Morus bassanus* in Iceland 1999.] Bliki 26: 17-20. (Icel., Engl. summ.).
Garðarsson, A. 2006a. [Recent changes in numbers of cliff-nesting seabirds in Iceland.] Bliki 27: 13-22. (Icel., Engl. summ.).
Garðarsson, A. 2006b. [Breeding success of Kittiwake in Iceland in 2005.] Bliki 27: 22-26. (Icel., Engl. summ.).
Garðarsson, A. & A. Petersen 2007. Decadal variation in distribution and numbers of European Shag *Phalacrocorax aristotelis* in Iceland. Waterbird Society, Barcelona Oct. 2007. Poster.
Jóhannsson, J.H. & B. Guðjónsdóttir 1995. [Atlas of breeding birds in Steingrímsfjörður and vicinity, NW-Iceland: a survey 1987–1994.] Fjölrit Náttúrufræðistofnunar 28. 76 pp. (Icel., Engl. summ.).
Laursen, K. 1989. Estimates of sea duck winter populations of the Western Palearctic. Danish Rev. Game Biol. 13(6): 1-22.
Lund-Hansen, L.C. & P. Lange 1991. The numbers and distribution of the Great Skua *Stercorarius skua* breeding in Iceland 1984–1985. Acta Nat. Isl. 34. 16 pp.
Petersen, A. 1979. [The breeding birds of Flatey and some adjoining islets, in Breidafjördur, NW. Iceland.] Náttúrufr. 49(2–3): 221–256. (Icel., Engl. summ.).
Petersen, A. 1981. Breeding biology and feeding ecology of Black Guillemots. D.Phil. thesis. University of Oxford, England. xiv + 378 bls.
Petersen, A. 1983. [The annual Christmas Counts in Iceland.] Bliki 2: 28–42. (Icel., Engl. summ.).
Petersen, A. 1993. [Kittiwake *Rissa tridactyla* colonies on the Snaefellsnes peninsula, W Iceland.] Bliki 13: 3–10. (Icel., Engl. summ.).
Petersen, A. 1997. Status and Conservation of Eiders: Iceland. Report to CAFF. 9 pp.
Petersen, A. 1998. [Icelandic Birds.] Vaka-Helgafell, Reykjavik. 312 pp. (Icel.).
Petersen, A. 2000. [Monitoring of Icelandic seabirds.] Natturufraedingurinn 69(3–4): 189–200. (Icel., Engl. summ.).
Petersen, A. 2001a. Black Guillemots in Iceland: A case-history of population changes (Box 70). Pp. 212–213 *in*: Arctic Flora and Fauna (Status and Conservation). CAFF/Edita, Helsinki. 272 pp.
Petersen, A. 2001b. [Conservation of the Common Eider in Iceland and future considerations.] Pp. 47–53 *in*: J. Jónsson (ed.). [The Common Eider and Eider husbandry in Iceland.] Mál og Mynd, Reykjavík. 528 pp. (Icel.).
Petersen, A. 2001c. [The Common Eider in Iceland. (Status of research and international on the conservation of eiders).] Náttúrufræðistofnun Íslands NÍ-01025. 29 pp.
Petersen, A. 2003. Icelandic Programs related to the Circumpolar Biodiversity Monitoring Program. Náttúrufræðistofnun Íslands. NÍ-03003. 19 p.
Petersen, A. 2006. Iceland. Pp. 42-47 *in*: Bakken, V., D. Boertmann, A. Mosbech, B. Olsen, A. Petersen, H. Ström & H. Goodwin 2006. Nordic Seabird Colony Databases: Results of a Nordic project on seabird breeding colonies in Faroes, Greenland, Iceland, Jan Mayen and Svalbard. TemaNord 2006: 512. 96 pp.
Petersen, A. Seabirds in Iceland: legislation and hunting statistics. *In prep*.
Petersen, A. & K. Egilsson 1998. [Works related to the natural history of Reykjavik and adjacent regions. (Reports by the Icelandic Institute of Natural History on the islands in Kollafjörður, peninsulas Álfsnes and Geldinganes, Öskjuhlíð hill, the Fossvogur bay and Reykjavík airport during the years 1985–1997).] Náttúrufræðistofnun Íslands NÍ-98031. 138 pp. (Icel.).
Petersen, A. & G. Hjartarson 1989. [The Icelandic Christmas Bird Counts: Some general points, and results for 1987.] Fjölrit Náttúrufræðistofnunar 11. 42 pp. (Icel., Engl. summ.).
Petersen, A. & G. Hjartarson 1991. [The Icelandic Christmas Bird Count: Results for 1988.] Fjölrit Náttúrufræðistofnunar 18. 38 pp. (Icel., Engl. summ.).
Petersen, A. & G. Hjartarson 1993. [The Icelandic Christmas Bird Count: Results for 1989.] Fjölrit Náttúrufræðistofnunar 23. 43 pp. (Icel., Engl.

summ.).
Petersen, A. & S. Ingvarsson 1995. [The numbers of breeding Cormorants and Shags in Faxaflói Bay.] Bliki 15: 16–20. (Icel., Engl. summ.).
Petersen, A. & S. Thorstensen 1990. [Birdlife at Akureyri airport and surrounding wetland areas, N-Iceland, 1987.] Bliki 9: 7–20. (Icel., Engl. summ.).
Petersen, A. & S. Thorstensen 1993. [The distribution and numbers of Black-headed Gulls in Eyjafjörður 1990.] Bliki 13: 45–59. (Icel., Engl. summ.).
Petersen, A. & S. Thorstensen 2001. [Birdlife in the delta area of river Eyjafjarðará, N-Iceland.] Náttúrufræðistofnun Íslands NÍ-01013. 67 pp (Icel.).
Petersen, A. & S. Thorstensen 2004. [Monitoring and population changes of Common Gulls *Larus canus* in Eyjafjörður (N-Iceland) 1980-2000.] Náttúrufraedingurinn 72(3-4): 144-154. (Icel., Engl. summ.).
Petersen, A. & S. Thorstensen 2005. [Monitoring of Black-headed Gulls *Larus ridibundus* in Eyjafjörður (N-Iceland) 1995 and 2000.] Náttúrufraedingurinn 73(1-2): 39-46. (Icel., Engl. summ.).
Skarphéðinsson, K.H. 1994. [Damage by White-tailed Eagles in Eider colonies.] Report by the Icelandic Institute of Natural History for the Ministry for the Environment. 120 pp. (Icel.).
Skarphéðinsson, K.H., G. Pétursson & J.Ó. Hilmarsson 1994. [Atlas of breeding birds in southwestern Iceland: a survey 1987–1992.] Fjölrit Náttúrufræðistofnunar 25. 126 pp. (Icel., Engl. summ.).

Norway

Hallvard Strøm, Tycho Anker-Nilssen and Rob Barrett

The overall goals of the Norwegian seabird monitoring programme are to evaluate the status and trends of seabird populations in relation to anthropogenic and natural environmental factors (Mehlum & Bakken 1994, Anker-Nilssen *et al*. 1996). The status of seabirds breeding on mainland Norway has recently been reviewed by Barrett *et al.* (2006). The status of seabirds breeding in North Norway and Svalbard (including the remainder of the Barents Sea) are reviewed in Anker-Nilssen *et al*. (2000).

Svalbard

The seabird monitoring programme for Svalbard was initiated in 1988 (Mehlum & Bakken 1994) and at present (2007), seven species are included in the programme: Northern Fulmar *Fulmarus glacialis*, Common Eider *Somateria mollissima*, Great Skua *Stercorarius skua*, Glaucous Gull *Larus hyperboreus*, Black-legged Kittiwake *Rissa tridactyla*, Common Murre *Uria aalge*, Thick-billed Murre *Uria lomvia* and Dovekie *Alle alle* (Strøm 2006). Monitoring of population development is carried out annually for all seven species except Dovekie. Data on survival, breeding success and chick diet are monitored on Bjørnøya (Bear Island) for all species except Northern Fulmar and on Spitsbergen for Black-legged Kittiwake, Thick-billed Murre and Dovekie (Strøm 2006). The seabird monitoring programme in Svalbard is organized by the Norwegian Polar Institute (NP), and data are stored in the institute's Seabird Colony Database – COLONY (Bakken 2000).

Mainland Norway

The seabird monitoring in Norway started in the 1960s, when professor Einar Brun systematically censused many of the large colonies along the mainland coast (Brun 1965, Barrett & Krasnov 1997, Barrett *et al.* 2006). Although Norway has long been recognized as being responsible for a significant part of the NE Atlantic seabird populations (Brun 1979), a comprehensive study of numbers and population trends of seabirds along the Norwegian coast was first initiated at a national level in 1979 as part of the *Norwegian Seabird Project* (Røv *et al.* 1984). Before this, the little knowledge concerning the population status and trends of Norwegian seabirds was based on total counts in a few selected colonies at irregular intervals. These were often limited in their accuracy, and their irregularity precluded detailed documentation of annual changes (Brun 1979, Barrett *et al.* 2006).

The Norwegian Seabird Project ended in 1984 and some of the population data was summarized by Barrett & Vader (1984). It was, however, immediately followed up by various mapping and monitoring projects, and much more detailed data concerning overall numbers, distribution and population trends have since been collected using international standards (e.g. Lorentsen 2007). Most of these data are now stored in The National Seabird Registry at the Norwegian Institute for Nature Research (NINA) (Lorentsen 2007, Barrett *et al.* 2006).

Morten Ekker: *Black Guillemots*, Norway 2006.

The National Monitoring Programme for Seabirds, which was established in 1988 and revised in 1996, now addresses population changes in 18 species of breeding seabirds along the coast, including the three key species (Atlantic Puffin *Fratercula arctica*, Black-legged Kittiwake and Common Guillemot) and are six key sites (Runde, Sklinna, Røst, Anda, Hjelmsøya and Hornøya) (Anker-Nilssen *et al.* 1996, Lorentsen 2007).

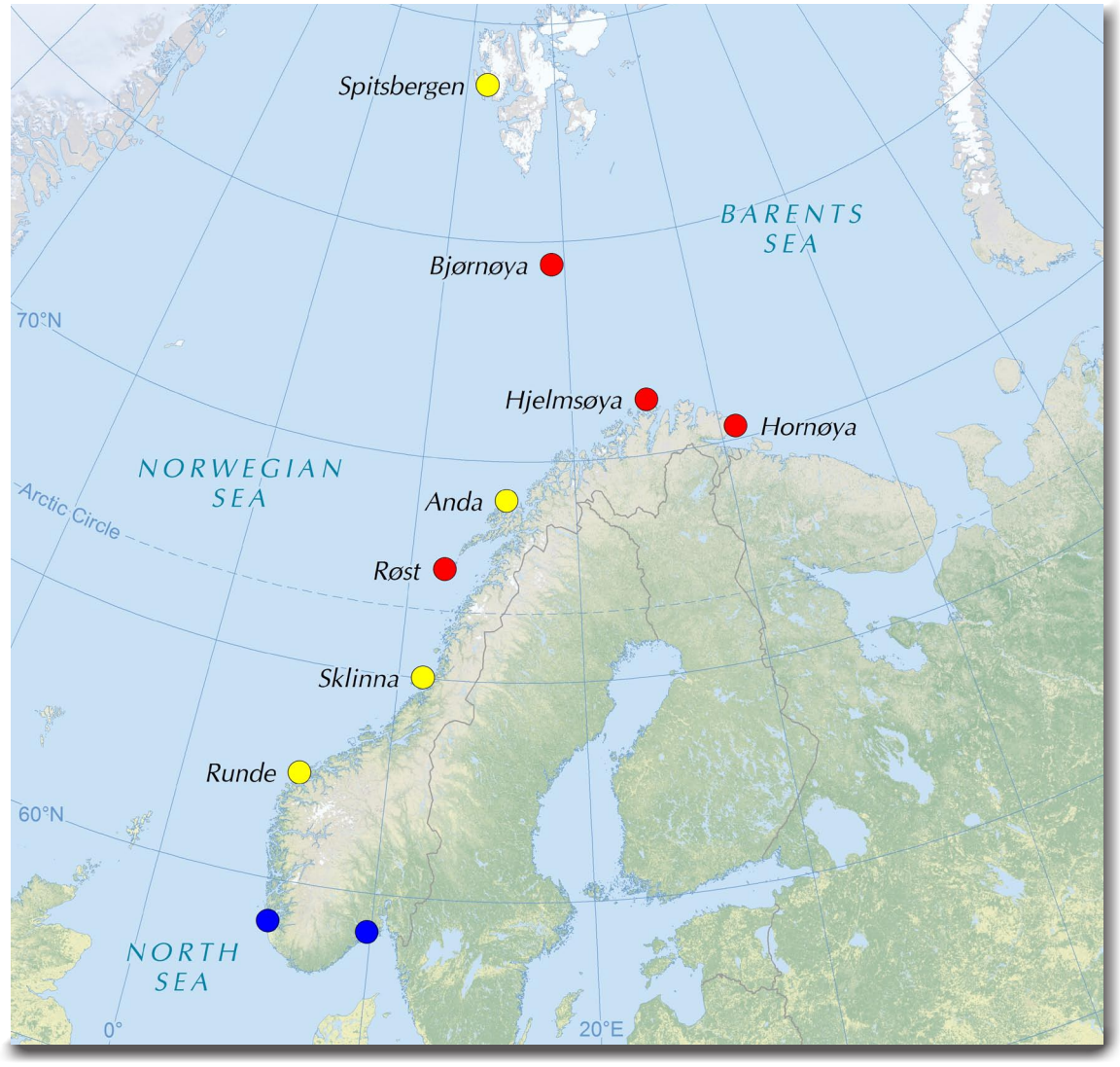
The SEAPOP programme

In 2005, the SEAPOP (SEAbird POPulations) programme was launched. Its aim is to coordinate a long-term, comprehensive, standardised and cost-effective study of the most important aspects of seabird numbers, distribution, demography and ecology in Norway, Svalbard and adjacent sea areas (Anker-Nilssen *et al.* 2005, 2006a,b, 2007). The formerly established monitoring activities, which include the national programmes on the mainland and Svalbard and long-term studies of seabird ecology on Røst, Hornøya and Bjørnøya, will be continued as integral parts of the SEAPOP programme. SEAPOP thus puts all previous seabird monitoring activity under one umbrella (Anker-Nilssen *et al.* 2005).

The activities in the two initial years were restricted to the Lofoten and Barents Sea area (see map), but from 2008 the programme will be implemented on a full national scale. The work is organized and carried out by the Norwegian Institute for Nature Research and the Norwegian Polar Institute, in close cooperation with the Tromsø University Museum, and is currently financed by the Ministry of Environment, the Ministry of Petroleum and Energy and the Norwegian Oil Industry Association.

Within the scheduled programme period of minimum ten years, SEAPOP aims to map in detail the distribution of breeding, staging and wintering seabirds along all coastlines of Norway and the Svalbard archipelago. For logistic and economic reasons, much of the highly dynamic distribution of seabirds at sea in the vast areas covered by the programme will be predicted using multi-disciplinary models. This work is done in close cooperation with the Institute of Marine Research in Bergen and is based on data collected during their ecosystem surveys in parts of the area.

The national monitoring of population trends that has been ongoing since the 1980s will be continued



The existing SEAPOP key-sites as of 2007.

and extended with more sites and species. The monitoring of reproduction, adult survival rates and diets of selected seabird species on the four previously established key-sites Røst, Hjelmsøya, Hornøya and Bjørnøya (see map) has been extended and further adjusted to meet the general design of the programme. Four new key-sites have been established; Spitsbergen, Anda, Sklinna and Runde. The key-site on Spitsbergen is divided among several localities because there is no single site in the area that holds a sufficient variety of breeding species. When the programme is implemented on the full national scale in 2008, at least three additional key areas will be established in southern Norway, most likely including a selection of sites in the southwest (North Sea coast), south and southeast (Skagerrak coast).

The SEAPOP programme will also fund a number of more specialised, shorter-term studies of seabird ecology and habitat use, some of which will apply methods like data loggers and satellite telemetry.

The SEAPOP Web (www.seapop.no) is the primary line of communication from the research institutions to the partners involved in the programme. All data and information which is collected through the various SEAPOP projects are presented on the web in the most relevant formats for the different users groups targeted by the programme, and technical reports are downloadable as PDF documents. This structure not only ensures that everyone gets the same information, but that the access to new, updated and quality-controlled results is immediate and that the information is standardised in such a way as to be most useful for all involved. As the major share of this information is freely available as maps, tables, figures and text, we also hope it will be of interest for educational purposes and to the general public.

References

Anker-Nilssen, T., V. Bakken, H. Strøm, A. Golovkin, V. Bianki & I.P. Tatarinkova (eds) 2000. The Status of Marine Birds Breeding in the Barents Sea Region. Norsk Polarinst. Rapport Ser. no. 113.

Anker-Nilssen, T., R.T. Barrett, J.O. Bustnes, K.E. Erikstad, P. Fauchald, S.-H. Lorentsen, H. Steen, H. Strøm, G.H. Systad & T. Tveraa 2007. SEAPOP studies in the Lofoten and Barents Sea area in 2006. NINA Report 249. 63 pp.

Anker-Nilssen, T., R.T. Barrett, J.O. Bustnes, K.E. Erikstad, P. Fauchald, S.-H. Lorentsen, H. Steen, H. Strøm, G.H. Systad & T. Tveraa 2006a. SEAPOP studies in the Lofoten and Barents Sea area in 2005. NINA Report 127. 38 pp.

Anker-Nilssen, T., R.T. Barrett, J.O. Bustnes, K.E. Erikstad, P. Fauchald, S.-H. Lorentsen, H. Steen, H. Strøm, G.H. Systad & T. Tveraa 2006b. The SEAPOP programme – a milestone for the mapping and monitoring of seabirds in Norway. Poster at the 9th International Conference of the Seabird Group, 1 - 3 September 2006, University of Aberdeen, Scotland, UK.

Anker-Nilssen T., J.O. Bustnes, K.E. Erikstad, S.-H. Lorentsen, T. Tveraa, H. Strøm & R.T. Barrett 2005. SEAPOP. A national seabird programme for improved decision support in marine areas. NINA Rapport 1. 66 pp. (In Norwegian)

Anker-Nilssen T., K.E. Erikstad & S.-H. Lorentsen 1996. Aims and effort in seabird monitoring: an assessment based on Norwegian data. Wildlife Biol. 2: 17-26.

Bakken, V. (ed.) 2000. Seabird Colony Databases of the Barents Sea Region and the Kara Sea. Norwegian Polar Institute Report Series No. 115. 78 pp.

Barrett, R.T., Lorentsen S-H. & T. Anker-Nilssen 2006. The status of breeding seabirds in mainland Norway. Atlantic Seabirds 8(3): 97-126.

Barrett, R.T. & W. Vader 1984. The status and conservation of breeding seabirds in Norway. ICBP Tech Publ. 2: 323-333

Brun, E. 1965. Polarlomvien *Uria lomvia* (L.) som rugefugl i Norge. Sterna 6: 229-250.

Brun, E. 1979. Present status and trends in populations of seabirds in Norway. Pp. 289-301 *in*: J.C. Bartonek & D.N. Nettleship (eds). Conservation of Marine Birds of Northern North America. US Dept Fish Wildl. Ser. Wildlife Res. Rep. 11.

Lorentsen, S.-H. 2007. The national monitoring programme for seabirds. Results up to and including 2007. NINA Rapport 313, 54 pp. (In Norwegian)

Mehlum, F. & V. Bakken 1994. Seabirds in Svalbard (Norway): status, recent changes and management. Pp. 155-171 *in*: D.N. Nettleship, J. Burger & M. Gochfeld (eds). Seabirds on islands: threats, case studies and action plans. BirdLife Conservation Ser. No. 1.

Røv, N., J. Thomassen, T. Anker-Nilssen, R.T. Barrett, A.O. Folkestad & O. Runde 1984. Sjøfuglprosjektet 1979-1984. Directorate for Nature Management, Trondheim, Viltrapport 35: 1-109.

Strøm, H. 2006. Jan Mayen and Svalbard. Pp. 48-56 *in*: V. Bakken, D. Boertmann, H. Goodwin, A. Mosbech, B. Olsen, A. Petersen & H. Strøm. Nordic Seabird Colony Databases: Results of a Nordic project on seabird breeding colonies in Faroes, Greenland, Iceland, Jan Mayen and Svalbard. TemaNord 2006. 96 pp.

