Distribution of Murres Outside the Breeding Season

"Circumpolar Murre Banding Program"

North Atlantic Region

Common Murre

Thick-billed Murre

CAFF Technical Report No. 13
(2004)

Conservation of Arctic Flora and Fauna

CAFF Designated Agencies:
Canadian Wildlife Service, Yellowknife, Canada
Finnish Ministry of the Environment, Helsinki, Finland
Greenland Homerule, Ministry of the Environment, Nuuk, Greenland
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 Fish and Wildlife Service, Anchorage, Alaska, USA

This publication should be cited as:
CAFF, 2004. *Distribution of Murres Outside the Breeding Season. "Circumpolar Murre Banding Program"*. CAFF International Secretariat, Akureyri, Iceland, i-iv + 20 pp. ISBN: 9979-9526-7-9

For further information and additional copies, please contact:

CAFF International Secretariat
Hafnarstraeti 97
600 Akureyri
Iceland
Phone: +354 462-3350
Fax: +354 462-3390
Email: caff@caff.is
Internet: http://www.caff.is

CONSERVATION OF ARCTIC FLORA AND FAUNA

CAFF Technical Report No. 13
(2004)

Distribution of Murres Outside the Breeding Season

"Circumpolar Murre Banding Program"

North Atlantic Region

by

Aevar Petersen and Vidar Bakken

on behalf of the

CIRCUMPOLAR SEABIRD GROUP (CBird)
(an expert subgroup of CAFF)

About CAFF

The program for the Conservation of Arctic Flora and Fauna (CAFF) of the Arctic Council was established to address the special needs of Arctic ecosystems, species and their habitats in the rapidly developing Arctic region. It was initiated as one of four programs of the Arctic Environmental Protection Strategy (AEPS), which was adopted by Canada, Denmark/Greenland, Finland, Iceland, Norway, Russia, Sweden and the United States through a Ministerial Declaration at Rovaniemi, Finland in 1991. Other programs initiated under the AEPS and overtaken by the Arctic Council are the Arctic Monitoring and Assessment Programme (AMAP), the program for Emergency Prevention, Preparedness and Response (EPPR) and the program for Protection of the Arctic Marine Environment (PAME).

Since its inaugural meeting in Ottawa, Canada in 1992, the CAFF program has provided scientists, conservation managers and groups, and indigenous people of the north with a distinct forum in which to tackle a wide range of Arctic conservation issues at the circumpolar level.

CAFF's main goals, which are achieved in keeping with the concepts of sustainable development and utilisation, are:

- to conserve Arctic flora and fauna, their diversity and their habitats;
- to protect the Arctic ecosystems from threats;
- to improve conservation management laws, regulations and practices for the Arctic;
- to integrate Arctic interests into global conservation fora.

CAFF operates through a system of Designated Agencies and National Representatives responsible for CAFF in their respective countries. CAFF also has an International Working Group, which meets regularly to assess progress. CAFF is headed up by a chair and vice-chair who rotate among the Arctic countries. The CAFF International Secretariat, located in Akureyri, North Iceland, supports the chair and vice-chair; coordinates implementation of the CAFF Work Plan; coordinates cooperation with other Arctic Council working groups; and communicates CAFF goals and activities to the public.

The majority of CAFF's activities are directed to conserving Arctic biodiversity—the abundance and diversity of Arctic flora, fauna, and habitats—and to integrating indigenous people and their knowledge into CAFF. In recognition of this, the Arctic Ministers in 1998 endorsed CAFF's *Strategic Plan for Conservation of Arctic Biological Diversity* as a framework for future program activities. The Strategic Plan is built around five objectives addressing biodiversity monitoring, conservation of genetic resources, species and habitats, establishment of protected areas, conservation outside protected areas, and integration of biodiversity conservation objectives into economic plans and policies. Examples of major projects CAFF is currently working on are: a status report on Arctic biodiversity; development of a program to monitor Arctic biodiversity; assessment of climate change impacts on Arctic ecosystems in collaboration with AMAP and other Arctic organisations; assistance with implementation of circumpolar conservation strategies for murres (guillemots) and eiders; development of a Circumpolar Protected Areas Network (CPAN); preparing a Circumpolar Arctic Vegetation Map; and listing and mapping rare Arctic vascular plants. Whenever possible, CAFF works in co-operation with other international organisations and associations to achieve common conservation goals in the Arctic.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

Figures

Tables

1.0 Introduction

The murres (called guillemots in UK) *Uria* spp. (the auk family, Alcidae) are ecologically important components of the Arctic marine ecosystem. They are also intensively hunted or harvested in the circumpolar countries, and as such, form an important source of food for the Arctic people.

The present report describes a proposal for a co-operative banding (called ringing in the UK) project between the Arctic countries, which are responsible for the total breeding population of Thick-billed Murres (called Brünnich's Guillemots in the UK) *Uria lomvia*, and the majority of the Common Murres (Common Guillemots in the UK) *Uria aalge*. It is hoped that non-Arctic countries would also be able to join this project, since important Common Murre populations breed at lower latitudes, such as in the UK and Germany.

A working title of the project is the "*Circumpolar Murre Banding Program"*. Banding is recognized as an integral part of the International Murre Conservation Strategy and Action Plan (1996), developed within the Arctic Council working group CAFF (Conservation of Arctic Flora and Fauna). The present plan covers only the North Atlantic region, but can be looked upon as a template for the North Pacific region.

Various banding activities have been undertaken in the circumpolar countries during past decades. These data have been compiled into a common database and are presently being analyzed through the efforts of the Circumpolar Seabird Group (CBird), an expert subgroup of CAFF. These analyses set the scene for future information gathering where banding will be used as a tool for research and management of murre populations.

2.0 Purpose and Objectives

The main purpose of this document is to propose a coordinated international banding plan for Thick-billed Murres and Common Murres. Banding is an essential tool for describing with mapping the winter distribution of different murre populations, identifying overlapping distributions, determining the timing of migration, and ascertaining impacts of various mortality factors, such as hunting, upon these.

Two main objectives are proposed for executing this plan:

- Banding to be carried out in at least one, preferably more, key colonies in each country.
- Banding preferably to be undertaken in the entire breeding region of the two murre species during the same years.

Priorities should be given to murre populations in those regions where gap analyses have shown are most in need of further data.

3.0 Background

A proposal for a coordinated banding project was first tabled at a Nordic meeting on changes in alcid populations held in Norway 1992 (Ekker 1993). This call was in response to the Nordic Council of Ministers who had earlier passed a resolution as to the conservation of the Common Murre. The idea for a co-operative banding program was elaborated upon at the first Circumpolar Seabird Group (CBird 1) meeting in Sacramento, California, in January 1994, and originally Iceland, Norway and Canada were charged with putting together a discussion paper, later undertaken by Iceland and Norway.

The foundation for a banding project was elaborated in the Co-operative Murre Conservation Strategy (CAFF 1996), which was endorsed by the Arctic ministers in 1996 at the Inuvik Ministerial of the Arctic Environmental Protection Strategy (AEPS, now a part of the Arctic Council). This document was the first strategy to be developed by the Conservation of Arctic Flora and Fauna (CAFF) program. The Strategy contains six objectives which address: (1) Consumptive Use; (2) Non-Consumptive Use; (3) Commercial Activities and Industries; (4) Murre Habitat Protection and Enhancement; (5) Communication and Consultation; and (6) Research and Monitoring. Banding, as a research tool, can make significant contributions to all of these objectives.

4.0 The Project Proposal: The Usefulness of Banding

Banding is basically a tool, or a method, to achieve certain results, whereby a metal band is placed on the bird's leg in the hope that someone, who recovers it, will report the finding to the relevant banding office (of which there is basically one in each country). Banding has been used for over a century for researching the travels of birds, as well as the mortality factors, longevity, age of first breeding, survival, and other parameters important in the dynamics and long-term survival of populations. A century of scientific banding in the world was achieved in 1999, and celebrated in Helgoland, Germany, the year after.

A number of man-related factors influence the results of banding, such as the density of human occupation, if a species is hunted or not, the intensity of fishery operations, oiling probabilities, etc., as well as many natural ones. Banding is still the major technique for studying the travels of birds. Other techniques have been developed in recent years, such as satellite tracking and DNA-analyses, which in certain instances could be used to identify the origin of individual birds. As yet, these tools can supplement, yet not replace, banding data. It is important that a close affiliation is kept with these different techniques in the execution of a circumpolar banding plan. These may cast further light on certain aspects of banding results, hence help in their interpretation.

Banding makes an important contribution to the information required for the conservation of murres. A number of direct anthropogenic forces, such as hunting and egg-harvesting, indirect human-induced ones, such as climate change or incidental take in fishing gear, and natural factors, such as feeding conditions, can influence murre populations. There are certain risks for murres associated with migrating to other regions. Populations breeding in different countries come together during winter where

they are subject to hunting, although protected on their breeding grounds. Hence conservation of these populations is not fulfilled without an effective co-operation of the respective countries. The CAFF program creates a forum for the implementation of such multi-lateral initiatives, as it encourages cooperation between managers and scientists in different countries and allows for common analyses of data, which benefit from wider considerations than from within only a single country.

The challenge of the project includes identifying the wintering grounds of the different populations and age groups, the degree of mixing of populations, and the timing of migration. Individual murre populations may use different wintering areas and differ in their timing of migration. Different age classes can be segregated both in time and space outside the breeding season, as well as within the breeding season. Hence, any one murre population can have different patterns of dispersal, migratory routes, and wintering areas.

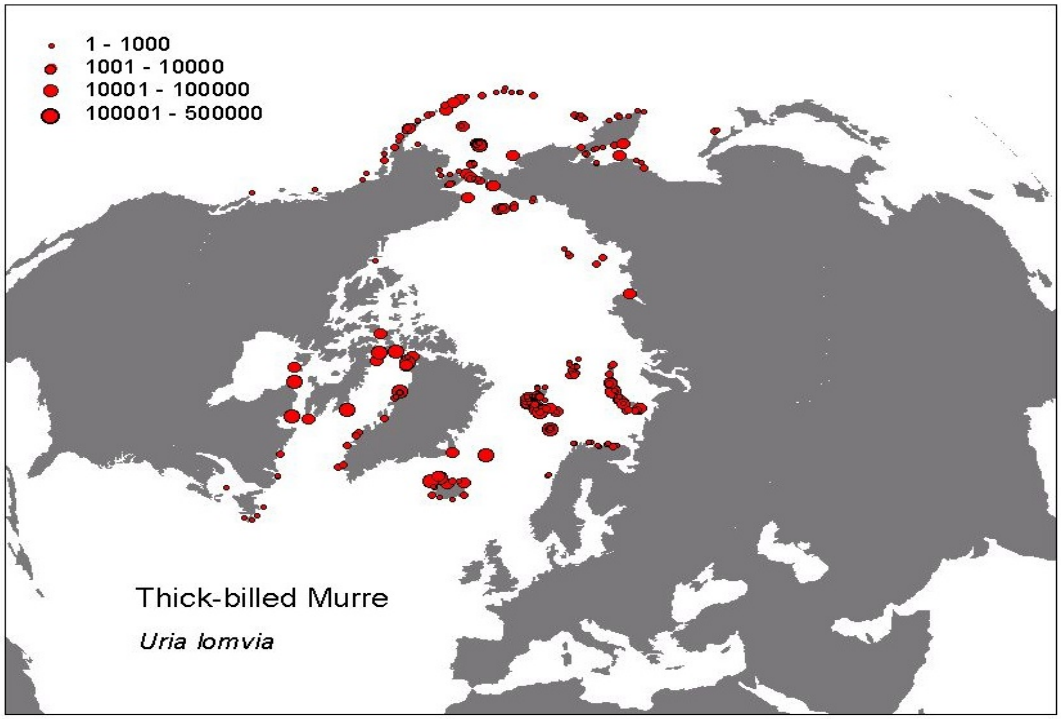
Banding also yields information on mortality rates, while if reinforced with population studies at colonies, would produce demographic information such as on production of young, age of breeding, recruitment of new breeders, etc. Moreover, it is important that the winter information can be related back to breeding sites where monitoring takes place so that trends at breeding colonies can be assessed in relation to wintering data, and *vice versa*. Therefore, a major challenge is to estimate what risks are associated with traveling to different wintering areas, such as pressures from various mortality factors in divergent regions. The resulting information can be used to study the implications of hunting, such as where and when this takes place, its intensity, and impact on the populations in question.

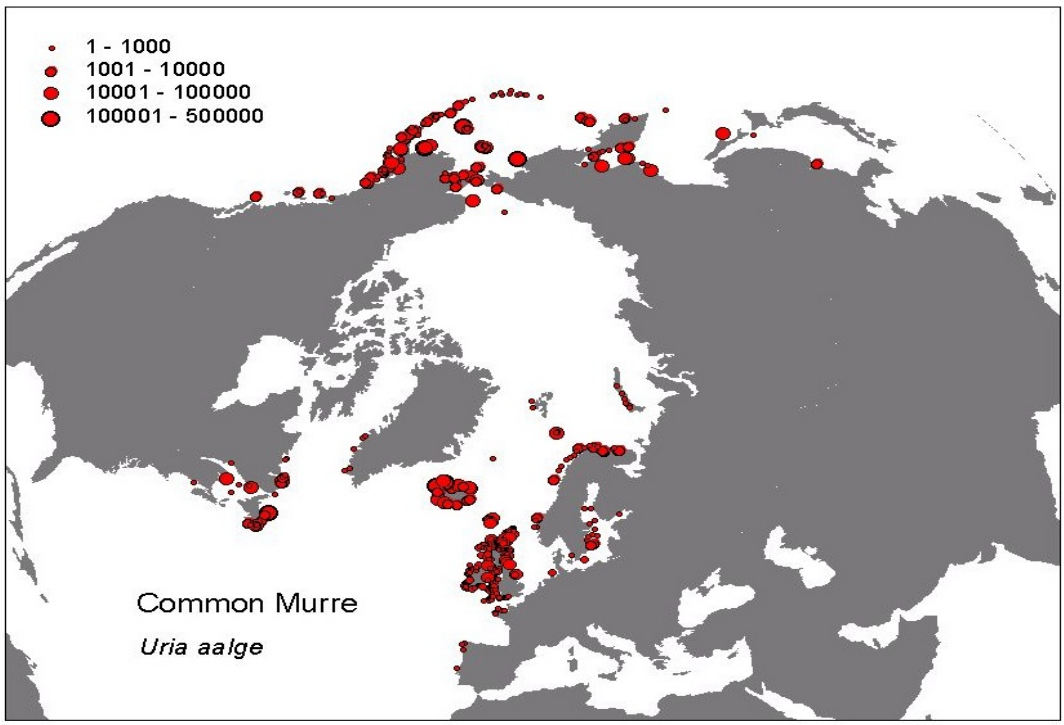
5.0 The Murre Populations

The breeding populations of the two murre species are partially segregated geographically. The world population of the Thick-billed Murre breeds totally within the CAFF-designated Arctic region – in USA, Canada, Greenland, Iceland, Jan Mayen, Svalbard, mainland Norway, and Russia.

The Common Murre is more widespread, breeding in the USA, Canada, Greenland, Iceland, Jan Mayen, Faeroes, Svalbard, mainland Norway, Russia, Sweden, Finland, Denmark, Germany, UK, France, Spain, and Portugal. This species is Low Arctic to temperate in distribution, with ca. 75% of the world population breeding in the Arctic. Therefore, a substantial part of the world population breeds south of the CAFF border, such as in the UK. Nonetheless, significant movements of Common Murres occur from the northern breeding areas into the temperate zone, as well as from the south into the Arctic region, calling for co-operation with non-CAFF countries. The world population of Thick-billed Murres is estimated at ca. 6.8 million breeding pairs (Nettleship & Evans 1985), of which ca. 75% are in the Atlantic region (Gaston & Jones 1998). The Common Murre is estimated at 4.17 million breeding pairs (Nettleship & Evans 1985), of which ca. 60% are found in the Atlantic region (Gaston & Jones 1998). The world breeding distribution of the two murre populations is shown in Fig. 1.