Russia: western part

Maria V. Gavrilo

This part deals with “western” Russian Arctic from Barents Sea to Eastern Taimyr Peninsula and Severnaya Zemlya (western Laptev Sea), which more or less correspond to natural distribution patterns of seabirds, i.e. correspond to “East Atlantic migration” populations. The area under consideration will be called simply Western Russian Arctic. The area considered includes the CAFF-defined Arctic area, i.e. only coasts of the White Sea belonging to Murmansk District (Kandalaksha Bay and southern and eastern Kola Peninsula coasts) are included in the analysis but not the rest areas of the White Sea where large seabird colonies do exist in Onega Bay in particular.

A list of seabird species breeding in Western Russian Arctic is quite long and includes 30 species. The breeding distribution of Russian arctic seabirds is known in general terms, mostly through irregular data collecting. There were several projects compiled breeding distribution of seabirds in selected areas (Northern Sea Route Dynamic Environmental Atlas (1998), Seabird colony databases for the Barents and Kara Seas (2000)). No specific countrywide seabird colony registration and one-time total population estimates have been carried out yet.In archipelagos with hundreds of small isles inhabited by eiders, gulls and terns birds are counted separately on each isle. During a Russian-Norwegian workshop on monitoring issues experts agreed to consider them as monitoring plots (breeding site) while “colonies” in such areas were defined as groups of islands with similar environmental conditions.

Most numerous colonial seabird species are Thick-billed Murre *Uria lomvia,* Dovekie *Alle alle* and Black-legged Kittiwake *Rissa tridactyla,* while Northern Fulmar *Fulmarus glacialis*, Common Murre *Uria aalge*, and Atlantic Puffin *Fratercula arctica are* present in much smaller numbers. Boreal-Atlantic elements in seabird fauna such as Razorbill *Alca torda*, Shag *Phalacrocorax aristotelis* and Great Cormorant *Phalacrocorax carbo* are not numerous and tied up with south-westernmost part of the Western Russian Arctic area. High Arctic element – the Ivory Gull *Pagophila eburnea* distributed within high-latitudinal archipelagos and Russian population is considered to comprise the majority of the world’s breeding population.

Skuas, most gulls and terns do not necessarily breed in colonies and thus their numbers are difficult to estimate and breeding colonies are hardly possible to count. Larger white-headed gulls like Great Black-backed Gull *Larus marinus* and Herring Gull *Larus argentatus* breed in high numbers in south-western part of the Western Russian Arctic and represent a considerable portion of the country’s population of the species. Mew Gull *Larus canus*, Black-headed

Maria Gavrilo: ***Ivory Gull is taken on Domashny Island, Severnaya Zemlya*****. Kara Sea.**

Gull *Larus ridibundus*, Little Gull *Larus minutus* and Common Tern *Sterna hirundo* penetrate only southernmost limits of the CAFF area and do not form any significant settlements.

Maria Gavrilo: Common Murres, Franz Josef Land.

Glaucous Gull *Larus hyperboreus,* West Siberian Gull *Larus heuglini*[1], Arctic Tern *Sterna paradisaea,* Parasitic Jaeger *Stercorarius parasiticus*, Long-tailed Jaeger *Stercorarius longicaudus*, and Pomarine Jaeger *Stercorarius pomarinus* are highly dispersed over Siberian tundras and on many islands but lack detailed distribution overviews, and their numbers are guesstimated at tens of thousands pairs for each species. Seaduck species considered here Common Eider *Somateria mollissima*, King Eider *Somateria spectabilis*, and Steller's Eider *Polysticta stelleri* are also difficult to assess in breeding pairs, and their numbers are better known from their wintering populations.

Northern Gannet *Sula bassana* and Great Skua *Stercorarius skua* are recent invaders into the Russian Arctic from the West Atlantic and breed in south Barents Sea in very low numbers but do not occur in any other part of the country.

Sabine´s Gull *Larus sabini* and Ross´ Gull *Rhodostethia rosea* demonstrate recently slight eastward expansion and have in Taimyr western limit of their distribution thus occur in the Western Russian Arctic in low numbers with small breeding colonies being dropped sparsely on suitable tundra habitats.

1 We follow most recent Russian Bird list (Stepanyan 2002) and consider larger white-headed and dark-mantled gulls inhabiting eastward from the White Sea through Siberia separate species West Siberian Gull *Larus heuglini*. In other sources they are considered Lesser Black-backed Gulls (*Larus fuscus heuglini*) or Herring Gulls (*Larus argentatus heuglini/taimyrensis/vegae*).

Traditionally, seabird monitoring in Russia is based on a network of strict nature reserves (*zapovedniks*, IUCN category I). Only selected colonies situated within the boundaries of such SPAs are monitored routinely. Longest monitoring series are obtained within the territory of Kandalaksha State Strict Nature Reserve (KSR). KSR's monitoring activity is concentrated on three areas including Kandalaksha Bay (White Sea), West and East Murman areas (south Barents Sea coast). Novaya Zemlya department of the Seven Strict Nature Reserve (the latter is now a part of KSR while the department does not exist anymore) used to carry out monitoring in largest colonies on Novaya Zemlya archipelago. For some species regular monitoring has been started in KSR as early as late 1920s corresponding to more than 70-years series for some sites. Unfortunately, recently the monitoring program in the remote areas on the Barents Sea coast has been discontinued due to staff shortage and logistic problems in the KSR. Monitoring is continued in the Kandalaksha Bay but with restricted coverage. Besides numbers other monitoring parameters include productivity, diet and phenology but these data are collected in some few colonies only.

Recently (since late 1990s) several new monitoring sites were established on the southern Barents Sea coast as a scientific initiative of research institute and these sites are not within designated protected areas.

An overview of the status of seabirds monitoring in the Russian part of the Barents Sea and in the White Sea is recently completed within the framework of Russian-Norwegian environmental co-operation in the Barents Sea region (Krasnov *et al.* 2004). The principal output expected of the project is harmonization of the monitoring parameters and optimizing of the monitoring site network within the Barents Sea region. No similar work has been done for the Siberian Russian Arctic and Chukotka.

The above mentioned project covers less than half of the Western Russian Arctic but almost the entire monitoring activity dealing with seabirds in Western Russian Arctic does occur within area concerned in the report. Allocation of the monitoring efforts accounts for the representativeness of species monitoring with respect to its distribution in the country.

Monitoring of few species having marginal distribution in the Western Russian Arctic can be considered as representative for the country population, these include Shag, Cormorant, Puffin, Razorbill, Gannet, and Great Skua. Establishment of breeding colonies of two latter species in the Russian Arctic is well documented (Krasnov & Nikolaeva 1995, Yu.V. Krasnov unpubl.). Major colonies of Greater Black-backed and Herring Gulls are also within the area of long-term monitoring activity.

Several seabird species have been monitored locally for a long time and on annual bases, but in no way do these cover the respective Russian populations in a representative way. These include Kittiwake, Thick-billed and Common Murres (Murman coast), Arctic Tern and Black Guillemot in the Kandalaksha Bay (White Sea) and on Murman coast (Krasnov *et al.* 1995, Anker-Nilssen *et al.* 2000, KSR Nature chronicles *unpubl.*). Common Eider is well monitored in the White Sea and to a lesser extent on the Murman coast (KSR Nature chronicles *unpubl.*), but taking into account that local populations of these species in the Western Russian Arctic are very much sedentary these long-term observations tell nothing about eider status in other part of the species range.

The least information about breeding numbers and trends are known for such colonial breeders as Dovekie and Fulmar. Not a single colony of these species has been censused completely, using relevant methods.

Many areas, large or small, have been censused for seabirds as part of general surveys of breeding birds of these areas. For few sites that have been visited on two or more occasions the quantitative data on breeding numbers of seabird species like eiders, skuas and gulls exist but these data are scattered and no compiled analyses are publicized.

Seabird Colony Registries for the Barents, White and the Kara Seas regions have been under development for several years, collating as much information as possible on the distribution of seabird colonies and their sizes at various times (SCRIB 2003, Kara Sea Register 2000). Both incidental information from various times and selected systematically obtained monitoring data have been collected into a database giving an overview of the trend at some colonies. Analysis of the data coverage with respect to species distribution over the area and their numbers is published (Bakken 2000). These registries include data on more than 20 species but not for jaegers, King and Steller's Eiders. In general seabird colonies in the Kara Sea, as well as northernmost colonies of the Barents Sea, almost completely lack monitoring observations compared to the White Sea and south Barents Sea.

Wintering seabirds are monitored at several sites around Kola Peninsula (Krasnov & Goryaev 2003). These counts cover mostly seaducks including three species of eiders. Recently an extensive aerial count has been conducted along the coast of Kola Peninsula which covered most important wintering grounds of eiders (Krasnov *et al*. 2004).

Best coverage is of the Common Eider, King Eider, Steller's Eider and also include Cormorant, and Glaucous Gull, which winter over in the area in small numbers.

A Seabird Colony Registry for the Barents Sea region is ongoing project but it does not include fieldwork to fill the evaluated gaps but targets on data verification and compilation of information obtained within other projects, for example that have been carried out as part of environmental impact assessments. Monitoring of wintering and moulting seaducks is evaluated to be useful to continue but this is dependent on finding financial support.

References

Anker-Nilsen, T., V. Bakken, H. Strom, A. Golovkin, I. Bianki & I. Tatrinkova (eds) 2000. The status of marine birds breeding in the Barents Sea region. Norsk Polarinstitutt, Tromsø.

Bakken, V. (ed.) 2000. Seabird colony databases of the Barents Sea region and the Kara Sea. Norsk Polarinstitutt Rapportserie. Norsk Polarinstitutt, 2000. N 115.

Brude, O.W. *et al* (eds) 1998. Northern Sea Route Dynamic Environmental Atlas. INSROP Working Paper No 99-1998, II-4-10. The Fridtjof Nansen Institute, Oslo.

Gavrilo, M., V. Bakken & K. Isaksen (eds) 1998. The Distribution, Population Status and Ecology of Marine Birds selected as Valued Ecosystem Components in the Northern Sea Route Area. INSROP Working Paper No. 123, II.4.2. 136pp+Appendix. The Fridtjof Nansen Institute, Oslo.

Krasnov, Yu.V., G.G. Matishov, K.V. Galaktionov & T.N. Savinova 1995. Murman's colonial seabirds. Saint-Petersburg, Nauka. Pp. 1-213 (Russian).

Krasnov, Yu.V. & N.G. Nikolaeva 1995, Change of status of the Great Skua in Eastern Europe. Ornitologiya, Moscow, Moscow State University Press, Iss. 26, Pp. 72-75 (Russian).

Krasnov, Yu.V., H. Strøm, M.V. Gavrilo & A.A. Shavykin 2004. Seabirds wintering in polynyas along Terskiy coast of the White Sea. Ornitologiya 30: 51-57. (Russian, Engl. summ.).

Russia: eastern part

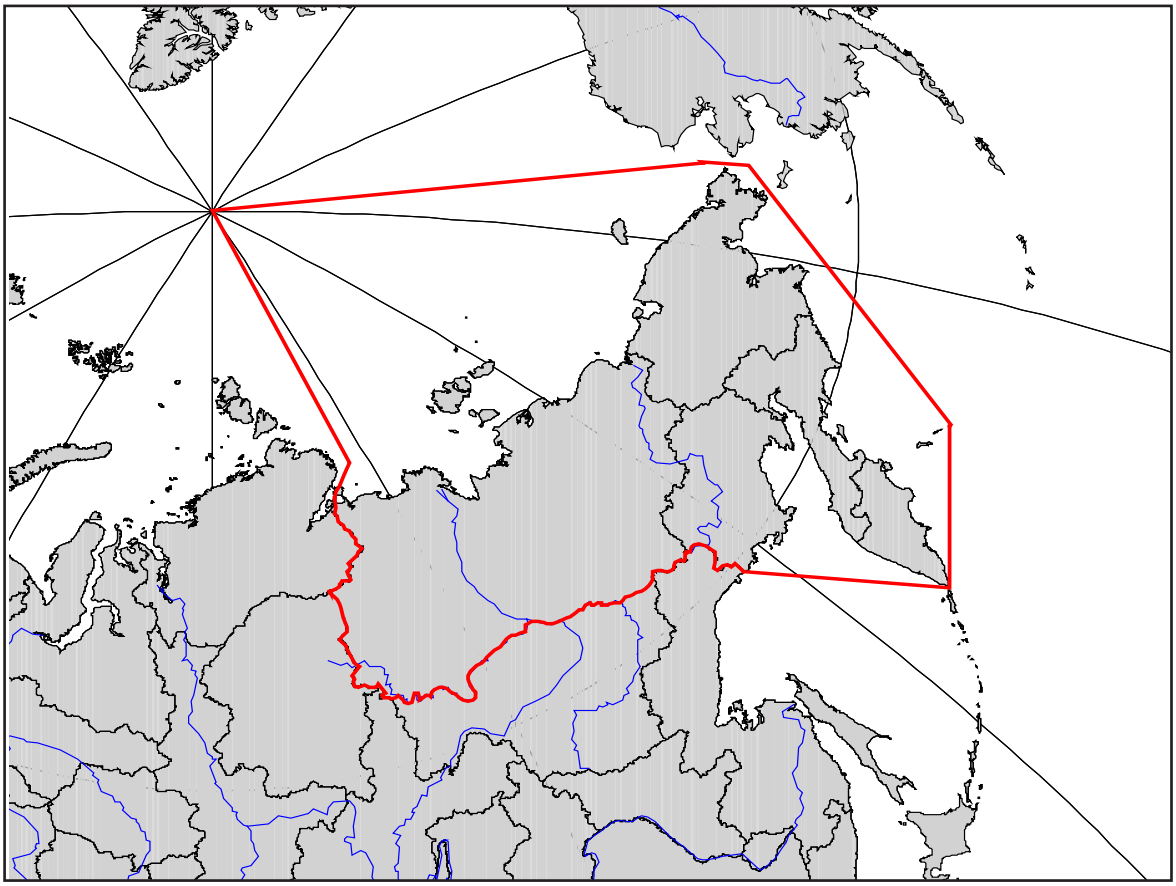
Yuri Artukhin

The region included in the east part of Russia extends from Taimyr to Chukotka, Kamchatka and the Commander Islands. This region is shown on the accompanying map.

Regularly 39 species of seabirds breed in this region. Breeding of one further species, Dovekie *Alle alle*, has not been proven, although it is supposed to take place in the Big Diomede Island, Bering Strait. Distribution of Fork-tailed Storm Petrel *Pterodroma furcata*, Leach´s Storm Petrel *Oceanodroma leucorrhoa*, Glaucous-winged Gull *Larus glaucescens*, and Red-legged Kittiwake *Rissa brevirostris* is very limited and is confined to the Commander Islands only. All the other species are distributed rather widely everywhere in the coastal and continental parts of the region. These species are: Northern Fulmar *Fulmarus glacialis*, Pelagic Cormorant *Phalacrocorax pelagicus*, Red-faced Cormorant *Phalacrocorax urile*, Common Eider *Somateria mollissima*, King Eider *Somateria spectabilis*, Spectacled Eider *Somateria fischeri*, Steller's Eider *Polysticta stelleri*, Parasitic Jaeger *Stercorarius parasiticus*, Long-tailed Jaeger *Stercorarius longicaudus*, Pomarine Jaeger *Stercorarius pomarinus*, Glaucous Gull *Larus hyperboreus*, Herring Gull *Larus argentatus*, Slaty-backed Gull *Larus schistisagus*, Mew Gull *Larus canus*, Black-headed Gull *Larus ridibundus*, Black-legged Kittiwake *Rissa tridactyla*, Sabine´s Gull *Larus sabini*, Ross´ Gull *Rhodostethia rosea*, Arctic Tern *Sterna paradisaea*, Common Tern *Sterna hirundo*, Aleutian Tern *Sterna aleutica*, Common Murre *Uria aalge*, Thick-billed Murre *Uria lomvia*, Spectacled Guillemot *Cepphus carbo*, Black Guillemot *Cepphus grylle*, Pigeon Guillemot *Cepphus columba*, Kittlitz´s Murrelet *Brachyramphus brevirostris*, Long-billed Murrelet *Brachyramphus perdix*, Ancient Murrelet *Synthliboramphus antiquus*, Least Auklet *Aethia pusilla*, Crested Auklet *Aethia cristatella*, Parakeet Auklet *Aethia psittacula*, Whiskered Auklet *Aethia pygmaea*, Horned Puffin *Fratercula corniculata*, and Tufted Puffin *Fratercula cirrhata*.

Among the breeding seabirds four species, Red-legged Kittiwake, Aleutian Tern, Kittlitz´s Murrelet and Long-billed Murrelet, have been included in the Russian Federation Red Book (RF List of Endangered Species).

Location, composition and number of most seabird colonies have been studied quite well as a result of multiple detail researches accomplished in the



Map of Eastern Russia

1980´s-1990´s (Vytkin 1986, 2000, Stishov *et al.* 1991, Golubova & Pleschenko 1997, Konyukhov *et al.* 1998, Artukhin 1999, Zelenskaya 2001). Majority of the data has been generalized (U.S. Fish and Wildlife Service 1999, Kondratyev *et al*. 2000). "White spots" stays 3 plots where large colonies of seabirds are scattered: the New Siberian Islands in the Arctic Ocean, Navarin Cape vicinities in the Bering Sea and Penzhinskaya Bay in the Sea of Okhotsk; which concerned information is mostly fragmentary and out of date.

At recent times long-term monitoring of seabird populations has been carrying out in two stations in Tauyskaya Bay in the northern Sea of Okhotsk. In 1987 in the west part of Tauyskaya Bay, the Talan Island, a field station has been organized (Kondratyev 1993), where annual observations for numbers, productivity, breeding chronology and diet of Black-legged Kittiwake, Common Murre, Thick-billed Murre, Ancient Murrelet, Crested Auklet, Parakeet Auklet, Horned Puffin, Tufted Puffin have been accomplished; Black-legged Kittiwakes and Creasted Auklets individual tagging program has been carried out in order to estimate the survival of these species (Golubova 2001, and others). Moreover, since 1993 monitoring has been carried out in the east part of Tauyskaya Bay, the Umara Island, on the state of the populations of Slaty-backed Gull, Black-legged Kittiwake, Spectacled Guillemot, and Tufted Puffin.

Gull populations (Glaucous-winged Gull, Black-legged and Red-legged Kittiwakes) have been monitored from time to time in the Commander Islands (Zelenskaya 1994, 1999, 2003). In 1970´s-1990´s long-term studies, including of monitoring, took place on the Wrangel Island on Pelagic Cormorant, Common Eider, Glaucous Gull, Black-legged Kittiwake, Black Guillemot, Thick-billed Murre, and Horned Puffin (Pridatko 1986, Stishov *et al*. 1991), in Chukotka on Pigeon Guillemot, Parakeet Auklet, Creasted Auklet and Least Auklet (Konyukhov 1993), and in tundra of the Lower Kolyma River and Chaun Gulf on Ross' and Sabine's Gulls (Andreev 1985, Kondratyev & Kondratyeva 1987).

The state of Eider populations in the Arctic coast were studied in 1993-1995 by aerial surveys covering all extensive areas of plain coastal tundra of North-Eastern Asia from the Kolyuchinskaya Bay to the Lena River delta (Poyarkov *et al.* 2000). These surveys were partly repeated in 2002 (Lappo *et al*. 2003). In 1990´s stationery monitoring studies of Steller's and Spectacled Eiders took place in the lower reaches of the Lena River and of the Indigirka River (Solovieva 1997, Pearce *et al.* 1998), and since 2002 Spectacled Eider has been monitored in the Chaun River delta, Western Chukotka.

Annually since 1975 spring counts of migrating waterfowl and shorebirds has been carried out in Kamchatka (Gerasimov & Gerasimov 1996, 2001, 2003). In the course of this work, moreover, the abundance of many species of seabirds (gulls especially), migrating along the coasts of Kamchatka, have been studied (Gerasimov 1992, Gerasimov *et al.* 1998, Gerasimov & Gerasimov 1999, Gersimov & Kalyagina 2000, and others).

Yuri Artukhin: ***Tourists up close with bird colony,*** **The Commander islands.**

There are no permanent programs of monitoring within the region for wintering seabirds. Systematic winter surveys of waterfowl including eiders were carried out in 1970´s in the seacoast of Kronotsky Bay, Eastern Kamchatka (Lobkov 1982) and in 1990´s-2000´s on the Commander Islands (Artukhin 2003, Belobrov & Artukhin 2005).