Fig. 1: World breeding distribution of the two murre species.





The estimated population size by country, either as numbers of breeding pairs or numbers of birds, is given in Table 1.

Table 1: The estimated size of different murre populations. The estimates refer to different years according to country. In some cases, numbers of birds are listed (B), in other cases pairs (P).

Country	Prs (P)/ Birds (B)	Common Murre	Thick-billed Murre	Reference
USA	B	6,000,000	6,000,000	USFWS 1992
Canada	P	600,000	1,454,000	Nettleship & Birkhead (1985)
Greenland	B	1,500 – 2,000	535,000	Kampp *et al.* (1994); Boertmann *et al.* (1996)
Iceland	P	992,340	579,450	Gardarsson (1995)
Jan Mayen	P	200	75,000	Snow & Perrins (1998)
Svalbard	B	100,000	850,000	Bakken & Pokrovskaya 2000; Barrett & Golovkin 2000
Norway	P	10-15,000	1-2,000	Bakken & Pokrovskaya 2000; Barrett & Golovkin 2000
Russia	B	15-20,000	500,000-1 mil.	Yu. Krasnov (unpubl.)
Finland	P	60-80	0	Snow & Perrins (1998)
Sweden	P	10-11,000	0	Snow & Perrins (1998)
Denmark	P	2,000	0	Snow & Perrins (1998)
Germany	P	2,400	0	Snow & Perrins (1998)
Faeroes	P	100-200,000	0	Snow & Perrins (1998)
UK	P	577,000	0	Snow & Perrins (1998)
France	P	320	0	Snow & Perrins (1998)
Spain	P	15-20	0	Snow & Perrins (1998)
Portugal	P	20	0	Monteiro *et al.* (1995)

For Thick-billed Murres, dramatic declines have taken place in Greenland during the last decades, due to over-hunting and bycatch in Salmon nets (Tull *et al.* 1972; Falk & Durinck 1991; Falk & Kampp 2001). Declines have also been described in Iceland, presumably due to intensive hunting on the wintering grounds (Gardarsson 1995; Náttúrufræðistofnun Íslands 2000). Population changes are less pronounced elsewhere. More accurate estimates and monitoring are especially needed in Russia and Iceland.

Declines have been observed in some of the larger populations of Common Murres, as well as in small, peripheral populations. Especially pronounced declines have taken place along the North-Norway coast and on Bear Island (Vader *et al.* 1990), and in the Faeroese population (Olsen 1982; ICES 1994), presumably due to over-fishing by man. Declines have also been reported for the small southern peripheral populations in France, Spain and Portugal. The rare Iberian subspecies *Uria aalge ibericus* is listed as a subspecies in need of special conservation efforts with the Bern Convention, even prior to the Prestige oiling incident in November 2002, which killed thousands of Common Murres. On the other hand, increases have been observed in Germany, the Baltic, eastern Canada, and Iceland. The very important British colonies have showed diverging trends. Further monitoring data are especially needed for the relatively large Icelandic and Russian populations, on which work has been rather limited.

6.0 Previous Banding Activities

The circumpolar countries have been engaged in various murre banding activities during past decades, in fact from as early as the 1930s, but mostly as irregular activities or short-term projects. The intensity of banding and available results vary profoundly between countries, depending on the size of the different murre populations and banding efforts as expected, but also due to factors such as how well the breeding colonies render themselves for banding operations due to varying degrees of accessibility. The number of recoveries gives a good indication of the available information. These include both recoveries from the national territories and the more long-distance movements between countries. The available information is summarized in Tables 2 and 3 for Common Murre and Thick-billed Murre, respectively.

Table 2: The number of Common Murre recoveries abroad and nationally as reported by national banding schemes (data until 1999 except where indicated). Some recoveries have been discarded because of uncertain data.

BANDING AREA	RECOVERIES ABROAD	NATIONAL RECOVERIES	TOTAL	
British Isles	2,904	3,188	6,092	
Canada	11	1,117	1,128	*
Denmark	108	165	273	
Faeroes	83	710	793	
Germany (Helgoland)	490	186	676	
Greenland	0	17	17	
Iceland	5	103	108	
Norway	22	407	429	
Portugal	?	?	?	
Russia	92	37	129	**
Spain	?	?	?	
Sweden	1,604	852	2,456	
USA	0	4	4	*
Total	5,319	6,786	12,105	

*Data until 1997; ** Data until 1995

Of the Arctic countries, Canada has carried out the most extensive research program on the Thick-billed Murre over many years, including banding (e.g. Gaston & Nettleship 1981; Gaston & Elliot 1991; Gaston *et al.* 1994). Common Murres have also been banded in large numbers. In Greenland, expeditions have been organized to colonies on both the east and west coasts, while most banding results for Thick-billed Murres in Greenland are from decades ago. Little information was available on either species in Iceland prior to a three-year pilot study in 1993-1995, since which a small scale banding has taken place, especially of Common Murres. On Svalbard, extensive banding took place on Bear Island in 1991 and at Kovalskifjellet in 1989 and 1992 (Bakken & Mehlum, in manuscript); while smaller scale banding has been executed at a few other colonies. Russia used to conduct a long-term banding program for murres during the period from the 1930s to the mid-1990s. Approximately 60,000 birds of both species were banded in Murman colonies by Kandalakshskiy Nature Reserve during this period. Complete data for Novaya Zemlya is lacking, but archival data for ca. 50,000 Thick-billed Murres banded in the archipelago (mostly at two colonies,

Gribovaya and Bezymannaya) in 1947-1951 by the Novozemelskiy Department of the Seven Islands State Nature Reserve do exist (Nikolaeva *et al*. 1996). Later, the Russian program was unfortunately cancelled, but Norwegian-Russian expeditions were arranged to Novaya Zemlya in three consecutive years (1994-1996) under a formal bilateral agreement (Strøm *et al*. 1994, 1995, 1997).

Table 3: The number of Thick-billed Murre recoveries abroad and nationally as reported by the national banding schemes (data until 1999 except where indicated). Some recoveries have been discarded because of uncertain data.

BANDING AREA	RECOVERIES ABROAD	NATIONAL RECOVERIES	TOTAL	
Canada	1,331	250	1,581	
Greenland	426	2,708	3,134	
Iceland	9	0	9	
Norway	209	4	213	
Russia	28	13	41	*
Total	2,003	2,975	4,978	

*Data until 1995

USA and Russia also have a similar agreement on seabird research in the Far East of Russia. In the Faeroes, UK, Sweden, Denmark and Germany, small scale banding of Common Murres takes place as part of individual research programs, general banding operations such as at bird observatories, or as initiatives by individuals.

A number of analyses have been carried out on murre movements using recoveries of murres banded in different countries. Such references include (and this is not a complete list):

Canada: Tuck (1961); Gaston & Nettleship (1981); Nettleship & Birkhead (1985); Donaldson *et al*. (1996)
Greenland: Salomonsen (1967); Kampp (1988)
Norway: Holgersen (1961); Runde (1982); Nikolaeva *et al*. (1996); Bakken *et al.* (2003)
Faeroes: Reinert (1976); Olsen (1982); Olsen *et al*. (2000)
UK: Southern *et al.* (1965); Birkhead (1974); Mead (1974); Swann & Ramsay (1983); Heubeck *et al.* (1990); Harris & Bailey (1992); Halley & Harris (1993); Harris *et al.* (1996); Wernham *et al*. 2002
Germany: Drost (1930); Schmidt (1983); Hüppop (1996)
Denmark: Lyngs & Kampp (1996)
Sweden: Peterz & Oldén (1987); Anon (1988); Lyngs (1993); Olsson *et al*. 1999
Russia: Tatarinkova *et al*. (1983); Nikolaeva *et al*. (1996).

Some insight is given here into the present knowledge of movements of murres. High Arctic Canadian Thick-billed Murres travel to West-Greenland and Newfoundland in winter, where they are subject to intensive hunting. Some birds stay in the ice polynyas of the far north the whole winter, as do many West-Greenlandic birds, which also winter along the southern part of Greenland and in Newfoundland waters. The movements of East-Greenland Thick-billed Murres are unknown, as are those of Jan

Mayen birds. Emerging results indicate Icelandic birds spend the winter in West-Greenland and Newfoundland, but more banding is needed. Conversely, Svalbard and

North Norwegian birds winter in Iceland, Greenland, and to a lesser extent in Newfoundland, where they are subject to hunting and oiling. Still large numbers of Thick-billed Murres, from the Svalbard and Russian colonies, spend the winter in the Barents Sea, while many Russian birds also travel to West-Greenland for the winter.

Recovery rates, from the present data available, only give partial information on the impact of hunting. For instance, the 5% recovery rate of Svalbard-ringed Thick-billed Murre chicks may suggest winter mortality likely to impact the breeding population. However, this depends significantly on the age of the birds at recovery; if the birds are adults, the effects are likely to be longer-lasting and be more serious to the population.

The movements of Common Murres are different from those of the Thick-billed Murres, as they are generally more sedentary than the Thick-billed Murres. The northward feeding movements of Common Murres in late winter are of particular interest. This is noticed, for instance, in Faeroese, British and German Common Murres, which move towards Norway and Iceland. Icelandic Common Murres appear to be near entirely sedentary, while little is known of the movements of the rare Greenland Common Murre population. Canadian Common Murres probably move offshore and south in winter. Faeroese birds travel southwards to the UK, while many are also sedentary. Norwegian birds stay along the Norwegian coast or move southwards into the North Sea, while German and British birds are primarily sedentary, some traveling further north and south, even entering the Mediterranean. Common Murres in Finland, Sweden and Denmark appear to spend the whole year in the Baltic without mixing with other populations. Little is known of the movements of the small peripheral French, Spanish, and Portuguese populations.

7.0 Future Banding Activities

The project involves banding sufficient numbers of murres at preferably the most important colonies, and in as widely geographically dispersed parts of the breeding range as possible. Banding in the same year is desirable but not essential since there appears to be little annual variations in recovery rates. Furthermore, this may not be practical for all participants, besides a sufficient number of birds is not likely to be secured in one season. Common analyses of banding results call for banding in all the participating countries at least within a limited timeframe, if not actually in the same years.

As an initial effort, a banding program over a 3-year period is recommended. It is necessary that banding be carried out on as many age groups as possible, i.e. breeders, sub-adults and young (or pulli), since each age group may show a different migration pattern. Wintering areas may also shift in time; also with certain temporal variations, both annual and seasonal, in relation to feeding conditions. The analyses underway on the material presently available have indicated that international efforts may be needed in some critical regions, such as Iceland and Russia. The main problems are of financial and logistic character rather than lack of experience or a banding scheme. For Russia,

it is recommended that the banding program be re-established in Murman and Novaya Zemlya, and also one initiated on Franz-Josef Land.

7.1 Banding sites

Members of the Circumpolar Seabird Group (CBird) have identified the national sites in the CAFF countries listed below as potentials for future banding work. These also include a preliminary list of sites outside the Arctic, especially of those populations making long-distance movements from natal areas into the Arctic (Table 4).

Table 4: Murre colonies recommended for banding purposes.

Country	Common Murre colonies	Thick-billed Murre colonies
Canada	Funk Island; Gannet Island	Coats Island; Digges Island; Coburg Island; Akpatok Island
Greenland	(no site identified; very rare)	Ittorqortoormiit/Scoresbysund; Avanersuaq/Thule; Udre Kitsissut
Iceland	Látrabjarg; Hornbjarg; Grímsey; Langanes; Skrúður; Krísuvíkurbjarg	Látrabjarg; Hornbjarg; Grímsey; Langanes; Skrúður; Krísuvíkurbjarg
Norway	Hornöya; Hjelmsoy; Röst; Runde	Hornöya
Jan Mayen	(no site identified; very rare)	(no site identified at this stage)
Svalbard	Bear Island	Bear Island; Kovalskifjellet; Fuglehuken
Russia	Kharlov island (Kandalaksha State Nature Reserve); Dvorovaya Bay; Bezymyannya Bay (Novaya Zemlya)	Kuvshin Island (Kandalaksha State Nature Reserve); Bezymyannya Bay; Arkangelskaya Bay/Vilkitski Bay (Novaya Zemlya); Cape Flora (Nordbruck Island, Franz Josef Land)
Denmark	Christiansö	
Sweden	Stora Karlsö	
Finland	(no site identified; very rare)	
Faeroes	Skuvoy	
Germany	Helgoland	
UK	Isle of May; Canna; Fair Isle	
France	(no site identified; very rare)	
Spain	(no site identified; very rare)	
Portugal	(no site identified; very rare)	

At these colonies, banding has been undertaken in the past or is considered suitable for a circumpolar banding program. One reason for selecting these colonies is that they are being, or should be, used for monitoring purposes. The location of these sites is shown on Fig. 2.

Fig. 2: Location of murre colonies recommended for banding purposes.

7.2 Band types

Most countries' banding schemes have their own sources of bands from commercial companies. Special bands on murres are produced by band makers, such as Lambourne's of UK, in order to compensate for the hard wear that is experienced on murre bands, eventually rendering the inscriptions on the traditional circular bands illegible. More recently, I.Ö. Mekaniska of Sweden, started producing similar bands. These are triangular, or pyramid-shaped, with the inscription on the sides. The excessive wear experienced with murres becomes concentrated on the underside of the band, instead of on the inscriptions. It is recommended that the special murre bands are used for the proposed banding plan. Although these are more expensive than traditional bands, they are considerably longer lasting than the traditional bands of aluminium, incaloy or stainless steel. Some of these bands are engraved with such large letters that they can even be read in the field with a telescope at short distances.

7.3 Banding recoveries

The usefulness of recovery data resulting from banding operations, especially the numbers of recoveries, depends on: (1) the numbers banded; and (2) the age of the birds at banding (reflected to some extent in the catching method used). It is necessary to band murres at different ages (adults, sub-adults, chicks), employing different methods, because of possible differences in the temporal and geographical distribution of the age classes and sexes. Such divergent strategies are already shown by the murres on leaving the cliff towards the end of the breeding season when the chick is only about 25% grown. The male murre accompanies the chick while the female goes elsewhere into moult and becomes flightless.

Different temporal and geographical distribution may influence the susceptibility of the birds to recovery, and the rate of mortality in birds usually varies between age classes. These factors may affect the number of birds needed for banding so as to produce meaningful results. How representative the recoveries are also depends, among others, on the recovery methods, since there are biases towards human-induced mortality factors (shooting, bycatch, etc.) in the sample. The distribution of humans, the existence of beached-bird survey programs, high proportion of birders, etc. furthermore influence the reported distribution of recoveries.

7.4 Data recording

It is important that full use is made of birds captured for banding since the primary cost of travelling to murre colonies is substantial. Hence, the data gathered at capture and their circumstances should be recorded as carefully as possible. Besides the basic data, i.e. species, band number, location, date, age, and bander, a variety of supporting information can be important when analyzing the data. Such information includes catching method, presence or absence of brood patch, food carried by the adults, and capture site within the colony.

The brood patch is used by breeders for incubating their single egg. Its absence therefore indicates an immature bird, while some non-breeders may have a partially developed brood patch. Food carried by full-grown birds can be taken as a sign of breeding and therefore maturity, as the birds are delivering food to their young. The full-grown birds moreover arrange themselves at different sites in or around the colony. The breeders stay on the breeding ledges, sometimes lying on the water below the cliff, or flying to and from the ledges, also variable depending on the time of season. Immatures of Common Murres frequently stay in non-breeding “clubs”, most often on rocks or on non-breeding ledges below the cliff, contrary to the Thick-billed Murres, which stay offshore and are more pelagic than Common Murres. The catching method often reflects the place at which the birds are caught, and therefore their behavior. The baseline is that individual birds behave in a different manner, so the records made can be important when analyzing their dispersal according to different age classes and their breeding status.