Studying the features of seabird distribution in the sea, including the number dynamics, has been accomplishing since 1960´s. The works were especially intense in 1980´s-1990´s in the course of large-scale monitoring for the state of pelagic communities in the Russian Far East seas (Shuntov 1998).

Yuri Artukhin: *Ecotourism in action*, The Commander islands.

According to the program of monitoring of coastal ecosystems of Eastern Kamchatka in 1981-1990 mortality of seabirds has been studied on the basis of survey beaches for dead seabirds in the shore zone of the State Biosphere Kronotsky Reserve (Lobkov 1986, 1991). In 1993-2001 an observation program on the incidental mortality of seabirds in the drift net salmon fishery by Japanese vessels in the Far-Eastern Russian Exclusive Economic Zone was carried out (Artukhin *et al.* 1999, 2000, 2001, Artukhin & Burkanov 2000). Since 2003 similar program on the mortality of seabirds in the long-line fishery in Russian zone of the Bering Sea and adjacent waters has been launched.

Special studies on the influence of subsistence hunting on the waterfowl with special focus on eider harvest have been carried in the Lower Indigirka River and in Northern Chukotka (Syroechkovski *et al.* 2003a,b, Syroechkovski & Klokov 2003). Traditional egg gathering of Glaucous-winged Gull eggs for subsistence use of local Native population (Aleuts) resumed on Toporkov Island, where the largest colony of this species is located. Additionally, up to several hundreds of Tufted Puffins were harvested on this island each year. This harvest is conducted under the supervision of specialists from the Commander State Reserve, since the seabird colony is located within the reserve boundaries.

Banding of seabirds is carried out nowadays in only small numbers as opportunities arise, mostly as sidelines to other projects. Only one purposeful project of mass banding of seabirds has been accomplished in the region; – more than 10 thousands of Black-headed Gulls breeding in the Avacha River delta, South-East Kamchatka were banded in 1970´s – 1980´s (Gerasimov *et al.* 1985, Gerasimov 1990), resulting in knowledge of the places of wintering of this species.

On the whole, current monitoring studies of seabirds in the eastern part of Russia is limited both the number of studied species, and in the number of observation sites. The volume of obtained information is obviously insufficient for making objective estimation of the state of seabird populations within this region.

References

Andreev, A.V. 1985. Breeding success of Ross's gull *Rhodostethia rosea* (McGill) in Nizhnekolymckaya tundra and its' determining factors. Rare and endangered birds of the Far East. Vladivostok, DVNTS AN SSSR, p. 110-131.

Artukhin, Yu.B. 1999. Cadastre of seabird colonies of the Commander Islands. The biology and conservation of the birds of Kamchatka. Moscow, Dialog-MGU, 1: 25-35, 139-144.

Artukhin, Yu.B. 2003. On the status of waterfowl wintering areas on the Bering Island. Casarca, no. 9: 377-392.

Artukhin, Yu.B., V.N. Burkanov & P.S. Vyatkin 1999. Incidental mortality of seabirds in the driftnet salmon fishery by Japanese vessels within the Russian Exclusive Economic Zone, 1993-1998. The biology and conservation of the birds of Kamchatka. Moscow, Dialog-MGU, 1: 93-108.

Artukhin, Yu.B., V.N. Burkanov, A.N. Zaochny & V.S. Nikulin 2000. Mortality of seabirds in the Japanese driftnet salmon fishery in Russian waters of the Bering Sea, 1993-1999. The biology and conservation of the birds of Kamchatka. Moscow 2: 110-126.

Artukhin, Yu.B., A.N. Zaochny, S.I. Kornev, V.S. Nikulin & A.I. Testin 2001. Mortality of seabirds in the Japanese driftnet salmon fishery in Russian waters of the Bering Sea, 2000-2001. The biology and conservation of the birds of Kamchatka. Moscow, BCC Press, 3: 81-85.

Artyukhin, Yu.B. & V.N. Burkanov 2000. Incidental mortality of seabirds in the drift net salmon fishery by Japanese vessels in the Russian Exclusive Economic Zone, 1993-1997. Seabirds of the Russian Far East. Ottawa, Can. Wildl. Serv., Spec. Publ., p. 105-115.

Belobrov, R.V. & Yu.B. Artukhin 2005. Alerting information about wintering waterfowl on the

Commander Islands. Waterfowl of Northern Eurasia: Abstracts presented to the Third International Symposium (October 6-10, 2005, Saint-Petersburg, Russia). Saint-Petersburg, p. 35-36.

Gerasimov, N.N. 1990. Banding common Black-headed Gulls at the Avacha River delta. Problems of Kamchatka geography. Petropavlovsk-Kamchatsky, Dalnevostochnoe Knizhnoe Izdatelstvo, no. 10, p. 191-192.

Gerasimov, N.N. & Yu.N. Gerasimov 1999. The spring migration of gulls, terns and jaegers in the mouth of the Moroshechnaya River (north-western Kamchatka) in 1990. The biology and conservation of the birds of Kamchatka. Moscow, Dialog-MGU, v. 1, p. 53-56.

Gerasimov, N.N., H. Sugava & S. Otsuki 1985. Joint research on the biology of the black-headed gull by ornithologists of Japan and the USSR. Acta XVIII Congressus Internationalis Ornithologici. Moscow, Nauka, p. 1181.

Gerasimov, Yu.N. 1992. Migration of cormorants and alcids along the western shore of Kamchatka. Study of colonial seabirds in the USSR. Magadan, IBPS DVO RAN, p. 25-27.

Gerasimov, Yu.N. & N.N. Gerasimov 1996. Waterfowl spring migration study in Kamchatka, Russia. Salim Ali birth celebration: 9-16 November 1996: Pan-Asian Ornithological Congress and XII BirdLife Asia Conference Coimbatore, India. Abstracts, p. 3.

Gerasimov, Yu.N. & N.N. Gerasimov 2001. Research on the migrations of Kamchatka birds. Actual problems of research and protection of the birds of East Europe and North Asia. Kazan, Izd. “Matbugat jorty”, p. 170.

Gerasimov, Yu.N. & N.N. Gerasimov 2003. Estimation of Anatidae number on Kamchatka based on spring counts. Modern problrms of ornithology in Siberia and Central Asia. Ulan-Ude, Buryat State University Press, 2: 36-37.

Gerasimov, Yu.N. & E.E. Kalyagina 2000. The spring migration of gulls in the south-west of Kamchatka // The biology and conservation of the birds of Kamchatka. Moscow, 2: 69-73.

Gerasimov, Yu. N., Matsina, A. I., Ryzhkov, D. I., 1998. Spring migration of jaegers, gulls and terns near the Vakhil River mouth, East Kamchatka. Russian Journal of Orhithology. Express-Issue, no. 37, p. 11-14.

Golubova, E.Yu. 2001. Productivity monitoring of alcids on Talan Island (Northern Sea of Okhotsk). Biological fundamentals of stable evolution of coastal marine ecosystems. Apatity, p. 59-61.

Golubova, E.Yu. & S.V. Pleshchenko 1997. Seabird colonies of the North Okhotsk Sea region. Species diversity and population status of waterside birds in North-East Asia. Magadan, SVNST DVO RAN, p. 141-162.

Kondratyev, A.Ya. 1993. The Talan Island field station in the northern Sea of Okhotsk. Beringian Seabird Bull. 1: 18-19.

Kondratyev, A.Ya. & L.F. Kondratyeva 1987. Comparative characteristics of the nesting ecology of Ross’s and Sabine’s Gulls. Ornithology, 22: 35-50.

Kondratyev, A.Ya., N.M. Litvinenko, Yu.V. Shibaev & P.S. Vyatkin 2000. The breeding seabirds of the Russian Far East. Seabirds of the Russian Far East: Ottawa, Can. Wildl. Serv., Spec. Publ., p. 37-81.

Konyukhov, N.B. 1993. Comparative biology of some species of closed-nesting alcids. Dissertation: Moscow, Institute of Ecology and Evolution, Russian Academy of Sciences.

Konyukhov, N.B., L.S. Bogoslovskaya, B.M. Zvonov & T. van Pelt 1998. Seabirds of the Chukotka Peninsula, Russia. Arctic, 51 (4) 315-329.

Lappo, E.G., E.E. Syroechkovski jr. & A.V. Kondratyev 2003. On the aerial waterfowl surveys using “AN-3” plane in Chukotka in summer 2002. Management and conservation of waterfowl populations in Northern Eurasia (with special focus on the White Sea Baltic flyway): Abstracts, presented to the International symposium (April, 23-28, 2003, Olonets, Karelia, Russia). Petrozavodsk, p. 98-99.

Lobkov, E.G. 1982. Waterfowl wintering sites in the central parts of Eastern Kamchatka. Problems of Kamchatka geography. Petropavlovsk-Kamchatsky, Dalnevostochnoe Knizhnoe Izdatelstvo, no. 8, p. 40-46.

Lobkov, E.G. 1986. Cases of mass seabird mortality in summer along Kamchatka shores // Seabirds of the Far East. Vladivostok, DVNTS AN SSSR, p. 88-95.

Lobkov, E.G. 1991. Phenomenon of the periodic splashes of seabird mortality near Kamchatka seashores. Proceedings of the 10th All-Union Ornithological conference. Minsk, Navuka i tekhnika, p. 99-101.

Pearce, J.M., D. Esler & A.G. Degtyarev 1998. Nesting ecology of Spectacled Eiders *Somateria fischeri* on the Indigirka River Delta, Russia. Wildfowl, 49: 110-123.

Poyarkov, N.D., J.I. Hodges & W.D. Eldridge 2000. Atlas of bird distribution in the coastal tundras of North-Eastern Asia (materials of 1993-1995 aerial surveys). Moscow, BCC Press, p. 1-88.

Pridatko, V.I. 1986. Colonial seabirds of Wrangel and Herald Islands. Ecology and protection. Dissertation: Kiev, Kievski Gosudarstvennyi Universitet.

Shuntov, V.P. 1998. Seabirds of the Far East seas of Russia. Vladivostok, TINRO, p. 1-423.

Solovieva, D.V. 1997. Timing, habitate use and breeding biology of Steller’s Eider in the Lena-Delta, Russia. IWRB Seaduck Bull. no. 7, p. 35-39.

Stishov, M.S., V.I. Pridatko & V.V. Baranyuk 1991. Birds of Wrangel Island. Novosibirsk, Nauka, Sibirskoe Otdelenie, p. 1-254.

Syroechkovski, E.E. jr. & K.B. Klokov 2003. The effect of hunting by indigenous peoples of the

North on waterfowl: methodological approaches // Management and conservation of waterfowl populations in Northern Eurasia (with special focus on the White Sea Baltic flyway). Abstracts, presented to the International symposium (April, 23-28, 2003, Olonets, Karelia, Russia). Petrozavodsk, p. 236-237.

Syroechkovski, E. jr., V. Buzun, E. Lappo & K. Klokov 2003a. Steller's Eider in Chukotka: results of distribution and subsistence hunting surveys in 2002. Unpubl. rep. Goose, Swan and Duck Study Group of Northern Eurasia. Moscow, p. 1-24.

Syroechkovski, E. jr., K. Klokov & E. Lappo 2003b. Waterfowl subsistence hunting in Lower Indigirka with special focus on Eider harvest. Results of the year 1999. Unpubl. rep. Goose, Swan and Duck Study Group of Northern Eurasia. Moscow, p. 1-19.

U.S. Fish and Wildlife Service 1999. Beringian seabird colony catalog: Computer database and colony status record files. Anchorage, Alaska.

Vyatkin, P.S. 1986. Nesting cadastres of colonial birds in the Kamchatka Region. Seabirds of the Far East. Vladivostok, DVNTS AN SSSR, p. 36-52.

Vyatkin, P.S. 2000. Nest cadastre of colonial seabirds of the coasts of Koryak Highland and Eastern Kamchatka. The biology and conservation of the birds of Kamchatka. Moscow, 2: 7-15.

Zelenskaya, L.A. 1994. The influence of disturbance on the incubation success of glaucous-winged gulls. Beringian Seabird Bull. 2: 64-65.

Zelenskaya, L.A. 1999. The state of the seabird colony on Toporkov Island (Commander Islands) in 1998. Beringian Seabird Bull. 4: 38-41.

Zelenskaya, L.A. 2001. Distribution and number of seabirds on the Commander Islands in 1999-2000. The biology and conservation of the birds of Kamchatka. Moscow, BCC Press, v. 3, p. 64-71.

Zelenskaya, L.A. 2003. The breeding success of Red-legged Kittiwakes *Rissa brevirostris* on the Commander Islands. The biology and conservation of the birds of Kamchatka. Moscow, BCC Press, v. 5, p. 67-72.

Sweden

Henrik Österblom

Seabird monitoring in Sweden is provided by i) a few university initiatives, ii) the Swedish Bird Ringing Centre at the Museum of Natural History, iii) ornithological volunteer organisations iv) local monitoring initiatives and v) local environmental agencies. However, the Swedish Species Information Centre (http://www.artdata.slu.se/) is currently (2004) collecting estimated population status for all relevant species. The national environmental authority with responsibility for seabirds, the Swedish EPA, is not running any monitoring programme for marine birds at all. Hence a reliable overview of relevant information is lacking for this report and therefore no institutional logo can be presented.

The seabirds breeding in Sweden are Great Cormorant *Phalacrocorax carbo,* Common Eider *Somateria mollissima,* Parasitic Jaeger *Stercorarius parasiticus,* Long-tailed Jaeger *Stercorarius longicaudus,* Great Black-backed Gull *Larus marinus,* Herring Gull *Larus argentatus,* Lesser Black-backed Gull *Larus fuscus,* Common Gull *Larus canus,* Black-headed Gull *Larus ridibundus,* Little Gull *Larus minutus,* Black-legged Kittiwake *Rissa tridactyla,* Arctic Tern *Sterna paradisaea,* Caspian Tern *Sterna caspia,* Common Tern *Sterna hirundo,* Little Tern *Sterna albifrons,* Black Tern *Chlidonias niger*, Razorbill *Alca torda,* Common Murre *Uria aalge,* and Black Guillemot *Cepphus grylle.*

The only research conducted with continuity on marine birds in Sweden are two projects funded by the WWF, “Marine birds in the Baltic” and “the Caspian Tern” respectively. The species studied include Common Murre *Uria aalge,* Long-tailed Duck *Clangula hyemalis,* Razorbill *Alca torda,* Caspian Tern *Sterna caspia,* and since 2003, also Lesser Black-backed Gull *Larus fuscus.* The studies are focused on breeding phenology, chick diet, adult survival and potential threats from oiling, bycatch, and mink predation on terns.

Lena: ***Examining a gull chick.***

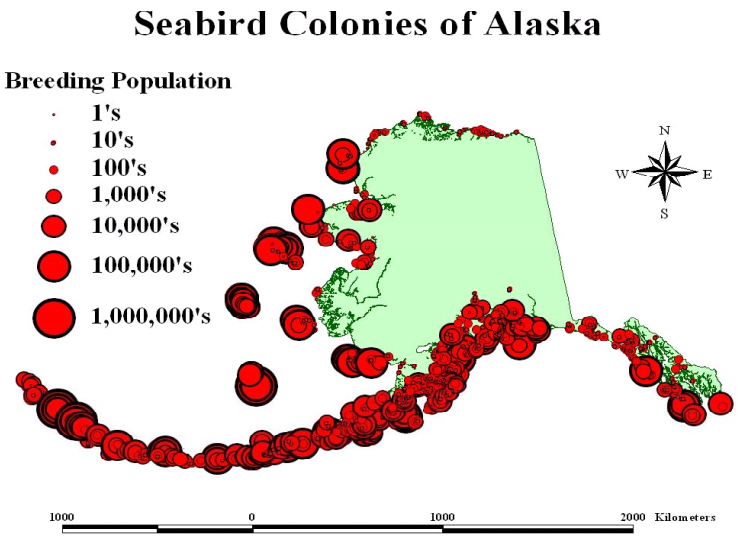
United States (Alaska)

David Irons

Introduction

Alaska supports North America's greatest concentration of seabirds. Approximately 50 million seabirds of 38 species breed in Alaska at more than 1600 colonies around the coast (see map). Eighty percent of Alaska's seabirds nest on lands managed by Alaska Maritime National Wildlife Refuge. The remaining colonies are on lands of other wildlife refuges, national parks and monuments, national forests, the state of Alaska, and private owners. Most seabird species spend the majority of their time at sea, foraging or resting in waters under the jurisdiction of the State of Alaska and the United States (USFWS 1992).

Alaska has a monitoring program designed to detect trends in seabird populations, or to detect conditions that are expected to result in population trends (Dragoo *et al.* 2008). Monitoring data allows identification of problems in the ecosystem or a particular species before these problems become severe, while management actions may still be effective. Monitoring takes place on selected species at selected sites (see map), which were chosen to represent all seabirds in the larger ecosystem. Monitoring data are collected in a standardized manner that permits statistical comparison among years and sites.



Alaskan seabird colonies, distribution and size

Lisa Sheffield: *Common and Thick-billed Murres at St. Lawrence Island in the Bering Sea,* Alaska 2003.

Seabird species and the regions and sites where they are monitored in Alaska, an asterisk indicates which species are monitored at each site.

Region	Site	Northern Fulmar	Storm Petrels	Red-faced Cormorant	Pelagic Cormorant	Unidentified Cormorant	Glaucous-winged Gull	Black-legged Kittiwake	Red-legged Kittiwake	Common Murre	Thick-billed Murre	Unidentified Murre	Pigeon Guillemot	Least Auklet	Crested Auklet	Rhinoceros Auklet	Tufted Puffin
N. Bering/ Chukchi	St. Lawrence I.									*	*						
N. Bering/ Chukchi	C. Lisburne							*				*					
N. Bering/ Chukchi	C. Thompson							*				*					
N. Bering/ Chukchi	Bluff							*		*							
N. Bering/ Chukchi	Hall I.									*	*						
SE Bering	St. Paul I.	*						*	*	*	*						
SE Bering	St. George I.	*						*	*	*	*						
SE Bering	C. Newenham							*		*							
SE Bering	C. Peirce				*			*		*							
SE Bering	Round I.							*		*							
SE Bering	Bogoslof I.																*
SE Bering	Aiktak I.		*			*	*					*	*				*
SW Bering	Agattu I							*				*					
SW Bering	Nizki/Abaid Is.					*											*
SW Bering	Shemya I.					*											
SW Bering	Buldir I.		*		*		*	*	*		*		*				*
SW Bering	Adak I.																*
SW Bering	Ulak I.		*			*						*					*
SW Bering	Kasatochi I.					*	*						*	*	*		
SW Bering	Koniuji I							*	*			*					
Gulf of Alaska	Semidi Is.			*	*												
Gulf of Alaska	Chowiet I.	*						*				*					
Gulf of Alaska	Puale Bay						*	*				*					
Gulf of Alaska	Chiniak Bay			*	*			*									
Gulf of Alaska	Nord I.									*							
Gulf of Alaska	E. Amatuli I.		*				*	*		*							*
Gulf of Alaska	Gull I.				*			*		*							
Gulf of Alaska	Chisik/Duck Is.							*		*							
Gulf of Alaska	Chiswell Is.									*							
Gulf of Alaska	P. William Snd							*					*				
Gulf of Alaska	Middleton I.				*		*	*				*					
Southeast	St. Lazaria I.		*		*		*					*	*			*	*

Lisa Sheffield: Adult *Black-legged Kittiwake with chick at St. Lawrence Island in the Bering Sea*, Alaska 2003.

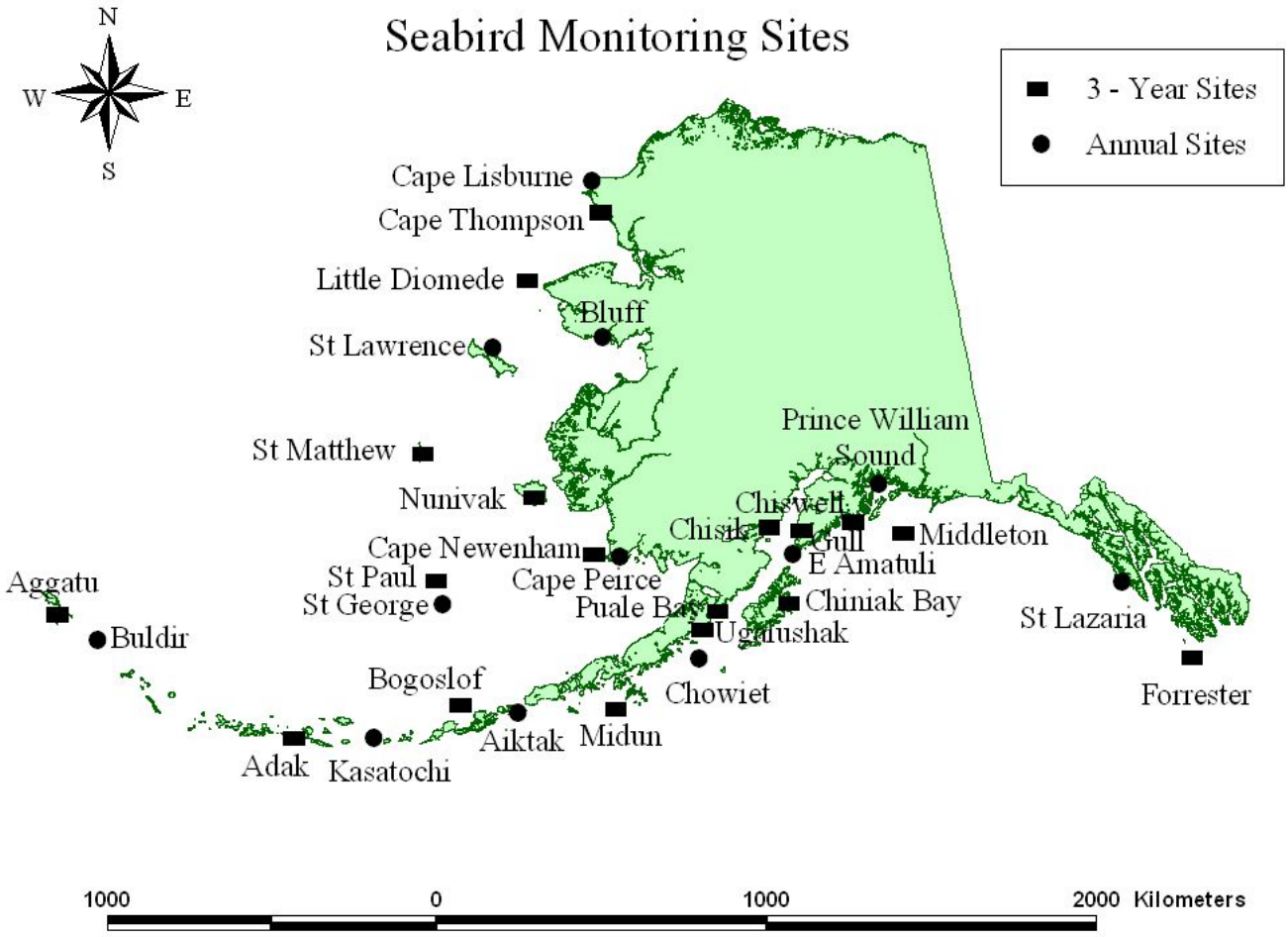
Monitoring plan

1. Seabird colony monitoring

Selection of colonies for monitoring: Colonies and species were selected to represent Alaska's seabird species and marine ecosystems with efficient use resources (see map and table).

Colonies were selected to represent all major Alaskan marine regions. Population trends in colonies are influenced by nearby oceanographic features such as currents and upwellings. Trends in colonies that are near each other and have similar oceanography tend to be correlated, whereas colonies affected by different currents or upwellings usually exhibit unrelated trends (Dragoo *et al.* 2008). In general, colonies have been selected for monitoring at intervals of 400 to 600 km. This spacing is expected to represent overall ecosystem trends well and results in a reasonable monitoring effort. However, a few sites have been added because of strong public interest in the conservation of marine resources and a high potential for human perturbation (see e.g. Piatt *et al.* 1990, Lance *et al.* 2001).

A monitoring site in most cases is a single colony (a contiguous group of breeding birds). Some islands or cliff areas that support several distinct breeding groups (e.g., St. George Island and Cape Thompson) comprise one site. In the Gulf of Alaska, a number of small colonies grouped within a large bay have been found to interchange breeding individuals, and trends in localized groups therefore may not reflect larger ecosystem trends (Ainley *et al.* 2003). For this reason Chiniak Bay (Kodiak Island) and Prince William Sound are monitoring sites.



Seabird colony monitoring sites in Alaska.

Annual monitoring is done for approximately half the sites (see map). Monitoring at the remaining sites is done every 3 to 5 years (or more often, if feasible). These sites provide "calibration" of the annual sites to ensure that their changes are representative of the ecosystem.

Most monitoring sites contain several index species (see "Selection of species", below), and they have relatively large populations (approximately 5% or more of the regional seabird population) (USFWS 2005), the better to reflect overall trends. A few smaller colonies are proposed for annual monitoring because they are accessible, but such sites will be "calibrated" by nearby larger "three-year" sites.

Selection of species for monitoring: Several species were selected for monitoring from those that breed in Alaska (see table). These species provide an index to trends in other species. Index species tend to be relatively easy to observe (nests are visible, or if underground, are easily accessible). Index species generally are abundant, so that statistically valid samples can be obtained, and they are widespread, so that trends can be compared among areas. Their breeding biology is usually well understood.

Index species were selected to represent major feeding guilds: surface-feeders and divers, and those that rely on fish and on invertebrates (plankton) during the breeding season. In addition, a range of nesting habitat is represented.

The species that can be monitored in a region differ among areas of Alaska, but at least one group in each feeding guild usually is present. For instance, auklets are numerous from the Bering Straits to the Aleutians, storm-petrels in the Aleutians and Gulf of Alaska (Stephensen & Irons 2003, USFWS 2005). Pigeon Guillemots are the principal diving seabird in sheltered waters of the Gulf of Alaska (Agler *et al*. 1995, Sullivan *et al* 2005). Colonies are scattered but easy to monitor (although timing is different than for other seabird species); a monitoring program (as opposed to overall surveys and intensive studies) needs to be proposed for them.

Lisa Sheffield: *Tufted Puffin at St. Lawrence Island in the Bering Sea*, Alaska 2003.

Selection of parameters to monitor at colonies: A major objective of the monitoring program is to provide information on trends in seabird populations.

Populations of all index species are monitored. In most cases this is done on sample plots rather than by counting whole colonies, which facilitates replication of counts and exact inter-year comparisons. Populations may not be monitored in crevice-nesting species, for which methods are still being developed (USFWS 2000c).

Reproductive success of seabirds reflects ecosystem changes much more rapidly than do populations (Cairns 1987, Suryan *et al*. 2001) and productivity also helps to predict eventual population trends. Productivity is monitored for all species in all colonies. Usually observations are made from nest establishment through fledging, which gives the best information on timing of failure. However, only the numbers of young fledged per nest may be determined at some sites.

Population trends in seabirds often are linked to food availability (Suryan & Irons 2001). Data such as species of prey and amounts or frequency of feeding can be collected without large additional effort and will help in interpretation of trends. Environmental data that can help with interpretation are available from other agencies.

Adult survival is perhaps the most important parameter that determines population trends and is therefore very important to have suvh information. However it is a difficult parameter to obtain data for and there are few species and locations that we have survival data for in Alaska (Hatch *et al.* 1983, Hatch 1987).

2. At-sea monitoring

Little monitoring has been done at sea. Ships solely for monitoring seabirds are costly and difficult to find funding. However after the Exxon Valdez Oil Spill at-sea monitoring was conducted in Prince William Sound for 18 years (Sullivan *et al.* 2005). The purpose of this monitoring was to determine effects and recovery of marine birds from the oil spill (Irons *et al.* 2000, Lance *et al.* 2001). Since 1989 some monitoring has occurred in other coastal area such as Glacier Bay National Park, Kenai Fiords National Park, Cook Inlet and various other localities throughout Alaska. Presently we do not have an at-sea monitoring plan or program, but both are in progress and we hope to have a plan done by 2010.

INVENTORY PLAN

1. Breeding colonies

Numbers of seabirds in each species are censused (counted or estimated) at all breeding colonies in the state. For species that nest in the open and can be observed easily, such as murres, kittiwakes, and gulls, exact numbers are recorded if feasible (USFWS 2000a). For species that nest underground, such as

puffins, auklets, and storm-petrels, numbers of burrows are counted or estimated in some cases (USFWS 2000b). However, many of estimates of fossorial species are qualitative. Usually colony inventories consist of a one-time count or estimate at each colony. Even though the quality of colony inventories differ among species and studies, standard reporting methods are necessary to ensure that quality of the data can be assessed. The exact location of each colony is required. Photographic documentation, in addition to visual counts, allows detection of changes in habitat use and help confirms apparent changes in numbers (USFWS 2005).

A seabird colony inventory is valid for several years. However, inventories should be repeated at intervals of no more than 10 years to ensure that estimates do not become obsolete due to major changes or shifts in populations. Colonies where censuses are of poor quality, in comparison with those at similar colonies, should be re-censused as soon as feasible.

Inventories are conducted as the opportunity arises during other field work in an area. Inventories in remote areas that are not visited for other purposes will require dedicated expeditions, however.

2. Inventory of seabirds at sea

Bird distributions and abundance at sea (i.e., beyond bays and headlands) are surveyed at all seasons by standardized "watches" from vessels (Gould & Forsell 1989). Surveys at sea require the use of an ocean-going vessel and considerable time to cover large areas. To keep costs at a reasonable level, these studies are usually done opportunistically during cruises for other purposes. Most pelagic areas have low densities of seabirds, but surveys indicate feeding concentrations and other important habitat areas. Such surveys should be incorporated into the activities of all cruises by seabird biologists.

Lisa Sheffield: *Common and Thick-billed Murres at St. Lawrence Island in the Bering Sea*, Alaska 2003.

Opportunistic surveys produce good estimates of relative abundance, but some scientists do not think they yield reliable estimates of population numbers. Cruises that are dedicated to statistically designed seabird surveys permit reliable estimates of populations, where these are needed. Marine bird distributions in bays are surveyed using different methods than those on the high seas.

3. Status of information: Databases

North Pacific Seabird Colony Database: All historic and current information on colony size and location is stored in the North Pacific Seabird Colony Database, which is maintained by the US Fish and Wildlife Service in Anchorage, Alaska. New census data are submitted regularly to the Colony Database Manager. Maps and reports on seabird colonies are available to managers and researchers via the internet (USFWS 2008).

North Pacific Seabird Monitoring Database: Summary results from seabird monitoring are stored in the North Pacific Seabird Monitoring Database, which is maintained by the US Geologically Survey and the USFWS and will be also online. Raw data from monitoring are not stored in a central database, but they are archived by each office so that they will be available for future statistical comparisons.

North Pacific Pelagic Seabird Database: At-sea transect data are stored and analyzed in the North Pacific Pelagic Seabird Database, which is maintained by the US Geological Survey and USFWS and will be on the internet soon.

References

Agler, B.A., S.J. Kendall, P.E. Seiser & D.B. Irons 1995. Estimates of marine bird and sea otter abundance in Lower Cook Inlet, Alaska, during summer 1993 and winter 1994. Unpubl. Final Rep., OCS Study MMS 94-0063. U.S. Fish and Wildl. Serv., Migr. Bird Manage., Anchorage, Alaska. 124 pp.

Ainley, D.G., R.G. Ford, E.D. Brown, R.M. Suryan & D.B. Irons 2003. Prey availability, interference competition, and the geographic structure of seabird colonies: a study of Black-legged Kittiwakes and forage fish in Prince William Sound, Alaska. Ecology 84: 709-723.

Cairns, D.K. 1987. Seabirds as indicators of marine food supplies. Biological Oceanography 5: 261–271.

Dragoo, D.E., G.V. Byrd & D.B. Irons 2008. Breeding status, population trends and diets of seabirds in Alaska, 2005. U. S Fish and Wildl. Ser. Report AMNWR 08/03.

Gould, P.J. & D.J. Forsell 1989. Techniques for shipboard surveys of marine birds. U.S. Fish Wildl. Serv., Fish Wildl. Tech. Rep. 25. 22 pp.

Hatch, A. S. 1987. Adult survival and productivity of

Northern Fulmars in Alaska. Condor 89: 685-696.
Hatch, S.A., G.V. Byrd, D.B. Irons & G.L. Hunt jr 1993. Status and ecology of Kittiwakes in the North Pacific. K. Vermeer, K. Briggs, S. Fefer & D. Siegel-Causey (eds). Status, ecology, and conservation of marine birds of the temperate North Pacific. Canadian Wildl. Serv., Spec. Publ.
Irons, D.B., S.J. Kendall, W.P. Erickson, L.L. McDonald & B.K. Lance 2000. Nine years after the Exxon Valdez oil spill: effects on marine birds in Prince William Sound, Alaska. Condor 102: 723-737.
Lance B.K., D.B. Irons, S.J. Kendall & L.L. McDonald 2001. An evaluation on marine bird population trends following the Exxon Valdez oil spill, Prince William Sound, Alaska. Marine Pollution Bulletin 42: 298-309.
Piatt, J.F., C.J. Lensink, W. Butler, M. Kendziorek & D.N. Nysewander 1990. Immediate impact of the "Exxon Valdez"_oil spill on marine birds. Auk 107: 387-397.
Stephensen, S. W. & D.B. Irons 2003. Comparison of colonial breeding seabirds in the Bering Sea and the Gulf of Alaska. Marine Ornithology 31: 167-173.
Sullivan K.M., A.E. McKnight, D.B. Irons, S.W. Stephensen & S. Howlin 1995. Marine bird and sea otter population abundance of Prince William Sound, Alaska: trends following the T/V Exxon Valdez oil spill from 1989-2004. Unpubl. Annual Rep., Exxon Valdez Oil Spill Restoration Project 04159. U.S. Fish and Wildl. Serv., Migr. Bird Manage., Anchorage, Alaska. 148 pp.
Suryan, R.M. & D.B. Irons 2001. Colony and population dynamics of Black-legged Kittiwakes in a heterogeneous environment. Auk 118: 636-649.
Suryan, R.M., D.B. Irons, M. Kaufman, J. Benson, P.G.R. Jodice, D.D. Roby & E.D. Brown 2001. Short-term fluctuations in forage fish availability and the effect on prey selection and brood-rearing in the Black-legged Kittiwake *Rissa tridactyla*. Marine Ecology Progress Series 236: 273-287.
USFWS 1992. Alaska seabird management plan. Unpubl. Rept. U.S. Fish and Wildlife Service, Anchorage, Alaska. 102 pp.
USFWS 2000a. Standard operating procedures for population inventories: Ledge-nesting seabirds. U.S. Fish and Wildl. Ser. Rep Homer, Alas.
USFWS 2000b. Standard operating procedures for population inventories: Burrow-nesting seabirds. U.S. Fish and Wildl. Ser. Rep Homer, Alas.
USFWS 2000c. Standard operating procedures for population inventories: Crevice-nesting seabirds. U.S. Fish and Wildl. Ser. Rep Homer, Alas.
USFWS 2008. North Pacific Seabird Colony Database. U.S. Fish and Wildlife Service. Anchorage, Alaska, USA.

The Overall Circumpolar Monitoring Effort

Information was compiled of the monitoring effort taking place in the circumpolar countries. Monitoring primarily falls into five categories; numbers, survival, productivity, diet, and phenology. During analysis, if numbers of colonies in a country were estimated with a range, then the middle figure is taken for analytical purposes. These programs differ in frequency, most have monitoring frequency of 1-5 years, some 5-10 but others 11-20 years. Each species is counted as one initiative although two or more species may be linked in one program, or different parameters may be combined in same program.

In recent years around 1500 initiatives involving monitoring of numbers at colonies have been run in the Arctic countries. Around 260 projects include measures of productivity, about 170 of phenology, around 140 of diet, while trailing are about 50 monitoring projects for survival. These programs are distributed very unevenly both with regards to species and countries. Certain factors of variability are inherent in the compiled data, such as what is termed a monitoring project, the intensity of monitoring, length of the data series, distribution between countries, etc.

Disregarding 520 solitary pairs of Parasitic Jaeger in Finland the most intensively monitored species is the Black-legged Kittiwake (197 colonies). Next are Mew Gull (141), Arctic Tern (132), Common Eider (114), and Great Cormorant (103). The circumpolar distribution of the Kittiwake and Common Eider monitoring is striking, while the monitoring effort of the others is heavily skewed towards individual countries, such as Mew Gull (Iceland), Arctic Tern (Faroes), and Great Cormorant (Nordic countries and western Russia). Of species scoring under 100 monitored colonies but next in line are Great Black-backed and Herring Gulls, which rely much on extensive monitoring efforts in Finland and western Russia.

If we look at the other end of the spectrum, there are no monitoring programs for eight Arctic seabird species; Manx Shearwater, Storm Petrel, Brandt´s Cormorant, Thayer´s Gull, Western Siberian Gull, Boneparte´s Gull, Little Tern, and Cassin´s Auklet. It could be argued that the Arctic countries should not have the primary responsibility for five of these species. Arctic responsibility is however clearly with three, i.e. Thayer´s Gull, West Siberian Gull, and Cassin´s Auklet, and emphasis should be placed to remedy this situation in the countries in question (Canada, Russia, USA). As regard the last-mentioned

Carsten Egevang/ARC-PIC.COM : *Trapping Sabine's Gull at Sand Island,* Northeast Greenland 2007.

species this is a priority monitoring species in British Columbia, which harbors most of the world population but in the Arctic range, this species is less well monitored. Although these species do not have any monitoring programs, there is little difference between several more species, which only have one program going (9 species), two (7), or three (6) programs, all for detecting numerical changes.

The frequency of monitoring differs greatly between programs and countries. Countries with the greatest intensity of monitoring (Finland, Norway, western Russia, and USA) aim at monitoring every year to every fifth. While some effort in Iceland and Canada, for instance, is based on monitoring every year, others only have a frequency of 5-10 or 11-20 years. The optimal monitoring frequency necessarily remains a debating issue among seabird biologists.

Various other, or more detailed, analyses can be performed on the data compiled among the Arctic countries. The details are found in Appendix 2.

Besides the frequency of monitoring an important question always remains, if the monitoring can be considered representative for the country in question, and subsequently at the circumpolar level. This is a difficult aspect to tackle but for many current monitoring projects it is very clear that adequate representativeness is lacking. In most cases only selected colonies can be monitored in light of the size and distribution of the given species. This does not of course apply to those cases in which the total population is monitored. Usually these involve rare species or those breeding in highly clumped aggregations, while the common or highly dispersed ones can only be monitored at selected colonies. As regards the current monitoring activities in many cases this has been started through interest of individual researchers or bird observers. These activities may not necessarily include the species which were selected on a wider basis. Yet since many of the projects have been ongoing for years the importance of long-term data series needs to be recognized.

Carsten Egevang/ARC-PIC.COM: *Counting murres*, Greenland.

Components of a Circumpolar Seabird Monitoring Network

Ideally all seabird species should be monitored. Most of the components of a *Circumpolar Seabird Monitoring Network* (CSMN) allow for monitoring of all species, which happen to be present at the given place and time.

It is important to have different approaches to monitoring seabirds. That way they can be covered at different stages of their life cycle, at various times of year, and at individual areas of importance for their continued survival. The following main components of the network have been identified (and there is a certain amount of overlap):

- Colony monitoring, with three sub-components (a) colony registry, (b) total colony counts, and (c) partial colony counts (plots, transects)
- At-sea surveys
- Harvest statistics
- National lists of breeders and non-breeders
- National Endangered Species Lists
- Banding

Colony monitoring

Of the six components of a CSMN one is particularly complicated, i.e. colony monitoring, and needs to be discussed in some detail. One aspect is selecting which seabird species are most important for monitoring at the colony and at the circumpolar level. Another is which parameters should be most importantly monitored at respective study colonies. These will be dealt with below, but to measure the progress in the Arctic countries the CBird Group recommends the following actions:

- Decide on a circumpolar seabird colony monitoring plan
- Develop a standardized circumpolar seabird colony registry format
- Compile and analyze Arctic seabird colony data, including trend data, every 10 years

The CBird Group has been working on a circumpolar seabird monitoring plan for a number of years. With the present report the preparatory framework is mostly finished and the main question remains, if the countries are willing and prepared to implement such a plan. One part of a monitoring plan is knowledge of the whereabouts of Arctic seabird colonies. Hence each country needs to establish a colony registry. Some of the Nordic countries have agreed on a standardized circumpolar seabird colony registry format (Bakken *et al.* 2006). More broadly, the Arctic countries are

Morten Ekker: *Glaucous Gull and Kittiwake*, Norway 2006.

considering if this format can be extended to the circumpolar Arctic. For instance Canada is actively engaged in adopting this registry. Compilation of monitoring data at regular intervals gives a measure of the effectiveness of a circumpolar monitoring program, creates data of use by many stakeholders, helps to identify main problems and monitoring gaps, and should be helpful in releasing funds for continued monitoring work.