7.5 Other field data

Field trips to suitable Arctic murre banding sites are usually expensive, and banding is demanding on manpower, if sufficient numbers of birds are to be banded. Therefore, it is advisable that such trips are used as fully as possible. Other data, which would be helpful for other initiatives, could be collected at the time of banding. It is recommended that, for instance, information is also collected on food carried to young; biometry measurements obtained (according to a standard protocol to avoid different ways of measuring); blood samples taken for DNA analyses; samples for contaminant analyses; and parasites (e.g. ticks, feather lice) collected.

8.0 Data Handling and Analyses

Certain amounts of data already exist on the movements of murres. Co-operative efforts have already been initiated to bring these data together for common analyses before further banding studies are undertaken. Hitherto, analyses have only been carried out on the basis of information from a single country at a time. The value of the

present exercise is its wide geographic coverage. Information for different populations are brought together and analyzed with reference to each other, in order to achieve a better picture of population movements and mixing. However, it is already known that the present information is highly variable and will not fully describe the movements of murres as achieved through banding. Common analyses of present data give a clearer picture as to how to execute a future co-operative circumpolar banding plan.

It is suggested that the project be carried out in three parts:

- Analyzing the presently available data for the Thick-billed Murre and the Common Murre;
- A migration atlas;
- A common assessment after an initial period of three years of intensive banding.

Part one is presently underway led by Norway, with co-operation from Iceland, Greenland, and Canada, and with the support of other countries. This work forms a part of the PhD thesis by Vidar Bakken, and will eventually be published as two scientific papers under the authorship of the participating parties. The papers deal with the present migration routes of both species in relation to genetic variance, subspecies, and the environmental situation during the Pleistocene period, which influenced the evolution of the migration pattern of the species. As regards the Common Murre, this is primarily done in co-operation between Norway, Iceland, and Faeroes. The Baltic Common Murre populations are principally separate and a common analysis is desirable for banding results from Denmark, Sweden, and Finland.

Part two, the migration atlas, is presently at the planning stage. This will mainly be based on maps from the present banding analyses and forms a background document for future banding plans.

Part three is suggested for summers 2005-2007, when the analyses of the presently available material will be completed. An integrated analysis of all the circumpolar material could be timely at the earliest in 2009.

9.0 Major Gaps in Banding Activities

The compilation of banding return data and the on-going analyses of this material, currently carried out by Vidar Bakken, has identified some of the major gaps in the current banding data sets. However, as we currently do not have the banding data available, only the banding returns, it is not possible to conduct a full gap analysis.

For the Thick-billed Murre, the largest single gap for a large population is Iceland, especially for chicks and immatures. Few or no data are available for the relatively small population on Jan Mayen and for birds from the Franz-Josef Land archipelago. Further banding is also needed for the Thule and Upernavik districts in West-Greenland, for the East-Greenland colonies, and Novaya Zemlya colonies in Russia.

Within the CAFF region, further banding of Common Murres is especially required in Iceland. In earlier years, considerable banding was undertaken in Canada, Norway and

Russia, but less effort more recently. Continued banding in more southerly countries, such as the Faeroes and UK, would also improve any future analyses.

10.0 The Participants

For the purpose of this proposed project of the Arctic countries, the initial participation is expected from Canada, Greenland, Iceland, Faeroes, Norway, and Russia for the North Atlantic for both species. As related to the Common Murre, it is also suggested that participation be sought from within those countries from where birds migrate into the Arctic, especially the UK, and Germany. It is further recommended that attention be given to the Baltic Common Murre population, although non-Arctic, with the participation of Denmark, Sweden, and Finland.

11.0 Funding Opportunities

Field expenses are considerable for work at most colonies due to their remoteness, e.g. travel and logistics, for the demand on manpower, the bands, etc. Besides contributions from institutional budgets and national research funds, which may fund part of individual national efforts, it is desirable to collaborate on applications to international funding agencies, such as the EU, the Nordic Council, or others.

12.0 Integration with Other Data

To realize the full value of murre banding results, it is important to recognize other kinds of data, which are related to the issue at hand, such as information on distribution at sea, DNA-analyses, and data from monitoring.

12.1 Distribution at sea

Banding will contribute only limited information for murres on the high seas. The great majority of hunting takes place from land-based stations, and hence at relatively short distances from coasts. Murres are pelagic in distribution and many of the birds, which die out at sea may never be recovered, as their remains sink at sea. Some are scavenged, their remains disintegrate, and eventually fall to the bottom. Other techniques are therefore needed if we are to understand the temporal and spatial dispersal of murres in greater detail.

Several nations have carried out surveys of seabirds at sea. These studies have contributed to the knowledge of temporal and numerical distribution of individual species, including murres, in different parts of the North Atlantic. Some valuable surveys (but by no means the only ones) can be mentioned, such as those run by Canada (Brown *et al.* 1975; Brown 1986; Lock *et al.* 1997) and the UK in their respective waters (Blake *et al.* 1983; Tasker *et al.* 1987; Reid *et al.* 2001), but also others, such as in Greenlandic waters (Mehlum 1989; Petersen 1993; Mosbech & Johnson 1999; Merkel *et al.* 2002), Norwegian seas (Anker-Nilssen *et al.* 1988; Mehlum 1989, 1991; Erikstad 1991; Joiris 1992; Isaksen 1995), and Faeroese waters (Taylor & Reid 2001; Skov *et al.* 2002). Much smaller scale survey data are available from Iceland (Danielsen *et al.* 1990; Petersen 1993; Gardarsson 1999) and Russia for the Barents Sea area. Russia recently started aerial surveys for seabirds allowing large areas of high seas to be covered in short periods (Krasnov *et al.* 2004). First results provide unique data on murre distributions in the post-breeding period in major

portions of the Barents Sea (Krasnov & Chernook 1996; Krasnov & Nikolaeva 1996; Krasnov *et al.* 2002). Still large ocean regions have yet to be surveyed, or are at best poorly known, including at different times of the year. These areas include the Russian waters east of the Barents Sea; the waters between Svalbard, Jan Mayen, and East-Greenland; the seas between Iceland, Norway and Faeroes; that between Iceland and Greenland; and the high seas between Greenland and the High-Arctic Canadian islands.

Two types of tracking devices have become available for bird research in recent years, satellite trackers and data loggers. A number of technical difficulties still limit the use of satellite transmitters on murres, such as size and weight of the device, battery life, and shape of the antenna. Murres have a high body mass compared to wing area, and additional wing loading could be critical for their survival. The minimum weight of commercial satellite transmitters available now is ca. 20g but even adding this weight to birds, which already have a high wing loading, can be detrimental (Hatch *et al.* 1995, 1996).

Data loggers have also certain difficulties relating to their size for use on murres. Moreover, they rely on capturing the respective birds again for downloading the information gathered on the location of the birds on given dates, contrary to the satellite trackers, which transmit their accumulated data. For practical purposes, data loggers would be put on birds nesting at a given site, relying on the birds to return to the same site the next breeding season. Theoretically, the movements of the birds can be traced from the time the device was attached.

12.2 The origin of birds

Other means by which to trace the movements of murres relate to examining the birds themselves. The applicability of such methods relies on local genetic and morphometric (biometric) variations in birds of the same species, but such variations have only been partially described for murres. There is, therefore, still much scope for additional studies using, among others, all the scientific specimens at numerous museums, to describe the variations between murre populations.

More recently, advances in DNA-techniques give promising results, which eventually could lead to identifying the origin of individual birds, wherever they are captured, and by which advancing the knowledge on murre movements and the degree of mixing of populations. Studies are underway in this direction, facilitated among others, by the CAFF circumpolar co-operation (Friesen *et al*. 1993, 1996 a, b).