Selecting species for colony monitoring
Colony monitoring is of such time-consuming and extensive nature that not all species can be practically monitored over the whole circumpolar region. Besides, only but few of the Arctic seabirds are distributed throughout the whole region. We therefore need to find a way to narrow the list of species to be monitored at the circumpolar level, in as an objective way possible.

A number of aspects need to be taken into consideration when selecting the most relevant species for colony monitoring at the circumpolar level. These parameters would mostly be the same at the national level. In reality monitoring projects have rarely been started from an overall strategy but rather from the interest of individual researchers and birders. Existing national programs will have to be looked at as the core of a circumpolar program, as for the *Circumpolar Biodiversity Monitoring Program* (CBMP) as a whole. It is not practical or scientifically advisable to stop monitoring programs, which may have a long history, on account of new programs, which may be selected in a more objective way. However it is equally clear that national programs vary greatly in scope and intensity from one country to another. Obvious gaps in national programs need to be identified and addressed, while the circumpolar relevance also has to be kept in mind. Species may be considered of large national value, while much less importance is attached to it at the circumpolar level.

The following aspects were considered during the development of the *Circumpolar Seabird Monitoring Network*, in order to find out the most relevant seabird species for monitoring:

- Current national and international programs
- Arctic responsibility, i.e. % of the world population breeding in the Arctic
- National responsibility, i.e. % of population breeding in respective country
- General Arctic breeding distribution (Arctic Ocean, the Pacific, both)
- International commitments, i.e. species in international conventions, strategies, treaties, etc.
- National lists of birds of Arctic conservation concern (including endangered species lists)
- National economic importance
- Imminent threats, e.g. oil pollution, hunting, bycatch, climate change
- Relevance as environmental indicators
- Scientific or cultural importance nationally
- Different trophic levels or ecological importance

The CBird Group engaged in an exercise to score the above parameters in order to find out the species, which should be of most relevance for a truly circumpolar program. The above parameters were grouped according to the following headings, as (a) Arctic responsibility, (b) conservation importance, (c) societal importance, (d) scientific importance, (e) importance as ecological indicators, and (f) national priorities. The scores related to breeding birds and were given as 1, 3 or 5. To simplify the analysis all criteria were given equal weight, which most likely is not true, or correct, and perhaps not even desirable. Unequal weighing would have needed considerably more work and dialogue before execution, while a more complicated analysis may not necessarily have given any better results.

The primary parameter for selection of a particular species is that they have a circumpolar distribution. This does not hold all the time since very local species may be important to monitor on the basis of being found only in the Arctic. In both cases a truly Arctic responsibility is at stake. Adding other parameters gives a list of species, which are deemed of particular relevance for circumpolar monitoring.

With this list finalized each country then needs to choose the most relevant areas or colonies to be monitored that will give a reasonable representation of the given national populations. The numbers of sites monitored to give a representative view of the national situation, is a subject on its own and cannot be dealt with here in detail. For certain species, the murres for instance, the appropriate colonies have already been chosen for monitoring, during earlier work of the CBird Group. Species chosen for monitoring and respective sites chosen for monitoring by the Arctic Council working group on contaminants, AMAP, also needs to be taken into account. Moreover what monitoring components are chosen for each species depends on what is being monitored for, i.e. as indicators of habitat/ecosystem changes, climate change, hunting pressure, etc. Most monitoring programs will hopefully be structured thus that the results can be analyzed in different ways, to give answers to various environmental questions.

Based on ranking by the Arctic countries alone (see Appendix 2) the following Arctic species have been found as most worthy of circumpolar monitoring (their total score is given in brackets; Sweden could not participate in this exercise):

- Common Eider *Somateria mollissima* (273)
- Common Murre *Uria aalge* (268)

- Thick-billed Murre *Uria lomvia* (243)
- Black-legged Kittiwake *Rissa tridactyla* (238)
- Black Guillemot *Cepphus grylle* (202)
- Northern Fulmar *Fulmarus glacialis* (198)
- King Eider *Somateria spectabilis* (186)
- Arctic Tern *Sterna paradisaea* (178)
- Herring Gull *Larus argentatus* (146)
- Steller´s Eider *Polysticta stelleri* (121)

Several Arctic seabird species have been identified at various stages as relevant candidates for circumpolar monitoring, such as the murres cf. the Circumpolar Murre Monitoring Plan (CAFF 1996), eiders cf. the International Eider Conservation Strategy (CAFF 1997), and Black-legged Kittiwake, Black Guillemot, and Glaucous Gull because of their use by AMAP for contaminant programs, and Northern Fulmar. Most of these species are among those selected during the present exercise, although no such elaborate approach was used initially and not as parts of an integrated program.

Of the top three species, Common Eider came first with three countries, no. 2 with two and no. 3 with one. Common Murre was also no. 1 with three countries, no. 2 with one, and no. 3 with three. Again, Thick-billed Murre was no. 1 with three countries, no. 2 with also three but none no. 3. Two species, which received very low overall scores, were once no. 1 (West Siberian Gull) and once no. 2 (Lesser Black-backed Gull).

This is not the only way to classify the Arctic seabird species, in order to select objectively the species, which should be part of a recommended list of monitoring species. It is perfectly valid, for instance, to give greater weight to aspects such as “commonness” or rather “rareness”, Arctic responsibility, international commitment, economic or cultural importance, or validity as environmental indicators. Both common species and rare are valuable members of the Arctic ecosystem. Hence, very rare species, which may only occur in one or two countries, should be regarded and recognized as of true Arctic responsibility, not just that of the respective countries.

Environmental indicators
It is possible to look at the various aspects used for selecting the most relevant circumpolar species. One aspect is the applicability of species as environmental indicators, in the opinion of the compilers. The main findings are summarized below.

The compilers scored only those species, which occur within their own country and these are therefore the species they are most familiar with, although this still varies from species to species. The importance attached to the findings can be weighted against the numbers of responses received but the maximum answers were nine, relating to the number of countries. Five species received replies from all nine while in eight cases only one answer was forthcoming. The value of the species as environmental indicators were scored thus: 1 = Poor indicator; 3 = Average indicator; 5 = Good indicator. Compilers were requested to take into account aspects such as ease of censusing, food-web relations, ecosystem importance, and if already used as indicator.

Three species received top score (5), Black-legged Kittiwake, Thick-billed Murre, and Red-legged Kittiwake, while Common Murre received 4.6. Greater circumpolar reliance can presumably be attached to the last species, with nine answers than Red-legged Kittiwake, which only had three answers. The next species in line were Tufted Puffin, Glaucous-winged Gull, Red-faced Cormorant and Pelagic Cormorant, with a score of 4.3 but only three answers each. Next three were Atlantic Puffin, Great Cormorant and Northern Fulmar with scores 4.2 or 4.0. The overall details are found in Appendix 2. It was rather a surprise how low Common Eider scored considering the importance most of the Arctic countries attach to this species. Procellariforms generally scored low (except Northern Fulmar), presumably by and large because of methodological problems in censusing. The jaegers were also generally low, and many of the gulls, although they were distributed more between high, medium and low scores.

Arctic responsibility
One measure of Arctic responsibility for the survival of a species is the breeding distribution. Another is the numbers of birds breeding, not the least in relation to the size of the global breeding population. During the present exercise we looked at the global distribution, i.e. whether entirely Arctic or partially so, and the measures were 5 = entire; 3 = >50%; 1 = <50%. If over 50% the species was arbitrarily judged to be of “Arctic responsibility”. The Arctic distribution was also looked at in more detail, i.e. if only Pacific, only Atlantic in distribution, or both. The category “Both” was considered indicating a greater circumpolar relevance. Also a degree of “National responsibility” of the Arctic countries, given of the proportion breeding in the Arctic part of the country, was measured given as 5 = entire; 3 = >50%; 1 = <50%.

Of the 64 species 18 (28%) breed only in the Arctic countries, while 46 (72%) are partially Arctic. They also breed further towards south, sometimes a substantial part of the population.

In the case of circumpolar relevance 15 (23%) of the Arctic seabird species are Holarctic, 25 (39%) breed on the Atlantic side only, while 24 (38%) are only found in the Pacific. Presumably a greater circumpolar relevance can be placed on the Holarctic species, of which four breed only in the Arctic, i.e. Glaucous Gull, Ivory Gull, Sabine´s Gull, and Thick-billed Murre. They should be regarded as high priority species for monitoring. Although Thick-billed Murre

agreement/convention/cooperation	Canada	Faroes	Finland	Greenland	Iceland	Norway	Russia	Sweden	USA
Arctic Council (CAFF/CBird)	1	1	1	1	1	1	1	1	1
Convention of Biological Diversity (CBD)	1	1	1	1	1	1	1	1	0
Bern Convention	0	0	1	0	1	1	0	1	0
Bonn Convention on the conservation of migratory species of wild animals	0	1	1	0	0	1	0	1	1
Convention of Trade in Endangered Species (CITES)	1	0	1	1	1	1	1	1	1
Convention for the Protection of Migratory Birds	1	0	0	0	0	0	1	0	1
Helsinki Commission (HELCOM) – Baltic Marine Environment Protection Commission	0	0	1	0	0	0	1	1	0
Ramsar Convention	1	1	1	1	1	1	1	1	1
OSPAR Convention	0	1	1	1	1	1	0	1	0
EMERALD Network	0	0	1	0	1	1	1	1	0
African Eurasian Waterbird Agreement (AEWA)	0	0	1	0	0	0	0	1	0
World Concervation Union (IUCN)	1	0	1	1	1	1	1	1	1
European Union (Birds Directive)	0	0	1	0	0	0	0	1	0
Wetlands International	0	0	1	0	0	1	1	1	0
Bilateral Norwegian-Russian Environmental Cooperation	0	0	0	0	0	1	1	0	0
US-Russia Environmental Agreement	0	0	0	0	0	0	1	0	1

Overview of international agreements and other cooperations to which the Arctic states are party, or not.

has received a great deal of attention by the Arctic countries, much less emphasis has been placed on the three gull species. In recent years Glaucous Gull and Ivory Gull have received greater attention by the CBird Group because of possible population declines. An international conservation strategy and action plan is now been formulated for the latter species by members of the CBird Group, and increased research has taken place in the countries of its breeding distribution (Canada, Greenland, Norway, Russia).

International commitments

An overview was compiled of the main international agreements, conventions etc, which the Arctic

Carsten Egevang: *Examining an Arctic Tern chick*, Greenland 2006.

countries have signed and contain species lists of concern (see table). Some of these cooperations are global while others include Europe only, and others bilateral. Included are also cooperations, which are not agreements or conventions, but work at the global level, and are important in the present context such as Wetlands International and BirdLife International, that are non-governmental organizations (NGOs).

Trophic levels
The species that were ranked highest were looked upon in a different way, taking the trophic level at which they forage into account. The trophic level gives a certain measure of their place in the marine ecosystem. This was considered important in order to cover the different sectors of the marine environment, and is in line with the concept of an ecosystem-based approach.

Initially only a simplified classification was used; surface feeders, planktonivores, piscivores or mid-water feeders, and benthic feeders. Grouping the species with the highest score into these categories gives these results (three species in each group and score in brackets):

Surface feeders:
- Black-legged Kittiwake (238)
- Northern Fulmar (198)
- Arctic Tern (178)

Planktonivores:
- Leach´s Storm Petrel (120)
- Ivory Gull (103)
- Crested Auklet (71)

Piscivores (mid-water feeders):
- Common Murre (263)
- Thick-billed Murre (243)
- Atlantic Puffin (114)

Benthic (bottom) feeders:
- Common Eider (273)
- Black Guillemot (202)
- King Eider (186)

This is somewhat different picture from the one obtained earlier. This list includes 12 species of which eight are the same as before, with the two lowest scores fallen out (Herring Gull, Steller´s Eider).

During discussions in the CBird Group of the results one group of species was found lacking, i.e. Omnivores, besides Planktonivores and Piscivores came to be arranged in a different manner, i.e. as Surface Planktonivores, Diving Planktonivores, Surface Piscivores, and Diving Piscivores. The matrix was not sent out again due to these changes, but the final recommended list of species for circumpolar monitoring reflects these new categories and was agreed upon at the CBird meeting in Greenland 2008.

Proposed list of species for monitoring
Having valuated the pros and cons of the above aspects and ranks, the Circumpolar Seabird Group (CBird) recommends that the following species be considered parts of a integrated *Circumpolar Seabird Monitoring Network*:

Surface Piscivores:
- Black-legged Kittiwake
- Northern Fulmar
- Arctic Tern

Surface Planktonivores:
- Leach´s Storm Petrel
- Fork-tailed Storm Petrel

Diving Piscivores:
- Common Murre
- Thick-billed Murre
- Atlantic Puffin
- Tufted Puffin

Diving Planktonivores
- Least Auklet
- Dovekie

Benthic feeders:
- Common Eider
- King Eider
- Black Guillemot
- Pigeon Guillemot
- Shag
- Pelagic Cormorant
- Great Cormorant

Omnivores:
- Glaucous Gull
- Glaucous-winged Gull
- Herring Gull
- Great Black-backed Gull

Lisa Sheffield: *Common Murres at St. Lawrence Island in the Bering Sea,* Alaska 2003.

The present list includes 22 species, which is a third of the Arctic seabird species. Each country needs to consider which species on this list breeds or occurs within its boundaries, and will hopefully adjust its monitoring activities accordingly.

The CBird Group does not advice that monitoring be stopped although a given species does not show up as a priority species at the circumpolar level. The species in question may still give valuable information, as well as being a priority species at the national level. The present exercise can be used by the Arctic countries to identify gaps in their national programs. However, here we only concentrate on the circumpolar aspect and circumpolar relevance as the key aspects. A full gap analysis is a subject of its own and should be performed at a later stage.

Colony monitoring parameters
It is important to identify which parameters should be monitored. Depending on the different stages the following parameters were identified by the CBird Group to be included in a circumpolar seabird monitoring program:

- Numbers
- Productivity (recruitment)
- Survival
- Diets
- Phenology

The basic monitoring unit is numbers. This can be expressed in different ways (e.g. as pairs or as birds), mainly on account of the methodologies applied depending on species, but to some extent depending on tradition of researchers. Parameters affecting numbers are mostly productivity and survival. Confounding parameters often included are immigration (on productivity) and emigration (on survival). What other factors are included in a monitoring program depends on the specific aim of the program, but diet is recognized as such an important factor affecting seabird populations that this should be included in monitoring programs. Some phenological data are usually needed for planning the time at which numbers are most efficiently counted. Methodology in general is a subject which needs careful examination and comparison

A suite of other parameters, physical and biotic, are needed for interpretation of monitoring results. These include the following (and the list is not complete):

- Climate data (air temperature, winds, etc.)
- Oceanographic data (salinity, depth, sea temperature, currents, sea ice, etc.)
- Climate change models (including NAOs, subpolar gyres, etc.)
- Plankton distributions and magnitudes, both phyto- and zooplankton
- Contaminants (of which there is a whole suite)
- Fisheries and fish stock data
- Oil spill data

Analysts would like to look at various aspects of climate and other data, which could therefore be broken into various subsets. Same goes for most other supplementary data. It is not recommended that compilation of these data be part of the CSMP, rather cooperation be forged with those who have the task of measuring and compiling these data, such as climatologists, oceanographers, fish biologists, etc.

At-sea surveys
Birds at sea are proxies for ecosystem health and as such represent important environmental indicators. In at-sea surveys the full scale of seabird biodiversity present in a respective area at given time of year is covered, and censuses can in theory be carried out at any time of year. The distribution of seabirds at sea changes as water masses change so the census results need to be compared to physical characteristics of the water, i.e. sea surface temperature (SST) and salinity, and biotic factors e.g. primary production and zooplankton data. At-sea monitoring allows population trends and changes in distribution to be determined for many species simultaneously.

Winter surveys of seabirds are inevitably carried out at sea but can sometimes be difficult to execute due to poor weather conditions, limited light conditions and few working research vessels. We suggest concentrating monitoring transects on high density areas, which are often coastal and which in some locations can be done from small boats or even from the shore. We also suggest aerial surveys, which are even more weather-dependent but have shorter sampling times and much larger coverage than vessels.

Environment Canada: *Common Tern chick banding*, Random Island, NL 2006.

Yuri Artukhin: *Red-legged Kittiwakes.*

recently the following ideas have been put forward for at-sea surveys:

- start with 10 to 15 pilot areas
- monitor every year to three years
- monitor selected coastal and open sea areas
- use local ferries and research vessels for permanent transects
- use vessels of opportunity for one-time transects
- use observers on vessels with continuous plankton recorders
- liason with existing global monitoring programs

In some countries the so-called Christmas Bird Counts have been carried out for decades along set coastlines. Such counts are differentially relevant to seabird species and monitor primarily those, which are found relatively inshore, e.g. cormorants, eiders, gulls, and guillemots.

Harvest statistics

Harvest data can give a measure or index of the local abundance of species and population trends over time. Data are obtained from local or national government programs and trends in numbers can be derived as with other monitoring data. Harvest data also helps interpretation of possible effects of hunting on the respective populations. Such data also need interpretation itself since many human-related factors can influence the results, as the harvest data are open to ambiguities such as differences in reporting by hunters, distribution of humans, etc. Populations in countries and areas without seabird harvests could be used in comparison with hunted populations. For interpretation of harvest data some measure of effort should be taken, such as season length, number of harvesters, and total number of harvest days, to allow catch per unit effort (CPUE) to be calculated.

National lists of breeders and non-breeders

As climate changes species range will change. Simple national lists of breeders in an area or country will with time, show changes in species composition. Extinct breeding species should be included in such a compilation. The species composition of non-breeders occurring in an area may also change. Hence simple lists of regular winter visitors, regular through-migrants, and vagrants are of monitoring value. Species lists for countries are inexpensive indicators, which are normally being compiled by bird enthusiasts but are often thwarted by not having information of effort. Climate change modelling is a more elaborate methodology, which gives various opportunities to try out hypotheses.

National endangered species lists
Lists of endangered species nationally are normally easy to access and available in all countries. Through time such lists can provide information on trends in numbers of rare species and thus is a measure of changes in bird fauna. These changes can be related to causal environmental factors, natural or anthropogenic, and indicate how well conservation actions are working.

Banding
Banding as a methodology is essential for certain aspects of monitoring. In well-structured programs banding can augment productivity information and increase the sample available using the network of large numbers of amateur banders. More importantly banding is crucial for survival analyses. Survival of adult breeding birds is one of the most important parameter for the population dynamics of seabirds, most of which are long-lived, but can vary according to life history traits of the different species. For some species it may be more important to monitor than, for instance, productivity, even though survival data are much more difficult to come by.

Other national or global initiatives
It is not the intention here to give a complete overview of monitoring activities taking place on seabirds globally. That subject warrants a report of its own.

Most seabird programs are at the national level. In the CAFF countries probably the best organized seabird monitoring programs are those in Norway (SEAPOP; Anker-Nilssen *et al.* 2005) and Alaska. The latter is a part of the *Pacific Seabird Group Monitoring Program*, encompassing a number of US states. The Finnish seabird monitoring program is the oldest one at least in Scandinavia and started in the 1940´s. This is still the only monitoring program for Baltic seabirds. Some advanced computer programming (TRIM) is used for analyzing population trends. *The UK Seabird Monitoring Program* deserves mentioning (Walsh *et al*. 1995, Tasker 2000, Mitchell *et al*. 2004).

Most countries unfortunately do not have an organized and integrated program, which is adhered to according to a pre-set schedule and funded by environmental authorities. Much of monitoring activity depends on the initiatives and efforts of individual bird observers or bird observatories. Projects may have been started from sheer species-specific interest, e.g. as university projects, or through interest in certain local bird faunas.

Within the Arctic countries the present initiative, the *Circumpolar Seabird Monitoring Network*, is a rare opportunity. Globally only one such seabird monitoring scheme is known, i.e. that of the Antarctic States within the *Commission for the Conservation of Antarctic Marine Living Resources* (CCAMLR), which maintains *CCAMLR Ecosystem Monitoring Program* (CEMP), a part of which deals with seabirds (CCAMLR 2004). When the *Circumpolar Seabird Monitoring Network* gets off the ground and going, this would be a really unusual undertaking at the global level.

References

ACIA 2004. Arctic Climate Impact Assessment. Cambridge Univ. Press. 1042 pp.

Anker-Nilssen T., J.O. Bustnes, K.E. Erikstad, S.-H. Lorentsen, T. Tveraa, H. Strøm & R.T. Barrett 2005. SEAPOP. A national seabird programme for improved decision support in marine areas. NINA Rapport 1. 66 pp. (In Norwegian).

Bakken, V. & K. Falk (eds) 1998. Incidental take of seabirds in commercial fisheries in the Arctic countries. CAFF Tech. Rep. no. 1. 50 pp.

Bakken, V., D. Boertmann, A. Mosbech, B. Olsen, A. Petersen, H. Ström & H. Goodwin 2006. Nordic Seabird Colony Databases: Results of a Nordic project on seabird breeding colonies in Faroes, Greenland, Iceland, Jan Mayen and Svalbard. TemaNord 2006: 512. 96 pp.

CAFF 1996. International Murre Conservation Strategy and Action Plan. 16 pp.

CAFF 1997. Circumpolar Eider Conservation Strategy and Action Plan. 16 pp.

CAFF 2000. CAFF/AMAP Workshop on a Circumpolar Biodiversity Monitoring Program, Reykjavik, 7-9 February 2000 (Summary Report). CAFF Tech. Rep. No. 6, AMAP Report 02:00. 21 + appendices.

CAFF 2002. CAFF Work Plan 2002 – 2004. Endorsed at CAFF IX, Abisko, Sweden, August 2002. 3 p.

CAFF 2002.1 Circumpolar Seabirds Expert Group. Eighth Meeting. Progress Report. April 2002. 66 p.

CAFF 2002. Arctic Flora and Fauna. Recommendations of Conservation. 14 pp.

CAFF 2003. Circumpolar Seabird Group. CBird IX. Tromso, Norway 27-31 January 2003. Progress Report. September 2003. 103 p.

CAFF 2004. Circumpolar Seabird Group. CBird X. Tórshavn, Faroe Islands, February 25-28, 2004. Accomplishments 2002-2004 & Work Plan 2004-2006. August 2004.

CAFF 2005. Circumpolar Seabird Group. CBird XI. Aberdeen, Scotland 2-5 March 2005. Progress Report. March 2005. 16 p.

CAFF 2006. Circumpolar Seabird Group. CBird XII. St. Petersburg, Russia 27 February – 2 March 2006. Progress Report. March 2006. 19 p.

CAFF 2007. Circumpolar Seabird Group. CBird XII. Stockholm, Sweden 28 February - 3 March 2007. Progress Report. March 2007. 18 p.

CAFF 2008a. Developing an Integrated and Sustained Arctic Biodiversity Monitoring Network (CBMP Five-year Implementation Plan). CAFF homepage http://arcticportal.org/uploads/9s/jO/9sjOfiGjYNXxc-PXB6bDZA/CBMP-Imlementation-Plan--jan-11-08.pdf.

CAFF 2008b. Circumpolar Seabird Group. CBird XIV. Nuuk, Greenland 8 February – 11 February 2008. Meeting Report. February 2008. 18 p.

CCAMLR 2004. CCAMLR Ecosystem Monitoring Program. Standard Methods. 268 pp. http://www.ccamlr.org/pu/E/e_pubs/std-meth04.pdf

Chardine, J. & V. Mendenhall 1998. Human disturbance at Arctic seabird colonies. CAFF Tech. Rep. no. 2. 18 pp.

Chardine, J., J.M. Porter & K.D. Wohl 2000. Workshop on seabird incidental catch in the waters of Arctic countries. CAFF Tech. Rep. no. 7. 65 pp.

Denlinger, L. & K. Wohl (eds). Seabird Harvest Regimes in the Circumpolar Nations. CAFF Tech. Rep. no. 9. 52 pp.

Mitchell, P.I., S.F. Newton, N. Ratcliffe & T.E. Dunn 2004. Seabird populations of Britain and Ireland (Results of the Seabird 2000 census (1998-2002)). T & A.D. Poyser, London. 511 pp.

Petersen, A., C. Zöckler & M.V. Gunnarsdóttir 2004. Circumpolar Biodiversity Monitoring Program (Framework Document). CAFF CBMP Report No. 1. 40 pp.

Tasker, M.L. 2000. The UK and Ireland seabird monitoring programme - a history and introduction. Atlantic Seabirds 2(3-4): 97-102. Special issue.

Walsh, P.M., D.J. Halley, M.P. Harris, A. Del Nevo, I.M.W. Sim & M.L. Tasker 1995. Seabird Monitoring Handbook for Britain and Ireland: a compilation of methods for survey and monitoring of breeding seabirds. JNCC, RSPB, ITE, Peterborough. 14 pp. + species accounts + references + appendices.

Wohl, K. & J. Pagnan 1994. Conservation of Arctic Flora and Fauna: Circumpolar Seabird Group Amended Meeting Report - 1994. Circumpolar Seabird Bull. 1: 30-37.

Appendix 1. A list of Arctic Seabirds

The following 64 seabird species have been identified by the CBird Group as constituting “Arctic Seabirds” for the purpose of this report:

Northern Fulmar	*Fulmarus glacialis*
Manx Shearwater	*Puffinus puffinus*
Fork-tailed Storm Petrel	*Pterodroma furcata*
Storm Petrel	*Hydrobates pelagicus*
Leach´s Storm Petrel	*Oceanodroma leucorrhoa*
Northern Gannet	*Sula bassana*
Great Cormorant	*Phalacrocorax carbo*
Shag	*Phalacrocorax aristotelis*
Pelagic Cormorant	*Phalacrocorax pelagicus*
Brandt´s Cormorant	*Phalacrocorax penicillatus*
Double-crested Cormorant	*Phalacrocorax auritus*
Red-faced Cormorant	*Phalacrocorax urile*
Common Eider	*Somateria mollissima*
King Eider	*Somateria spectabilis*
Spectacled Eider	*Somateria ficheri*
Steller’s Eider	*Polystica stelleri*
Parasitic Jaeger	*Stercorarius parasiticus*
Long-tailed Jaeger	*Stercorarius longicaudus*
Pomarine Jaeger	*Stercorarius pomarinus*
Great Skua	*Stercorarius skua*
Thayer´s Gull	*Larus thayeri*
Iceland Gull	*Larus glaucoides*
Glaucous Gull	*Larus hyperboreus*
Glaucous-winged Gull	*Larus glaucescens*
Great Black-backed Gull	*Larus marinus*
Herring Gull	*Larus argentatus*
Lesser Black-backed Gull	*Larus fuscus*
West-Siberian Gull	*Larus heuglini*
Slaty-backed Gull	*Larus schistisagus*
Mew Gull	*Larus canus*
Bonaparte´s Gull	*Larus philadelphia*
Black-headed Gull	*Larus ridibundus*
Little Gull	*Larus minutus*
Sabine´s Gull	*Larus sabini*
Ivory Gull	*Pagophila eburnea*
Black-legged Kittiwake	*Rissa tridactyla*
Red-legged Kittiwake	*Rissa brevirostris*
Ross´ Gull	*Rhodostethia rosea*
Arctic Tern	*Sterna paradisaea*
Caspian Tern	*Sterna caspia*
Common Tern	*Sterna hirundo*
Little Tern	*Sterna albifrons*
Aleutian Tern	*Sterna aleutica*
Black Tern	*Chlidonias niger*
Razorbill	*Alca torda*
Common Murre	*Uria aalge*
Thick-billed Murre	*Uria lomvia*
Dovekie	*Alle alle*
Spectacled Guillemot	*Cepphus carbo*
Black Guillemot	*Cepphus grylle*
Pigeon Guillemot	*Cepphus columba*
Kittlitz´s Murrelet	*Brachyramphus brevirostris*
Marbled Murrelet	*Brachyramphus marmoratus*
Long-billed Murrelet	*Brachyramphus perdix*
Ancient Murrelet	*Synthliboramphus antiquus*
Cassin´s Auklet	*Ptychoramphus aleuticus*
Rhinoceros Auklet	*Cerorhinca monocerata*
Least Auklet	*Aethia pusilla*
Crested Auklet	*Aethia cristatella*
Parakeet Auklet	*Aethia psittacula*
Whiskered Auklet	*Aethia pygmaea*
Atlantic Puffin	*Fratercula arctica*
Horned Puffin	*Fratercula corniculata*
Tufted Puffin	*Fratercula cirrhata*

Appendix 2a: The seabird species breeding in each of the Arctic countries: Distribution and trophic level.

no	species - english	species - scientific	breeding distr.	Arctic breed. distr.	Alaska	Canada	Faeroes	Finland	Greenland	Iceland	Norway (Arctic)	Russia western	Russia eastern	Sweden	No. countries found	Norway (Non-Arctic)	feeding trophic level	feeding method
01	Northern Fulmar	Fulmarus glacialis	Arctic (part)	Pacific/Atlantic	1	1	1	0	1	1	1	1	1	0	8	1	invertebrate/offal/forage fish	surface feeder
02	Manx Shearwater	Puffinus puffinus	Arctic (part)	Atlantic	0	0	1	0	0	1	0	0	D	D	2	0	forage fish	surface feeder
03	Fork-tailed Storm Petrel	Pterodroma furcata	Arctic (part)	Pacific	1	0	0	0	0	0	0	0	1	D	2	0	plankton	surface feeder
04	Storm Petrel	Hydrobates pelagicus	Arctic (part)	Atlantic	0	0	1	0	0	1	1	0	D	D	3	1	plankton	surface feeder
05	Leach's Storm Petrel	Oceanodroma leucorhoa	Arctic (part)	Pacific/Atlantic	1	0	1	0	0	1	1	0	1	D	5	1	plankton	surface feeder
06	Northern Gannet	Sula bassana	Arctic (part)	Atlantic	0	0	1	0	0	1	1	0	D	D	3	1	forage fish	plunge-diving
07	Great Cormorant	Phalacrocorax carbo	Arctic (part)	Atlantic	0	0	0	1	1	1	1	1	D	1	6	1	forage fish/invertebrates	benthic feeder
08	Shag	Phalacrocorax aristotelis	Arctic (part)	Atlantic	0	0	1	0	0	1	1	1	D	D	4	1	forage fish/invertebrates	benthic feeder
09	Pelagic Cormorant	Phalacrocorax pelagicus	Arctic (part)	Pacific	1	0	0	0	0	0	0	1	1	D	3	0	forage fish	benthic/mid-water
10	Brandt's Cormorant	Phalacrocorax penicillatus	Arctic (part)	Pacific	1	0	0	0	0	0	0	0	D	D	1	0	forage fish	benthic/mid-water
11	Double-crested Cormorant	Phalacrocorax auritus	Arctic (part)	Pacific/Atlantic	1	0	0	0	0	0	0	0	D	D	1	0	forage fish	benthic/mid-water
12	Red-faced Cormorant	Phalacrocorax urile	Arctic	Pacific	1	0	0	0	0	0	0	0	1	D	2	0	forage fish	benthic/mid-water
13	Common Eider	Somateria mollissima	Arctic (part)	Pacific/Atlantic	1	1	1	1	1	1	1	1	1	1	10	1	invertebrates	benthic feeder
14	King Eider	Somateria spectabilis	Arctic	Pacific/Atlantic	1	1	0	0	1	0	1	1	1	D	6	0	invertebrates	benthic feeder
15	Spectacled Eider	Somateria fischeri	Arctic	Pacific	1	0	0	0	0	0	0	0	1	D	2	0	invertebrates	benthic feeder
16	Steller's Eider	Polysticta stelleri	Arctic	Pacific/Atlantic	1	0	0	0	0	0	0	1	1	D	3	0	invertebrates	benthic feeder
17	Parasitic Jaeger	Stercorarius parasiticus	Arctic (part)	Pacific/Atlantic	1	1	1	1	1	1	1	1	1	1	10	1	forage fish/offal/mammals/birds	tleptoparasitic
18	Long-tailed Jaeger	Stercorarius longicaudus	Arctic	Pacific/Atlantic	1	1	0	1	1	0	1	1	1	1	8	1	forage fish/offal/mammals/birds	tleptoparasitic
19	Pomarine Jaeger	Stercorarius pomarinus	Arctic	Pacific/Atlantic	1	1	0	0	0	0	0	1	1	D	4	0	forage fish/offal/mammals/birds	tleptoparasitic
20	Great Skua	Stercorarius skua	Arctic (part)	Atlantic	0	0	1	0	0	1	1	0	D	D	3	1	forage fish/offal	tleptoparasitic
21	Thayer's Gull	Larus thayeri	Arctic	Atlantic	0	1	0	0	0	0	0	0	D	D	1	0	invertebrate/offal/forage fish	coastal/surface feeder
22	Iceland Gull	Larus glaucoides	Arctic	Atlantic	0	1	0	0	1	0	0	0	D	D	2	0	invertebrate/offal/forage fish	coastal/surface feeder
23	Glaucous Gull	Larus hyperboreus	Arctic	Pacific/Atlantic	1	1	0	0	1	1	1	1	1	D	7	0	invertebrate/offal/birds	tleptoparasitic/coastal
24	Glaucous-winged Gull	Larus glaucescens	Arctic (part)	Pacific	1	0	0	0	0	0	0	0	1	D	2	0	invertebrate/offal/forage fish/birds	coastal/surface feeder
25	Great Black-backed Gull	Larus marinus	Arctic (part)	Atlantic	0	1	1	1	1	1	1	1	0	1	8	1	invertebrate/offal/forage fish/birds	coastal/surface feeder

Appendix 2a: The seabird species breeding in each of the Arctic countries: Distribution and trophic level.

no	species - english	species - scientific	breeding distr.	Arctic breed. distr.	Alaska	Canada	Faeroes	Finland	Greenland	Iceland	Norway (Arctic)	Russia western	Russia eastern	Sweden	No. countries found	Norway (Non-Arctic	feeding trophic level	feeding method
26	Herring Gull	Larus argentatus	Arctic (part)	Atlantic	1	1	1	1	1	1	1	1	1	1	10	1	invertebrate/offal/forage fish	coastal/surfacefeeder
27	Lesser Black-backed Gull	Larus fuscus	Arctic (part)	Atlantic	0	0	1	1	1	1	1	1	0	1	7	1	invertebrate/offal/forage fish	coastal/surfacefeeder
28	West Siberian Gull	Larus heuglini	Arctic	Pacific/Atlantic	0	0	0	0	0	0	0	1	0	0	1	0	invertebrate/offal/forage fish	coastal/surfacefeeder
29	Slaty-backed Gull	Larus schistisagus	Arctic	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	invertebrate/offal/forage fish	coastal/surfacefeeder
30	Mew/Common Gull	Larus canus	Arctic (part)	Pacific/Atlantic	1	1	1	1	0	1	1	1	1	1	9	1	invertebrate/offal/forage fish	coastal/surfacefeeder
31	Bonaparte´s Gull	Larus philadelphia	Arctic (part)	Pacific/Atlantic	1	1	0	0	0	0	0	0	0	0	2	0	invertebrate/offal/forage fish	coastal/surfacefeeder
32	Black-headed Gull	Larus ridibundus	Arctic (part)	Pacific/Atlantic	0	0	1	1	1	1	1	1	1	1	8	1	invertebrate/offal/forage fish	coastal/surfacefeeder
33	Little Gull	Larus minutus	Arctic (part)	Atlantic	0	0	0	1	0	0	1	1	0	1	4	0	invertebrate/offal/forage fish	coastal/surfacefeeder
34	Ivory Gull	Pagophila eburnea	Arctic	Pacific/Atlantic	0	1	0	0	1	0	1	1	0	0	4	0	plankton	surface feeder
35	Black-legged Kittiwake	Rissa tridactyla	Arctic (part)	Pacific/Atlantic	1	1	1	0	1	1	1	1	1	1	9	1	forage fish/plankton	surface feeder
36	Red-legged Kittiwake	Rissa brevirostris	Arctic	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	forage fish/invertebrate/plankton	surface feeder
37	Sabine´s Gull	Larus sabini	Arctic	Pacific/Atlantic	1	1	0	0	1	0	1	1	1	0	6	0	forage fish	surface feeder
38	Ross´ Gull	Rhodostethia rosea	Arctic	Pacific/Atlantic	0	1	0	0	1	0	0	1	1	0	4	0	forage fish	surface feeder
39	Arctic Tern	Sterna paradisaea	Arctic (part)	Pacific/Atlantic	1	1	1	1	1	1	1	1	1	1	10	1	forage fish/plankton	surface feeder
40	Caspian Tern	Sterna caspia	Arctic (part)	Pacific	1	0	0	1	0	0	0	0	0	1	3	0	forage fish	surface feeder
41	Common Tern	Sterna hirundo	Arctic (part)	Pacific/Atlantic	0	1	0	1	0	0	1	1	1	1	6	1	forage fish	surface feeder
42	Little Tern	Sterna albifrons	Arctic (part)	Atlantic	0	0	0	1	0	0	0	0	0	1	2	0	forage fish	surface feeder
43	Aleutian Tern	Sterna aleutica	Arctic	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	forage fish/plankton	surface feeder
44	Black Tern	Chlidonias niger	Arctic (part)	Atlantic	0	0	0	1	0	0	0	0	0	1	2	0	forage fish	surface feeder
45	Razorbill	Alca torda	Arctic (part)	Atlantic	0	1	1	1	1	1	1	1	0	1	8	1	forage fish	mid-water
46	Common Murre	Uria aalge	Arctic (part)	Pacific/Atlantic	1	1	1	1	1	1	1	1	1	1	10	1	forage fish/invertebrates	mid-water
47	Thick-billed Murre	Uria lomvia	Arctic (part)	Pacific/Atlantic	1	1	0	0	1	1	1	1	1	0	7	0	invertebrates/forage fish/plankton	mid-water
48	Dovekie	Alle alle	Arctic	Atlantic	0	1	0	0	1	0	1	1	0	0	4	0	plankton	mid-water
49	Spectacled Guillemot	Cepphus carbo	Arctic	Pacific	0	0	0	0	0	0	0	0	1	0	1	0	forage fish/invertebrates	benthic/mid-water
50	Black Guillemot	Cepphus grylle	Arctic (part)	Pacific/Atlantic	1	1	1	1	1	1	1	1	1	1	10	1	forage fish/invertebrates	benthic/mid-water

Appendix 2a: The seabird species breeding in each of the Arctic countries: Distribution and trophic level.

no	species - english	species - scientific	breeding distr.	Arctic breed. distr.	Alaska	Canada	Faeroes	Finland	Greenland	Iceland	Norway (Arctic)	Russia western	Russia eastern	Sweden	No. countries found	Norway (Non-Arctic	feeding trophic level	feeding method
51	Pigeon Guillemot	Cepphus columba	Arctic (part)	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	forage fish/invertebrates	benthic/mid-water
52	Kittlitz´s Murrelet	Brachyramphus brevirostris	Arctic	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	forage fish/plankton	mid-water
53	Marbled Murrelet	Brachyramphus marmoratus	Arctic (part)	Pacific	1	0	0	0	0	0	0	0	0	0	1	0	forage fish/plankton	mid-water
54	Long-billed Murrelet	Brachyramphus perdix	Arctic	Pacific	0	0	0	0	0	0	0	0	1	0	1	0	forage fish/plankton	mid-water
55	Ancient Murrelet	Synthliboramphus antiquus	Arctic (part)	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	forage fish/plankton	mid-water
56	Cassin´s Auklet	Ptychoramphus aleuticus	Arctic (part)	Pacific	1	0	0	0	0	0	0	0	0	0	1	0	plankton	mid-water
57	Rhinoceros Auklet	Cerorhinca monocerata	Arctic (part)	Pacific	1	0	0	0	0	0	0	0	0	0	1	0	forage fish	mid-water
58	Least Auklet	Aethia pusilla	Arctic	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	plankton	mid-water
59	Crested Auklet	Aethia cristatella	Arctic	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	plankton	mid-water
60	Parakeet Auklet	Aethia psittacula	Arctic	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	plankton/invertebrates/forage fish	mid-water
61	Whiskered Auklet	Aethia pygmaea	Arctic	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	plankton	mid-water
62	Atlantic Puffin	Fratercula arctica	Arctic (part)	Atlantic	0	1	1	0	1	1	1	1	0	0	6	1	forage fish/invertebrates	mid-water
63	Horned Puffin	Fratercula corniculata	Arctic	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	forage fish	mid-water
64	Tufted Puffin	Fratercula cirrhata	Arctic (part)	Pacific	1	0	0	0	0	0	0	0	1	0	2	0	forage fish	mid-water
				Total no. of species =	**41**	**25**	**20**	**18**	**23**	**23**	**29**	**30**	**39**	**19**		**22**		
				Pacific only	25													
		Arctic	30	Atlantic only	19				Found in all countries									
		Arctic (partly)	34	Pacific & Atlantic	20				Found in two countries									
			64		64				Found in all but two countries									
									Found in one country									
									Found in all but one country									