Stable isotopes analyses of murre tissues, e.g. muscle, bone, liver, and blood, may also turn out to be useful in differentiating birds from different colonies, if there are regional differences in diets (see Schmutz & Hobson 1998).

Ultimately, the combination of banding, morphometric, genetic, and stable isotope data may be the most powerful and versatile approach in identifying murre populations as to their geographic origin.

12.3 Colony monitoring

From a pragmatic, logistical point of view, banding should be undertaken at the same colonies as those that are monitored for the numbers of birds (although not necessarily on the same stretches of cliffs). Travel costs are substantial parts of the total budgets when working in the Arctic, and these should be used as economically as possible. From a scientific standpoint, it is also important that trends, which are picked up in wintering populations, be translated to breeding colonies, hence backed up with colony monitoring data in summer.

CAFF has developed a murre monitoring plan, which is complimentary to this murre banding plan. During the development of both plans, links have been secured to make sure the same colonies are chosen for monitoring and banding.

13.0 Bibliography

Anker-Nilssen, T., V. Bakken & K.-B. Strann 1988. Impact assessment oil/seabirds for petroleum activity in the Barents Sea south of 74º30'N. Viltrapport 46. 98 pp. (Norwegian)

Anon 1988. Guillemot *Uria aalge*. Swedish Bird Ringing Centre. Annual Report 1988: 9-15.

Bakken, V. & I.V. Pokrovskaya 2000. Brünnich's Guillemot *Uria lomvia*. Pp. 119-124 *in:* T. Anker-Nilssen, V. Bakken, H. Strøm, A.N. Golovkin, V.V. Bianki & I.P. Tatarinkova (eds). The status of marine birds breeding in the Barents Sea region. Norsk Polarinst. Rapportser. No. 113, Norwegian Polar Institute, Tromsø. 213 pp.

Bakken, V. & F. Mehlum, in manuscript. Wintering areas and recovery rates of Brünnich's Guillemot *Uria lomvia* ringed in the Svalbard archipelago. Manuscript submitted to Arctic.

Bakken, V., O. Runde & E. Tjørve 2003. Norwegian Bird Ringing Atlas. Stavanger Museum, Stavanger. 431 pp.

Barrett, R. & A.N. Golovkin 2000. Common Guillemot *Uria aalge*. Pp. 114-118 *in*: T. Anker-Nilssen, V. Bakken, H. Strøm, A.N. Golovkin, V.V. Bianki & I.P. Tatarinkova (eds). The status of marine birds breeding in the Barents Sea region. Norsk Polarinst. Rapportser. No. 113, Norwegian Polar Institute, Tromsø, 213 pp.

Birkhead, T.R. 1974. Movement and mortality rates of British Guillemots. Bird Study 21: 241-254.

Blake, B.F., M.L. Tasker, P.H. Jones & T.J. Dixon 1983. Distribution of seabirds in the North Sea. Final report of the Nature Conservancy Council´s Seabirds at Sea Team, Nov. 1979 – Nov. 1982. Nature Cons. Council, Edinburgh. 443 pp.

Boertmann, D., A. Mosbech, K. Kampp & K. Falk 1996. Seabird colonies in Western Greenland (60º - 79º 30' N. lat.). NERI Technical Report No. 170. 148 pp.

Brown, R.G.B. 1986. Revised Atlas of Eastern Canadian Seabirds. Canadian Wildlife Service. 111 pp.

Brown, R.G.B., D.N. Nettleship, P. Germain, C.E. Tull & T. Davis 1975. Atlas of eastern Canadian seabirds. Canadian Wildlife Service. 220 pp.

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

Danielsen, F., H. Skov, J. Durinck & D. Bloch 1990. Marine distribution of seabirds in the Northeast Atlantic between Iceland and Scotland, June-September 1987 and 1988. Dansk orn. Foren. Tidsskr. 84(1-2): 45-63.

Donaldson, G.M., A.J. Gaston, J.W. Chardine, K. Kampp, D.N. Nettleship & R.D. Elliot 1996. Winter distributions of Thick-billed Murres from the eastern Canadian Arctic and western Greenland in relation to age and time of year. Canadian Wildlife Service Occ. Pap. No. 96. 24 pp.

Drost, R. 1930. [On the movements of Helgoland Guillemots (*Uria aalge helgolandica*).] Vogelzug 1: 21-29. (German).

Ekker, M. 1993 (ed.). [Population changes in alcids in the Nordic countries.] Nordic Workshop on alcids, Songli, Trondheim, Norway, 21-23 Oct. 1992.

Erikstad, K.E. 1991. The pelagic distribution of seabirds and their prey in the Barents Sea outside the breeding season. *In*: R. Barrett (ed.). NINA Forskningsrapport Nr. 17: 42-55. (Norwegian).

Falk, K. & J. Durinck 1991. The bycatch of Thick-billed Murres in salmon drift nets off West Greenland in 1988. Pp. 23-27 *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. Pap. 69.

Falk, K. & K. Kampp 2001. [The murre in Greenland: possible effects of different factors influencing the population, and practical limits to resource utilization.] Grönlands Naturinstitut. Teknisk Rapport nr. 38. 54 pp. (Danish).

Friesen, V.L., W.A. Montevecchi & W.S. Davidson 1993. Cytochrome b nucleotide sequence variation among the Atlantic Alcidae. Hereditas 119: 245-252.

Friesen, V.L., W.A. Montevecchi, A.J. Baker, R.T. Barrett & W.S. Davidson 1996a. Population differentiation and evolution in the Common Guillemot *Uria aalge*. Molecular Ecology 5: 793-805.

Friesen, V.L., W.A. Montevecchi, A.J. Gaston, R.T. Barrett & W.S. Davidson 1996b. Molecular evidence for kin groups in the absence of large-scale genetic differentiation in a migratory bird. Evolution 50(2): 924-930.

Gardarsson, A. 1995. [Numbers and distribution of Common Murre *Uria aalge*, Thick-billed Murre *U. lomvia* and Razorbill *Alca torda* in Iceland.] Bliki 16: 47-65. (Icelandic, English summary).

Gardarsson, A. 1999. The density of seabirds west of Iceland. Rit Fiskideildar 16: 155-169.

Gaston, A.J. & R.D. Elliot (eds) 1991. Studies of High-Latitudes seabirds. 2. Conservation biology of Thick-billed Murres in the Northwest Atlantic. Can. Wildl. Serv. Occ. Paper 69. 63 pp.

Gaston, A.J. & I.L. Jones 1998. The Auks *Alcidae*. Oxford University Press, Oxford. 349 pp.

Gaston, A.J. & D.N. Nettleship 1981. The Thick-billed Murres of Prince Leopold Island (A study of the breeding ecology of a colonial high arctic seabird). Canadian Wildlife Service Mongr. Ser. No. 6. xxvii+349 pp.

Gaston, A.J., L.N. de Forest, G. Donaldsson & D.G. Noble 1994. Population parameters of Thick-billed Murres at Coats Islands, Northwest Terrirtories, Canada. Condor 96(4): 935-948.

Halley, D.J. & M.P. Harris 1993. Intercolony movements and behaviour of immature Guillemots *Uria aalge*. Ibis 135: 264-270.

Harris, M.P. & R.S. Bailey 1992. Mortality rates of Puffin *Fratercula arctica* and Guillemot *Uria aalge* and fish abundance in the North Sea. Biol. Conserv. 60: 39-46.

Harris, M.P., S. Wanless & T.R. Barton 1996. Site use and fidelity in the Common Guillemot *Uria aalge*. Ibis 138(3): 399-404.

Hatch, S.A., P.M. Meyers, D.M. Mulcahy & D.C. Douglas 1995. Using implanted satellite transmitters to track the movements of murres and puffins. (Abstract). Colonial Waterbird Soc. Bull. 19(2): 47.

Hatch, S.A., P.M. Meyers, D.M. Mulcahy & D.C. Douglas 1996. Seasonal movements and pelagic habitat use of murres and puffins determined by satellite telemetry. Exxon Valdez Oil Spill. Restoration Project Final Report. Nat. Biol. Serv., Alasaka Sci. Center. 32 p.