Appendix 2b: The population status of Arctic seabird species and year(s) of estimate

no	species - scientific	Country/Populations status/numbers																		
			Canada:	Greenland:			Faeroes:		Finland:		Iceland:		Norway:	Russia (west):		Russia (east):			Sweden:	
		numbers	year	numbers	year	numbers	year	numbers	year	numbers	year	numbers	year	numbers	year	numbers	year	numbers	year	numbers
1	Fulmarus glacialis	600000	1980s	>80,000 b.p.	2004*	600,000	1987			1-2,000,000	1995	),000-1,000,(	1994	750-950,000	1980-1990s	750-950,000	1980-1990s			1.424.200
2	Puffinus puffinus					25,000	1987			7-10,000	1995									
3	Oceanodroma furcata													1,000s	1980-1990s	1,000s	1980-1990s			3.195.336
4	Hydrobates pelagicus					250,000	1987			50-100,000	1995	1,000-10,000	1994							
5	Oceanodroma leucorrhoa	10s	1978			1,000	1987			80-90,000	1995	100-1,000	1994	1,000s	1980-1990s	1,000s	1980-1990s			3.551.344
6	Sula bassana					2,350	1995			25,400	1994	2,200	1995							
7	Phalacrocorax carbo			5,000 b.p.	2004*			1625	2003	2,539	1994	6,500	1985-95					22,000	2000	
8	Phalacrocorax aristotelis					1,500	1987			8-9,000	1995	8,800	1982-95							
9	Phalacrocorax pelagicus													>38,000	1980-1990s	>38,000	1980-1990s			43.764
10	Phalacrocorax penicillatus																			86
11	Phalacrocorax auritus	10s	2003																	6.016
12	Phalacrocorax urile													2,000	1990s	2,000	1990s			47.533
13	Somateria mollissima	400000	????	17000 b.p.	)2 and 20	6,000	2003	150,000	2003	300,000	1995	67,000	1981-90	60-95,000	1990s	50,000 ind.	1990s	360,000	2004	10.000
14	Somateria spectabilis	????	????	?								500	1982-198	85,000	1990s	170,000 ind.	1990s			12000
15	Somateria fischeri													80,000	1990s	160,000 ind.	1990s			7000
16	Polysticta stelleri													110,000	1990s	180,000 ind.	1990s			2.000
17	Stercorarius parasiticus	10-100 000	1980s	?		900	1981	520	1992	5-10,000	1995	5-9,000	1994-95	>20,000	1980-1990s	>20,000	1980-1990s	450-650	2004	?
18	Stercorarius longicaudus	10-100 000	1980s	?				500(100-2000	1998			1-5,000	1994	>37,500	1980-1990s	>37,500	1980-1990s	500-5,000	2004	?
19	Stercorarius pomarinus	10-100 000	1980s											17,500-20,000	1980-1990s	17,500-20,000	1980-1990s			?
20	Stercorarius skua					500	2003			5,400	1984-85	220-380	1990-95							
21	Larus thayeri	10-50 000	1980s	0 b.p.	2004*															
22	Larus glaucoides	10-50 000	1980s	30-100,000 b.p.	2004*															
23	Larus hyperboreus	10-50 000	1980s	30-100,000 b.p.	2004*					8000	1995	4-10,000	1970-199	27,500	1980-1990s	27,500	1980-1990s			9.799
24	Larus glaucescens													5,100	1999-2000	5,100	1999-2000			252.157
25	Larus marinus	3000	2002	5-7,000 b.p.	2004*	1,200	1981	2,700	2003	15-20,000	1998	25,100	1995					15,000	2000	
26	Larus argentatus	50 - 100 000	1980s	10-50 b.p.	2004*	1,500	1981	30,000	2003	5-10,000	1995	100,000	1990-95			70,000	1980-1990s	50-100,000	2000	1.567
27	Larus fuscus			500-1000 b.p.	2004*	9,000	1981	7,000	2003	25,000	1995	<600	1995					4-5,000	2000	
28	Larus heuglini													70,000	1980-1990s					
29	Larus schistisagus													140,000	1980-1990s	140,000	1980-1990s			2
30	Larus canus	10-100 000	1980s			1,000	1981	65,000	2003	700	2000	>20,000	1990s	>50,000	1980-1990s	>50,000	1980-1990s	100-200,000	2000	14.389
31	Larus philadelphia	10-100 000	1980s																	?
32	Larus ridibundus	1	2002	10-20 b.p.	1996	150	2003	100,000	1998	25-30,000	1995	1,000	1990s	125,000	1980-1990s	125,000	1980-1990s	135,000	1990	
33	Larus minutus							10,000	1998			0-10	1994					500	1995	
34	Pagophila eburnea	250	2003	500-1000	2004*							200	1980-1995							
35	Rissa tridactyla	220000	1980s	00-200,000 b.p	1996	160,000	1997-99			630,000	1983-85	757,000	1980-94	650-750,000	1980-1990s	650-750,000	1980-1990s	25-35	1995	1.321.987
36	Rissa brevirostris													16,600	1993-1994	16,600	1993-1994			208.851
37	Larus sabini	10-100 000	1980s	100-500 b.p.	2004*							2-6	1993-199	13,500	1980-1990s	13,500	1980-1990s			16

Appendix 2b: The population status of Arctic seabird species and year(s) of estimate

no	species - scientific	Country/Populations status/numbers																		
			Canada:		Greenland:		Faeroes:		Finland:		Iceland:		Norway:		Russia (west):		Russia (east):		Sweden:	
44	Chlidonias niger							20-30	1998									200	2000	
45	Alca torda	15000	2002	3-6,000 b.p.	2004*	4,500	1987	8,500	1999	380,000	1983-85	25-30,000	1966-94					18,500	2004	
46	Uria aalge	50000	2002	1,500-2,000 i.	1996	100,000	1997-99	35-40	2003	990,000	1983-85	110-115,000	1974-96	700-800,000	1980-1990s	700-800,000	1980-1990s	12-15,000	2004	2.500.000
47	Uria lomvia	1 950 000	1980-2000	360,000 b.p.	1996					580,000	1983-85	850,000	1973-95	750,000	1980-1990s	750,000	1980-1990s			3.100.000
48	Alle alle	100	????	0-33,000,000 b.	96 and 2002							>1,000,000	1994							
49	Cepphus carbo													13,500-16,000	1990s	13,500-16,000	1990s			
50	Cepphus grylle	10-100 000	1980s	25-100,000 b.p.	1996	3,500	1987	18,000	1999	10-15,000	1998	50,000	1985-89	25,000	1980-1990s	>12,000	1980-1990s	10-11,000	2004	693
51	Cepphus columba													18,200	1980-1990s	18,200	1980-1990s			48.889
52	Brachyramphus brevirostris													>>3,000	1990s	>>3,000	1990s			17000
53	Brachyramphus marmoratus																			750000
54	Brachyramphus perdix													>>5,000	1990s	>>5,000	1990s			
55	Synthliboramphus antiquus													19-21,500	1980-1990s	19-21,500	1980-1990s			218.766
56	Ptychoramphus aleuticus																			472.943
57	Cerorhinca monocerata																			170.095
58	Aethia pusilla													>3,800,000	1980-1990s	>3,800,000	1980-1990s			5.528.763
59	Aethia cristatella													,150-1,350,00	1980-1990s	1,150-1,350,000	1980-1990s			2.898.005
60	Aethia psittacula													145-170,000	1980-1990s	145-170,000	1980-1990s			407.173
61	Aethia pygmaea													1000s	1980-1990s	1000s	1980-1990s			10.000
62	Fratercula arctica	87000	1978	5-10,000 b.p.	2004*	550,000	1987			2-3,000,000	1995	2,000,000	1990							
63	Fratercula corniculata													140-165,000	1980-1990s	140-165,000	1980-1990s			938.020
64	Fratercula cirrhata													380,000	1980-1990s	380,000	1980-1990s			2.277.957

Explanations:

2004*: New estimate based on data from last 10 -20years in the Greenland Seabird Colony Database (GSCD 2004)

Use numbers of pairs if possible, otherwise indicate if numbers of individuals is used.

Use most recent estimate.

Appendix 2c: The population trends of Arctic seabird species.

no	species - english	species - scientific	Country/Population trends									
			Canada:	Faeroes:	Finland:	Greenland:	Iceland:	Norway:	W-Russia:	E-Russia:	Sweden:	USA:
			popl. trend	popl. trend	popl. trend	popl. trend	popl. trend	popl. trend	popl. trend	popl. trend	popl. trend	popl. trend
1	Northern Fulmar	Fulmarus glacialis	not	i?	x	?	i	not	not	i	x	not
2	Manx Shearwater	Puffinus puffinus	x	not?	x	x	not?	x	x	x	x	x
3	ork-tailed Storm Petr	Oceanodroma furcata	x	x	x	x	x	x	x	?	x	i?
4	Storm Petrel	Hydrobates pelagicus	x	not?	x	x	not?	?	x	x	x	x
5	Leach's Storm Petrel	Oceanodroma leucorhoa	?	not?	x	x	not?	?	x	?	x	i?
6	Northern Gannet	Sula bassana	x	not	x	x	not	not	i	x	x	x
7	Great Cormorant	Phalacrocorax carbo	i?	x	i	i	d	i	i	x	i	x
8	Shag	Phalacrocorax aristotelis	x	not	x	x	d	not	not?	x	x	x
9	Pelagic Cormorant	Phalacrocorax pelagicus	x	x	x	x	x	x	x	d	x	d
10	Brandt's Cormorant	Phalacrocorax penicillatus	x	x	x	x	x	x	x	x	x	?
11	uble-crested Cormo	Phalacrocorax auritus	i?	x	x	x	x	x	x	x	x	?
12	Red-faced Cormorant	Phalacrocorax urile	x	x	x	x	x	x	x	d	x	d
13	Common Eider	Somateria mollissima	not	not	d	d	s	not	not	d?	i?	not
14	King Eider	Somateria spectabilis	d	x	x	?	x	?	not	d	x	not
15	Spectacled Eider	Somateria fischeri	x	x	x	x	x	x	x	d	x	not
16	Steller's Eider	Polysticta stelleri	x	x	x	x	x	x	d?not	d	x	not
17	Parasitic Jaeger	Stercorarius parasiticus	?	not	i?	?	not?	?	not	not?	i	?
18	Long-tailed Jaeger	Stercorarius longicaudus	?	x	not?	?	x	?	not	not?	not	?
19	Pomarine Jaeger	Stercorarius pomarinus	?	x	x	x	x	x	not	not?	x	?
20	Great Skua	Stercorarius skua	x	i	x	x	i?	not	i	x	x	x
21	Thayer's Gull	Larus thayeri	?	x	x	x	x	x	x	x	x	x
22	Iceland Gull	Larus glaucoides	?	x	x	i?	x	x	x	x	x	x
23	Glaucous Gull	Larus hyperboreus	d?	x	x	i?	d	?	not	not?	x	?
24	Glaucous-winged Gul	Larus glaucescens	x	x	x	x	x	x	x	d	x	?
25	reat Black-backed G	Larus marinus	d	not?	d,i	i?	d	not	i	x	i	x
26	Herring Gull	Larus argentatus	not?	not?	d, i	i	i	not	not	not?	i?	x
27	ooer Black-backed G	Larus fuscus	x	d?	d	i	i	d	x	x	d?	x
28	West Siberian Gull	Larus heuglini	x	x	x	x	x	x	not	x	x	x
29	Slaty-backed Gull	Larus schistisagus	x	x	x	x	x	x	x	i	x	?
30	MewCommon Gull	Larus canus	?	i?	i	x	i	not	not	not?	d	?
31	Bonaparte's Gull	Larus philadelphia	?	x	x	x	x	x	x	x	x	?
32	Black-headed Gull	Larus ridibundus	i	i?	not?	?	d?	not	not	i?	d	x
33	Little Gull	Larus minutus	x	x	i	x	x	i	not	x	i	x
34	Ivory Gull	Pagophila eburnea	d	x	x	?	x	d?	not?	x	x	x
35	Black-legged Kittiwak	Rissa tridactyla	not	d	x	d	d	d	i,not	not?	not	not
36	Red-legged Kittiwake	Rissa brevirostris	x	x	x	x	x	x	x	not?	x	not
37	Sabine's Gull	Larus sabini	?	x	x	?	x	?	not	not?	x	?
38	Ross' Gull	Rhodostethia rosea	d	x	x	?	x	x	i?	not?	x	x
39	Arctic Tern	Sterna paradisaea	d?	i	i	d	not?	not?	not?	?	i	d
40	Caspian Tern	Sterna caspia	i	x	not	x	x	x	x	x	not	?
41	Common Tern	Sterna hirundo	?	x	i	x	x	not	not	?	d	x
42	Little Tern	Sterna albifrons	x	x	not?	x	x	x	x	x	not	x
43	Aleutian Tern	Sterna aleutica	x	x	x	x	x	x	x	not	x	d
44	Black Tern	Chlidonias niger	x	x	not?	x	x	x	x	x	not	x
45	Razorbill	Alca torda	i	d?	i	?	i?	not	not	x	i	x
46	Common Murre	Uria aalge	not	d	i	?	i	d,i	i	i?	i	not
47	Thick-billed Murre	Uria lomvia	i	x	x	d	d	not	not	not?	x	not
48	Dovekie	Alle alle	?	x	x	?	e	?	not	x	x	x

Appendix 2c: The population trends of Arctic seabird species.

no	species - english	species - scientific	Country/Population trends									
			Canada:	Faeroes:	Finland:	Greenland	Iceland:	Norway:	W-Russia	E-Russia:	Sweden:	USA:
			popl. trend	popl. trend	popl. trend	popl. trend	popl. trend	popl. trend	popl. trend	popl. trend	popl. trend	popl. trend
49	Spectacled Guillemot	Cepphus carbo	x	x	x	x	x	x	x	?	x	x
50	Black Guillemot	Cepphus grylle	?	not?	i	?	d?	?	not	?	d	d
51	Pigeon Guillemot	Cepphus columba	x	x	x	x	x	x	x	not	x	d
52	Kittlitz´s Murrelet	Brachyramphus brevirostris	x	x	x	x	x	x	x	?	x	d
53	Marbled Murrelet	Brachyramphus marmoratus	x	x	x	x	x	x	x	x	x	d
54	Long-billed Murrelet	Brachyramphus perdix	x	x	x	x	x	x	x	?	x	x
55	Ancient Murrelet	Synthliboramphus antiquus	x	x	x	x	x	x	x	not?	x	?
56	Cassin´s Auklet	Ptychoramphus aleuticus	x	x	x	x	x	x	x	x	x	?
57	Rhinoceros Auklet	Cerorhinca monocerata	x	x	x	x	x	x	x	x	x	?
58	Least Auklet	Aethia pusilla	x	x	x	x	x	x	x	?	x	?
59	Crested Auklet	Aethia cristatella	x	x	x	x	x	x	x	d?	x	?
60	Parakeet Auklet	Aethia psittacula	x	x	x	x	x	x	x	?	x	?
61	Whiskered Auklet	Aethia pygmaea	x	x	x	x	x	x	x	?	x	i
62	Atlantic Puffin	Fratercula arctica	not	d?	x	i	i?	d	not	x	x	x
63	Horned Puffin	Fratercula corniculata	x	x	x	x	x	x	x	not?	x	?
64	Tufted Puffin	Fratercula cirrhata	x	x	x	x	x	x	x	i?	x	?
	Explanations:											
	If possible use trends last 5 years; if not possible use up to maximum last 20 years.											
	x = does not apply; not = no overall trend; i = increase; i? = possible increase; d = decline; d? = possible decline; e = extinct (as breeder); ? = unknown											

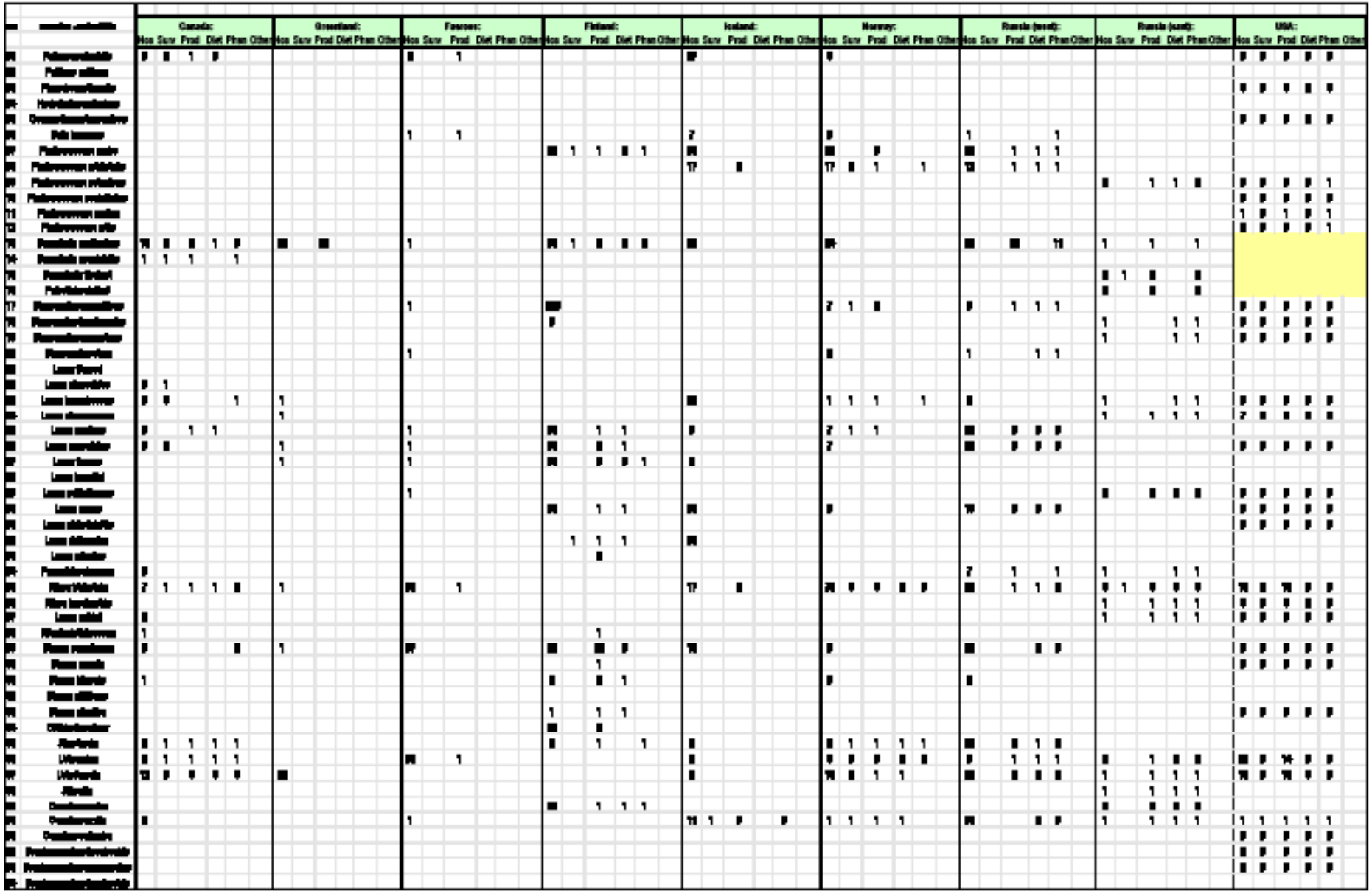
Appendix 2d: The number of seabird colonies monitored in the Arctic countries compared to the total number of colonies.