Heubeck, M., P.V. Harvey & J.D. Okill 1990. Changes in the Shetland Guillemot *Uria aalge* population and the pattern of recoveries of ringed birds, 1959-1990. Seabird 13: 3-21.

Holgersen, H. 1961. [On the movements of Norwegian Guillemots.] Sterna 4(6): 229-240. (Norwegian, English summary).

Hüppop, O. 1996. [Causes and trends of the mortality of Guillemots (*Uria aalge*) ringed on the island of Helgoland, German Bight.] Vogelwelt 38: 217-224. (German, English summary).

ICES 1994. ICES Report of the Study Group on Seabird/Fish Interactions. Copenhagen 6-10 September 1993. ICES CM 1994/L:3. 119 p.

Isaksen, K. 1995. Distribution of seabirds at sea in the northern Barents Sea. Nor. Polarinst. Medd. 135.

Joiris, C.R. 1992. Summer distribution and ecological role of seabirds and marine mammals in the Norwegian and Greenland seas (June 1988). J. Mar. Systems 3: 73-89.

Kampp, K. 1988. Migration and winter ranges of Brünnich´s Guillemots *Uria lomvia* breeding or occurring in Greenland. Dansk Orn. Foren. Tidsskr. 82(3-4): 117-130.

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 Int., Conserv. Ser. No. 1. 318 pp.

Krasnov, Yu.V. & V.I. Chernook 1996. [Seabirds as indicators of biologically productive zones when conducting autumn aerial survey in the open Barents Sea]. Pp. 95-106 *in*: [Instrumental measurements used in fisheries research: selected papers/PINRO]. PINRO Press, Murmansk (Russian).

Krasnov, Yu.V. & N.G. Nikolaeva 1996. [A modern distribution of marine colonial birds at the Barents Sea aquatory]. Pp. 101-113 *in*: G.G. Matishov (ed. in chief). [Pelagic zone's ecosystems of the western Arctic Seas]. Kola SC RAS Publishing House, Apatity. (Russian).

Krasnov, Yu.V., Yu.I. Goryaev, N.G. Nikolaeva, A.A. Shavykin, M.V. Gavrilo & V.I. Chernook 2002. [The Atlas of marine birds of the Pechora Sea]. Apatity. 150 pp. (Russian).

Krasnov, Yu.V., V.I. Chernook, M.V. Gavrilo, A.A. Shavykin & A. Tereshchenko 2004. [Usage of airplane-laboratories in aerial surveys of marine birds and mammals over the Arctic seas areas]. Zoological Journal 83(2). (Russian).

Lock, A.R., J. Petrie & A. Griswold 1997. PIROP – A database for mapping seabird distribution. Canadian Wildlife Service, Atlantic Region. 48 pp.

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

Lyngs, P. & K. Kampp 1996. Ringing recoveries of Razorbills *Alca torda* and Guillemots *Uria aalge* in Danish waters. Dansk Orn. Foren. Tidsskr. 90(3): 119-132.

Mead, C.J. 1974. The results of ringing auks in Britain and Ireland. Bird Study 21(1): 45-86.

Mehlum, F. 1989. Summer distribution of seabirds in northern Greenland and Barents Seas. Norsk Polarinst. Nr. 191. 56 pp.

Mehlum, F. 1991. Seabird distribution on the northern Barents Sea marginal ice-zone during late summer. Polar Res. 8(1): 61-65.

Merkel, F.R., A. Mosbech, D. Boertmann & L. Grondahl 2002. Winter seabird distribution and abundance off south-western Greenland, 1999. Polar Res. 21(1): 17-36.

Monteiro, L. *et al*. 1995. Talk at the Seabird Group meeting 26.3.1995.

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 Res. 18(1): 1-17.

Natturufraedistofnun Islands [Icelandic Institute of Natural History] 2000. [Redlist 2. Birds.]. Natturufraedistofnun Islands. 103 pp. [Authors: K.H. Skarphedinsson, A. Petersen & A. Ingadottir.] (Icelandic, English summary).

Nettleship, D.N. & T.R. Birkhead 1985. The Atlantic Alcidae. Acad. Press, London etc. xx + 574 pp.

Nettleship, D.N. & P.G.H. Evans 1985. Distribution and status of the Atlantic Alcidae. Pp. 53-154 *in*: Nettleship, D.N. & T.R. Birkhead (eds). The Atlantic Alcidae, Acad. Press, London, etc. xx + 574 pp.

Nikolaeva, N.G., Yu.V. Krasnov & R.T. Barrett 1996. Movements of Common *Uria aalge* and Brünnich´s Guillemots *U. lomvia* breeding in the southern Barents Sea. Fauna Norvegica, ser. C. Cinclus 19: 9-20.

Olsen, B. 1982. [A few reasons for decline in the Faeroese Common Murre population, estimated from the pattern of decline and banding results.] Viltrapport 21: 24-30. (Danish, English summary).

Olsen, B., J.-K. Jensen & A. Reinert 2000. Populations of Guillemots, Razorbills and Puffins in Faeroese waters as documented by ringed birds. GEM-report. No. C22-161-1. 33 pp.

Olsson, O., T. Fransson & K. Larsson 1999. Post-fledging migration of Common Murres *Uria aalge* in the Baltic Sea: management implications. Ecography 22(3): 233-239.

Petersen, I.K. 1993. [Birds on the high seas between North-Iceland, Jan Mayen and East-Greenland.] Nordisk Workshop, Trondheim, unpubl. Report. P. 28. (Danish).

Peterz, M. & B. Oldén 1987. Origin and mortality of Guillemots *Uria aalge* on the Swedish west coast. Seabird 10: 22-27.

Reid, J.B., C.M. Pollock & R. Mavor 2001. Seabirds of the Atlantic Frontier, north and west of Scotland. Cont. Shelf Res. 21: 1029-1045.

Reinert, A. 1976. [The Common Guillemot I-VI.] Dimmalaetting 99(97): 4; 99(98): 5; 99(100): 3; 99(192): 5; 99(107): 3,8; 99(114): 4-5. (Faeroese).

Runde, O. 1982. [Reasons for mortality in a few seabird species, as indicated by banding.] Viltrapport 21: 31-33. (Norwegian, English summary).

Salomonsen, F. 1967. [The Birds of Greenland.] Rhodos, Copenhagen. 342 pp. (Danish).

Schmidt, R. 1983. Wiederfunde beringter Trottellummen (*Uria aalge*) an der Ostseeküste der DDR. Ber. Vogelwarte Hiddensee 4: 87-96. (German).

Schmutz, J.A. & K.A. Hobson 1998. Geographic, temporal, and age-specific variation in the diets of Glaucous Gulls in Western Alaska. Condor 100: 119-130.

Skov, H., A. Upton, J. Reid, A. Webb, S. Taylor & J. Durinck 2002. Dispersion and vulnerability of marine birds in Faroese waters. Joint Nature Cons. Comm., Aberdeen. 106 pp.

Snow, D.W. & C.M. Perrins 1998. The Birds of the Western Palearctic. Concise Edition. Vol. 1. Non-Passerines. + Oxford Univ. Press, Oxford, New York. xxxii+1008 pp.

Southern, H.N., R. Carrick & W.G. Potter 1965. The natural history of a population of Guillemots (*Uria aalge* Pont.). Journal of Animal Ecology 34: 649-665.

Strøm, H., I.J. Øien, J. Opheim, E.A. Kuznetsov & G.V. Khakhin 1994. Seabird censuses on Novaya Zemlya 1994. Norwegian Ornithological Society. NOF Rapportserie. Report No. 2-1994. 38 pp.

Strøm, H., I.J. Øien, J. Opheim, E.A. Kuznetsov & G.V. Khakhin 1995. Seabird censuses on Novaya Zemlya 1995. Norwegian Ornithological Society. NOF Rapportserie. Report No. 3-1995. 24 pp.

Strøm, H., I.J. Øien, J. Opheim, G.V. Khakhin, S.N. Cheltsov & V. Kuklin 1997. Seabird censuses on Novaya Zemlya 1996. Norwegian Ornithological Society. NOF Rapportserie. Report No. 1-1997. 23 pp.

Swann, R.L. & A.D. Ramsay 1983. Movements from and age of return to an expanding Scottish Guillemot colony. Bird Study 30: 207-214.

Tasker, M.L., A. Webb, A.J. Hall, M.W. Pienkowski & D.R. Langslow 1987. Seabirds in the North Sea. Nature Conservancy Council, Peterborough. 336 pp.

Tatarinkova, I.P., V.N. Karpovich & Yu.V. Krasnov 1983. The birds of Murmansk – ringing results and territorial associations. Baltic Commission. Rep. Birds' Migr. Study 16: 38-54.

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

Tuck, L.M. 1961. The Murres: their distribution, populations and biology. – a study of the genus *Uria*. The Queen's Printer, Ottawa, Ont. 260 pp.

Tull, C.E., P. Germain & A.W. May 1972. Mortality of Thick-billed Murres in the West Greenland salmon fishery. Nature 237: 42-44.

U.S. Fish and Wildlife Service 1992. Alaska Seabird Management Plan. Unpubl. Report. 102 pp.

Vader, W., T. Anker-Nilssen, V. Bakken, R. Barrett & K.-B. Strann 1990. Regional and temporal differences in breeding success and population development of fisheating seabirds in Norway after collapses of herring and capelin stocks. Trans. IUGB Congr. 19: 143-150.

Wernham, C.V., M.P. Toms, J.H. Marchant, J.A. Clark, G.M. Siiriwardena & S.R. Baillie (eds) 2002. The Migration Atlas (Movements of the birds of Britain and Ireland). T. & A.D. Poyser, London. xvi+884 pp.

14.0 List of Principal Contributors

Vidar Bakken, University of Oslo, Zoological Museum, P.O. Box 1172, Blindern, 0318 Oslo, Norway

Robert Barrett, Tromsø Museum, Zoology Dept, University of Tromsø, N-9037 Tromsø, Norway

John Chardine, Canadian Wildlife Service, Marine Ecosystems, P.O. Box 6227, Sackville, New Brunswick E4L 1G6, Canada

Knud Falk, Danish Polar Center, Strandgade 100H, DK-1401 Copenhagen K, Denmark

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

Alexander Golovkin (deceased), State Committee on Environment and Nature Resource Protection, All Russia Research Institute for Nature Protection, Russia

Martti Hario, Finnish Game and Fisheries Research Institute, P.O. Box 6, FIN-00721 Helsinki, Finland

David Irons, U.S. Fish and Wildlife Service, 1011 E. Tudor Rd., Anchorage, Alaska AK99503, USA

Kaj Kampp, Zoological Museum, Universitetsparken 15, DK-2100 Copenhagen O, Denmark

Yuri Krasnov, Murmansk Marine Biological Institute RAS, Vladimirski 17, Murmansk, 183002, Russia

Flemming Ravn Merkel, Greenland Institute of Natural Resources, P.O. Box 570, DK-3900 Nuuk, Greenland

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

Hallvard Strøm, Norwegian Polar Institute, Polar Environmental Centre, N-9296 Tromsø, Norway

CAFF Publications

Arctic Flora and Fauna – Status and Conservation (2001)
Arctic Flora and Fauna – Recommendations for Conservation (2002)

CAFF Habitat Conservation Reports (HCR)

No. 1: The State of the Protected Areas in the Circumpolar Arctic (1994)

No. 2: Proposed Protected Areas in the Circumpolar Arctic (1996)

No. 3: National Principles and Mechanisms for Protected Areas in the Arctic Countries (1996)

No. 4: Circumpolar Protected Areas Network (CPAN) Principles and Guidelines (1996)

No. 5: Gaps in Habitat Protection in the Circumpolar Arctic (1996)

No. 6: Circumpolar Protected Areas Network (CPAN) Strategy and Action Plan (1996)

No. 7: Circumpolar Protected Areas Network (CPAN) Progress Report 1997 (1997)

No. 8: Summary of Legal Instruments and National Frameworks for Arctic Marine Conservation (2000)

No. 9: Gap analysis on the Russia Arctic (2000)

No. 10: Protected Areas of the Arctic: Conserving a Full Range of Values (2002)

CAFF Technical Reports

No. 1: Incidental Take of Seabirds in Commercial Fisheries in the Arctic Countries (1998)

No. 2: Human Disturbance at Arctic Seabird Colonies (1998)

No. 3: Atlas of Rare Endemic Vascular Plants of the Arctic (1999)

No. 4: Global Overview of the Conservation of Arctic Migratory Breeding Birds Outside the Arctic (1998)

No. 5: AMAP/CAFF Workshop on Climate Change, Rovaniemi. 24-25 March 1998 (1998)

No. 6: CAFF/AMAP Workshop on a Circumpolar Biodiversity Monitoring Program, Reykjavik 7-9 Feb, 2000: Summary Report (2000)

No. 7: Workshop on Seabird Incidental Catch In the Waters of Arctic Countries, Dartmouth, Nova Scotia 26-28 April 2000; Report and Recommendations (2000)

No. 8: CAFF Workshop on Conservation of Migratory Arctic Birds, Songli, Norway, 10-11 September 2000: Summary Report (2001)

No. 9: Seabird Harvest Regimes in the Circumpolar Nations (2001)

No. 10: Proceedings of the First International Conservation of the Arctic Flora and Fauna (CAFF) Flora Group Workshop (2002)

No. 11: The Conservation Value of Sacred Sites of Indigenous Peoples of the Arctic: A Case Study in Northern Russia (2004)

No. 12: Circumpolar Biodiversity Monitoring Program (CBMP) Coordination Meeting, Akureyri, Iceland, 11-12 April 2002 (2003)

No. 13: Distribution of Murres Outside the Breeding Season, “Circumpolar Murre Banding Program”, North Atlantic region, CBird (2004)

CAFF Strategies

Circumpolar Protected Areas Network (CPAN) Strategy and Action Plan (1996)

International Murre Conservation Strategy and Action Plan (1996)

Circumpolar Eider Conservation Strategy and Action Plan (1997)

The Co-operative Strategy for Conservation of Biological Diversity in the Arctic Region (1997)

Strategic Plan for the Conservation of Arctic Biological Diversity (1998)

Program Management and Meetings

Report of the Working Group 1992-1993 (1993)

Circumpolar Seabird Working Group Bulletin, Vol 1-2 (1995-1996)

CAFF Newsletter Vol 1-2 (1995-1996)

CAFF Report to Ministers 1996 (March 1996)

CAFF Report to SAOs 1997 (June 1997)

Third Meeting of the CAFF International Working Group (CAFF III), Reykjavík 1994: Proceedings (1994)

Fourth Annual Meeting of the CAFF International Working Group (CAFF IV), Moscow 1995: Summary Report (1996)

Fifth Annual Meeting of the CAFF International Working Group (CAFF V), Rovaniemi 1996: Summary Report (1997)

Sixth Annual Meeting of the CAFF International Working Group (CAFF VI), Nuuk 1997: Summary Report (1998)

Seventh Meeting of the CAFF International Working Group (CAFF VII), Yellowknife 1999: Summary Report (1999)

Eighth Meeting of the CAFF International Working Group (CAFF VIII), Trondheim 2000: Summary Report (2000)

Ninth Meeting of the CAFF International Working Group (CAFF IX), Abisko, 2002: Summary Report (2002)

Circumpolar Seabird Group, CBird IX, Tromsø 2003, Progress Report (2003).

For further information and additional copies contact:

CAFF INTERNATIONAL SECRETARIAT
Hafnarstraeti 97
600 Akureyri
ICELAND

Telephone: +354 462 3350
Fax: +354 462 3390
Email: caff@caff.is
Internet: http://www.caff.is

ISBN: 9979-9526-7-9