no	species - english	species - scientific	Country/No. of colonies monitored and total number of colonies															
				Canada:		Faeroes:		Finland:		Iceland:		Norway:	Russia (west):		Russia (east):			USA:
			nos	nos of	nos	nos of	nos	nos of	nos	nos of	nos	nos of	nos	nos of	nos	nos of	nos	nos of
			monitored	colonies	monitored	colonies	monitored	colonies	monitored	colonies	monitored	colonies	monitored	colonies	monitored	colonies	monitored	colonies
1	Northern Fulmar	Fulmarus glacialis	8	13	2	500			27	1500	4	125	1	16+	49	54	3	38
2	Atlantic Puffin	Fratercula arctica			0	10			1	7								
3	Fork-tailed Storm Petrel	Oceanodroma furcata													1	7	4	112
4	Storm Petrel	Hydrobates pelagicus			0	20			1	10	1							
5	Leach's Storm Petrel	Oceanodroma leucorhoa			0	2			1	12	1				2	20	3	94
6	Northern Gannet	Sula bassana			1	1			7	9	5		1	1				
7	Great Cormorant	Phalacrocorax carbo					20	20	30	30	32		21	30+				
8	Shag	Phalacrocorax aristotelis			0	25			17	150	17		12	14+				
9	Pelagic Cormorant	Phalacrocorax pelagicus													285	300	1	350
10	Brandt's Cormorant	Phalacrocorax penicillatus															1	2
11	Pelagic-crested Cormorant	Phalacrocorax aristotelis	0	1													2	105
12	Red-faced Cormorant	Phalacrocorax urile													50	50	7	214
13	Common Eider	Somateria mollissima	10	100s	1	25	1500	?	22	630	24	119	26	750	2	NA	?	?
14	King Eider	Somateria spectabilis	1	100s							1		1	n/r	3	NA	?	?
15	Spectacled Eider	Somateria fischeri													3	NA	?	?
16	Steller's Eider	Polysticta stelleri											1	n/r	3	NA	?	?
17	Parasitic Jaeger	Stercorarius parasiticus	0	100s	1	20	n.s.	unlikely	1	solitary	1		3	n/r	1	NA	1	?
18	Long-tailed Jaeger	Stercorarius longicaudus	0	100s			n.s.	?			1		1	n/r	2	NA	1	?
19	Pomarine Jaeger	Stercorarius pomarinus	0	100s									1	n/r	2	NA	1	?
20	Great Skua	Stercorarius skua			1	20			1	35	2	50	1	5+				
21	Thayer's Gull	Larus thayeri	0	100s														
22	Iceland Gull	Larus glaucoides	3	100s														
23	Glaucous Gull	Larus hyperboreus	8	100s					20	150	1	224	2	n/r	65	100s	1	144
24	Glaucous-winged Gull	Larus glaucescens													20	20	7	815
25	Great Black-backed Gull	Larus marinus	3	100s	1	25	n.s.	unlikely	3	300	7		25	300+				
26	Herring Gull	Larus argentatus	3	100s	1	25	2500	?	1	170	7		25	n/r	47	100s	1	35
27	Lesser Black-backed Gull	Larus fuscus			1	25	1500	?	2	300	1							
28	Slaty-backed Gull	Larus schistisagus											1	500	140	240	1	1
29	Ivory Gull	Pagophila eburnea	5	10s							1	44	7	ca. 50				
30	Black-legged Kittiwake	Rissa tridactyla	7	10s	50	50			17	250	70	214	31	310+	125	150	15	382
31	Red-legged Kittiwake	Rissa brevirostris													17	17	4	7
32	Sabine's Gull	Larus sabini	2	100s							1	2	1	n/r	2	100s	1	4
33	Ross' Gull	Rhodostethia rosea											1	10+	1	100s		
34	Arctic Tern	Sterna paradisaea	5	100s	67	67	2500	?	10	1500	5	80	25	500	4	100s	1	150

Appendix 2d: The number of seabird colonies monitored in the Arctic countries compared to the total number of colonies.

no	species - english	species - scientific	Country/Nos of colonies monitored and total number of colonies															
				Canada:		Faeroes:		Finland:		Iceland:		Norway:	Russia (west):		Russia (east):			USA:
			nos	nos of	nos	nos of	nos	nos of	nos	nos of	nos	nos of	nos	nos of	nos	nos of	nos	nos of
			monitored	colonies	monitored	colonies	monitored	colonies	monitored	colonies	monitored	colonies	monitored	colonies	monitored	colonies	monitored	colonies
40	Caspian Tern	Sterna caspia					20	20									0	1
41	Common Tern	Sterna hirundo					2500	?			0		2	?	5	100s		
42	Little Tern	Sterna albifrons					13	13										
43	Aleutian Tern	Sterna aleutica													8	100	0	62
44	Black Tern	Chlidonias niger					3	3										
45	Razorbill	Alca torda	2	5	0	25	500	?	2	40	2	1	20	27+				
46	Common Murre	Uria aalge	2	5	30	30	2	2	2	40	4	3	5	9+	80	110	20	225
47	Thick-billed Murre	Uria lomvia	12	14					2	30	16	146	20	80+	87	140	13	145
48	Dovekie	Alle alle									0	207	0	100				
49	Spectacled Guillemot	Cepphus carbo													21	80		
50	Black Guillemot	Cepphus grylle	2	100s	0	25	2500	?	11	250	1	202	30	750	14	30	1	13
51	Pigeon Guillemot	Cepphus columba													142	150	3	882
52	Kittlitz´s Murrelet	Brachyramphus brevirostris													4	NA	na	na
53	Marbled Murrelet	Brachyramphus marmoratus															na	na
54	Long-billed Murrelet	Brachyramphus longirostris													5	NA		
55	Ancient Murrelet	Synthliboramphus antiquus													4	8	1	90
56	Cassin´s Auklet	Ptychoramphus aleuticus															0	52
57	Rhinoceros Auklet	Cerorhinca monocerata															1	19
58	Least Auklet	Aethia pusilla													12	12	2	37
59	Crested Auklet	Aethia cristatella													16	16	2	43
60	Parakeet Auklet	Aethia psittacula													41	50	1	195
61	Whiskered Auklet	Aethia pygmaea													0	11	1	44
62	Atlantic Puffin	Fratercula arctica	3	6	0	75			3	650	3	107	10	22+				
63	Horned Puffin	Fratercula corniculata													177	230	0	634
64	Tufted Puffin	Fratercula cirrhata													179	230	8	702
			76		157	990	16208		320	6783	209	1524	291		1550		107	5737
				#DIV/0!		16		#DIV/0!		5		14		#DIV/0!		#DIV/0!		2
	Explanations:																	
	By monitoring we mean colonies censused twice or more completely, or on plots, with max. 20 years interval.																	
	"Nos monitored = The numbers of colonies of respective species, which is monitored.																	
	"Nos of colonies" = Total number of colonies of respective species in country or Arctic part of country, whichever is used.																	

Appendix 2e: The number of programmes for different monitoring parameters in the Arctic countries.



Appendix 2e: The number of programmes for different monitoring parameters in the Arctic countries

no	species - scientific	Canada:						Greenland:						Faeroes:						Finland:					
55	Synthliboramphus antiquus																								
56	Ptychoramphus aleuticus																								
57	Cerorhinca monocerata																								
58	Aethia pusilla																								
59	Aethia cristatella																								
60	Aethia psittacula																								
61	Aethia pygmaea																								
62	Fratercula arctica	3	1	2	1									1		1	1	1							
63	Fratercula corniculata																								
64	Fratercula cirrhata																								
	total	78	21	14	13	20	0	61	0	32	0	0	0	161	0	5	1	1	0	755	3	44	17	6	0

no	species - scientific	Iceland:						Norway:						Russia (west):						Russia (east):						USA:					
55	Synthliboramphus antiquus																			1		1		1		1	0	1	0	1	
56	Ptychoramphus aleuticus																									0	0	0	0	0	
57	Cerorhinca monocerata																			1		1	1	1		1	0	2	0	1	
58	Aethia pusilla																			1		1	1	1		2	1	3	5	3	
59	Aethia cristatella																			2	1	2	2	2		2	1	3	3	3	
60	Aethia psittacula																			1		1	1	1		0	0	1	1	1	
61	Aethia pygmaea																									0	0	1	1	1	
62	Fratercula arctica	3						3	3	2	2			10		3	3	3		1				1							
63	Fratercula corniculata																			1		1	1	1		0	0	2	1	1	
64	Fratercula cirrhata																			2		2	2	2		8	0	4	3	2	
	total	322	1	7	0	3	0	217	19	20	9	8	0	289	0	48	29	42	0	37	3	30	29	37	0	104	5	96	41	52	0

JSA: Data not available

Appendix 2f: The relevance of different Arctic seabird species as environmental indicators.

no	species - english	species - scientific	CANADA	FAEROES	FINLAND	GREENLAND	ICELAND	NORWAY	RUSSIA EASTERN	RUSSIA WESTERN	USA	total score	no. of answers		mean score
01	Northern Fulmar	Fulmarus glacialis	3	5		1	5	1	5	5	3	28	7		4,0
02	Manx Shearwater	Puffinus puffinus		1			1					2	2		1,0
03	Fork-tailed Storm Petrel	Pterodroma furcata					1		1	1	3	6	4		1,5
04	Storm Petrel	Hydrobates pelagicus		1			1	1				3	3		1,0
05	Leach´s Storm Petrel	Oceanodroma leucorrhoa		1			1	1	1	1	3	8	6		1,3
06	Northern Gannet	Sula bassana		3			3	1				7	3		2,3
07	Great Cormorant	Phalacrocorax carbo			3	5	5	3				16	4		4,0
08	Shag	Phalacrocorax aristotelis		1			3	5				9	3		3,0
09	Pelagic Cormorant	Phalacrocorax pelagicus							5	5	3	13	3		4,3
10	Brandt´s Cormorant	Phalacrocorax penicillatus									1	1	1		1,0
11	Double-crested Cormorant	Phalacrocorax auritus									1	1	1		1,0
12	Red-faced Cormorant	Phalacrocorax urile							5	5	3	13	3		4,3
13	Common Eider	Somateria mollissima	3	1	5	5	5	1	3	3	1	27	9		3,0
14	King Eider	Somateria spectabilis	1			3		1	3	3	3	14	6		2,3
15	Spectacled Eider	Somateria fischeri							3	3	3	9	3		3,0
16	Steller's Eider	Polysticta stelleri							3	3	3	9	3		3,0
17	Parasitic Jaeger	Stercorarius parasiticus	1	1	3	1	1	1	1	1	1	11	9		1,2
18	Long-tailed Jaeger	Stercorarius longicaudus	1		1	1		1	1	1	1	7	7		1,0
19	Pomarine Jaeger	Stercorarius pomarinus	1						1	1	1	4	4		1,0
20	Great Skua	Stercorarius skua		1			3	1				5	3		1,7
21	Thayer´s Gull	Larus thayeri	3									3	1		3,0
22	Iceland Gull	Larus glaucoides	3			3						6	2		3,0
23	Glaucous Gull	Larus hyperboreus	3			3	5	5	3	3	1	23	7		3,3
24	Glaucous-winged Gull	Larus glaucescens							5	5	3	13	3		4,3
25	Great Black-backed Gull	Larus marinus	3	1	3	3	1	3				14	6		2,3
26	Herring Gull	Larus argentatus	3	1	3	1	1	1	3		1	14	8		1,8
27	Lesser Black-backed Gull	Larus fuscus		1	5	1	3	1				11	5		2,2
28	West Siberian Gull	Larus heuglini								3		3	1		3,0
29	Slaty-backed Gull	Larus schistisagus							5	5	1	11	3		3,7
30	Mew/Common Gull	Larus canus	1	1	1		1	1	1	1	1	8	8		1,0
31	Bonaparte´s Gull	Larus philadelphia	1								1	2	2		1,0
32	Black-headed Gull	Larus ridibundus		1	3	1	1	1	1	1		9	7		1,3
33	Little Gull	Larus minutus			1			1				2	2		1,0
34	Ivory Gull	Pagophila eburnea	3			1		1				5	3		1,7
35	Black-legged Kittiwake	Rissa tridactyla	5	5		5	5	5	5	5	5	40	8		5,0
36	Red-legged Kittiwake	Rissa brevirostris							5	5	5	15	3		5,0
37	Sabine´s Gull	Larus sabini	3			1			1	1	1	7	5		1,4
38	Ross´ Gull	Rhodostethia rosea	3			1			1	1		6	4		1,5
39	Arctic Tern	Sterna paradisaea	5	5	1	3	3	1	1	1	3	23	9		2,6
40	Caspian Tern	Sterna caspia			5						1	6	2		3,0

Appendix 2f: The relevance of different Arctic seabird species as environmental indicators.

no	species - english	species - scientific	CANADA	FAEROES	FINLAND	GREENLAND	ICELAND	NORWAY	RUSSIA EASTERN	RUSSIA WESTERN	USA	total score	no. of answers		mean score
41	Common Tern	Sterna hirundo	5		1			1	1	1		9	5		1,8
42	Little Tern	Sterna albifrons			3							3	1		3,0
43	Aleutian Tern	Sterna aleutica							3	3	3	9	3		3,0
44	Black Tern	Chlidonias niger			1							1	1		1,0
45	Razorbill	Alca torda	3	3	5	1	3	1				16	6		2,7
46	Common Murre	Uria aalge	5	5	5	1	5	5	5	5	5	41	9		4,6
47	Thick-billed Murre	Uria lomvia	5			5	5	5	5	5	5	35	7		5,0
48	Dovekie	Alle alle	1			3		3				7	3		2,3
49	Spectacled Guillemot	Cepphus carbo							3	3		6	2		3,0
50	Black Guillemot	Cepphus grylle	3	3	3	5	5	5	1	1	5	31	9		3,4
51	Pigeon Guillemot	Cepphus columba							3	3	3	9	3		3,0
52	Kittlitz´s Murrelet	Brachyramphus brevirostris							1	1	5	7	3		2,3
53	Marbled Murrelet	Brachyramphus marmoratus									3	3	1		3,0
54	Long-billed Murrelet	Brachyramphus longirostris							1	1		2	2		1,0
55	Ancient Murrelet	Synthliboramphus antiquus							3	3	1	7	3		2,3
56	Cassin´s Auklet	Ptychoramphus aleuticus									1	1	1		1,0
57	Rhinoceros Auklet	Cerorhinca monocerata									1	1	1		1,0
58	Least Auklet	Aethia pusilla							3	3	3	9	3		3,0
59	Crested Auklet	Aethia cristatella							3	3	3	9	3		3,0
60	Parakeet Auklet	Aethia psittacula							3	3	1	7	3		2,3
61	Whiskered Auklet	Aethia pygmaea							1	1	1	3	3		1,0
62	Atlantic Puffin	Fratercula arctica	3	5		3	5	5				21	5		4,2
63	Horned Puffin	Fratercula corniculata							5	5	1	11	3		3,7
64	Tufted Puffin	Fratercula cirrhata							5	5	3	13	3		4,3

[1]"Environmental indicator": Compiler's opinion of species. 1 = poor indicator; 3 = average; 5 = good. Consider e.g. easy censusing, food-web relations, ecosystem importance, already used as indicators, etc.

Appendix 2g: The conservation concerns for Arctic seabirds.

no	species - scientific					Country/Concerns				
		Canada:	Greenland:	Faeroes:	Finland:	Iceland:	Norway:	Russia:	Sweden:	USA:
1	Fulmarus glacialis	none	h++	[illegible]		[illegible]		[illegible]		[illegible]
2	Pufinus pufinus	x		[illegible]						
3	Oceanodroma furcata	x						[illegible]		
4	Hydrobates pelagicus	x								
5	Oceanodroma leucorhoa	x						[illegible]		
6	Sula bassana	x		[illegible]						
7	Phalacrocorax carbo	none	h++		[illegible]	[illegible]				
8	Phalacrocorax aristotelis	x		[illegible]		[illegible]				
9	Phalacrocorax pelagicus	x						[illegible]		[illegible]
10	Phalacrocorax penicillatus	x								
11	Phalacrocorax auritus	none								
12	Phalacrocorax urile	x						[illegible]		[illegible]
13	Stercorarius maccormicki	[illegible]	h++, b++, c+, d/e+++		[illegible]	[illegible]		[illegible]		xx
14	Stercorarius spectabilis	[illegible]	h++, b++					[illegible]		
15	Stercorarius fischeri	x						[illegible]		[illegible]
16	Polyboroides skotosi	x						[illegible]		[illegible]
17	Stercorarius parasiticus	none			[illegible]	[illegible]		[illegible]		
18	Stercorarius longicaudus	none						[illegible]		
19	Stercorarius pomarinus	none						[illegible]		
20	Stercorarius skua	x								
21	Larus fuscus	none								
22	Larus glaucoides	none	h++, c+							
23	Larus hyperboreus	none	h++, c+			[illegible]		[illegible]		
24	Larus glaucescens	x						[illegible]		
25	Larus canus	x	h++, c+	[illegible]	calling[illegible]	[illegible]				
26	Larus argentatus	[illegible]		[illegible]	calling[illegible]	[illegible]		[illegible]		
27	Larus fuscus	x		[illegible]	[illegible]	[illegible]				
28	Larus heuglini							[illegible]		
29	Larus schistisagus	x						[illegible]		
30	Larus crassirostris	none			[illegible]			[illegible]		
31	Larus philadelphia	none								
32	Larus delawarensis	x			[illegible]	[illegible]		[illegible]		
33	Larus minutus	x								
34	Pagophila eburnea	[illegible]	d+++?							
35	Rissa tridactyla	[illegible]	b+++, d/e+					[illegible]		
36	Rissa brevirostris	x						[illegible]		[illegible]
37	Larus sabini	none						[illegible]		
38	Rhodostethia rosea	x						[illegible]		

Appendix 2g: The conservation concerns for Arctic seabirds.

no	species - scientific					Country/Concerns				
		Canada:	Greenland:	Faeroes:	Finland:	Iceland:	Norway:	Russia:	Sweden:	USA:
45	Alca torda	h**, oil**	?	h**	b***toxic algae*	e*;h**				
46	Uria aalge	h**, oil**	?	h**,e*	b*** toxic algae*	b***;e*;h**		cf*, b*, dis*, cop*, o***, h*, e*		cc
47	Uria lomvia	h**, oil**	h++, dis+, o+++			e*;h**		cf*, b*, dis*, cop*, o***, h*, e*		cc
48	Alle alle	h**, oil**	0++, h+++,							
49	Cepphus carbo	x						dis*, cop*, o***		
50	Cepphus grylle	none	h++, b++		dis* b***	h*;ip*		dis*, cop*, o***		
51	Cepphus columba	x						b*, dis*, cop*, o***		u***cc
52	Brachyramphus brevirostris	x						b*, o***		u***cc b*dis*p*o*dev*
53	Brachyramphus marmoratus	x								u***b*dis*p*o*dev*
54	Brachyramphus perdix	x						b*, o***, dev*		
55	Synthliboramphus antiquus	x						b*, dis*, cop*, o***,		
56	Ptychoramphus aleuticus	x								
57	Cerorhinca monocerata	x								
58	Aethia pusilla	x						b*, dis*, cop*, o***		ip*
59	Aethia cristatella	x						b*, dis*, cop*, o***, h*		ip*
60	Aethia psittacula	x						b*, dis*, cop*, o***, con***		
61	Aethia pygmaea	x						cop*, o***		
62	Fratercula arctica	oil**	h*** (Very few shot in the winter, only fleyg in the summer)			h*;ip*;cis*				
63	Fratercula corniculata	x						b*, dis*, cop*, o*		
64	Fratercula cirrhata	x						cf*, b*, dis*, cop*, o***, h*, e*		
	Explanations:									
	Mortality factors currently operating on species, not necessarily (but possibly, sometimes known) affecting population.									
	Please use the following codes when filling in the table:									
	cf = competition with fisheries; fw = fishery waste; b = bycatch; m = mariculture; dis = disturbance; cop = conflicts with other species; ip = introducted predators; cis = competition with introduced species									
	o = oil; h = harvesting/hunting (of birds); e = egging; con = contaminants; dev = development projects; wf = wind farms; u = unknown; others = (specify if use this code)									
	Add to code in table the following: * = breeding season; ** = non-breeding season; *** = both.									