Circumpolar Seabird Working Group

Incidental Take of Seabirds in Commercial Fisheries in the Arctic Countries

CAFF Technical Report no. 1

CAFF
Conservation of Arctic Flora and Fauna

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. The other AEPS programs were the Arctic Monitoring and Assessment Program (AMAP) and the programs for Emergency Prevention, Preparedness and Response (EPPR) and Protection of the Arctic Marine Environment (PAME). The AEPS is now integrated into the Arctic Council.

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 has met annually to assess progress and to develop Annual Work Plans. CAFF is headed up by a chair and vice-chair which rotate among the Arctic countries and it is supported by an International Secretariat. When needed, CAFF also sets up specialist and experts groups to handle program areas.

The majority of CAFF's activities are directed at conserving Arctic biodiversity—the abundance and diversity of Arctic flora, fauna, and habitats—and at integrating indigenous peoples and their knowledge into CAFF. Some examples are: development and implementation of conservation strategies and action plans for a Circumpolar Protected Areas Network (CPAN), for Arctic biological diversity, for circumpolar Murres and Eiders; work on a Circumpolar Arctic Vegetation Map (CAVM) and Atlas of Rare Endemic Vascular Plants; assessing impacts of climate change and UV-B radiation on Arctic ecosystems; mapping Traditional Ecological Knowledge; developing a program for monitoring Arctic Biological diversity; etc. Most of CAFF's work is carried out through a system of Lead Countries as a means of sharing the workload. Some projects are also assigned to the CAFF Secretariat. Whenever possible, CAFF works in co-operation with other international organisations and associations to achieve common conservation goals in the Arctic.

CAFF PUBLICATIONS:

CAFF Habitat Conservation Reports:

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)

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 Migratory Arctic Breeding Birds outside the Arctic (1998)

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

CAFF Strategies:

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

International Murre Conservation Strategy and Action Plan (March 1996)

Circumpolar Eider Conservation Strategy and Action Plan (June 1997)

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

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

CAFF Program Management and Meetings:

CAFF Report to Ministers 1996 (1996)

CAFF Report to SAAOs 1997 (1997)

Report of the Working Group 1992-1993 (1993)

Third Meeting of the CAFF International Working Group (CAFF III), Reykjavík1994: 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)

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

CAFF Newsletter Vol. 1-2 (1995-1996)

For further information and additional copies contact:

CAFF INTERNATIONAL SECRETARIAT
Hafnarstraeti 97
600 Akureyri
ICELAND

Telephone: +354 462 3350
Fax: +354 462 3390
E-mail: CAFF@nattfs.is; snorri@nattfs.is
Internet: http://www.grida.no/caff

ISBN NUMER: 9979-9294-5-6

Incidental Take of Seabirds in Commercial Fisheries in the Arctic Countries

Editors: Vidar Bakken and Knud Falk

Technical Report no. 1

from the

CIRCUMPOLAR SEABIRD WORKING GROUP (CSWG)

January 1998

CAFF
Conservation of Arctic Flora and Fauna

List of contributors:

Vidar Bakken
Norwegian Polar Institute
Middelthunsgate 29
P.O. Box 5072, Majorstua,
NO-0301 Oslo
Norway
Bakken@npolar.no

John Chardine
Canadian Wildlife Service
P.O. Box 6227
Sackville
New Brunswick E4L 1G6
Canada
john.chardine@ec.gc.ca

Knud Falk
Ornis Consult
Vesterbrogade 140A, 2
DK-1620 Copenhagen V
Denmark
ornis@inet.uni2.dk

Alexander Golovkin
State Committee of Environment and
Nature Resource Protection;
All-Russia Research Institute of Nature
Protection
113628 Sadki-Znamenskoye
Moscow
Russia
golovkin@golovkin.msk.ru

Martti Hario
Finnish Game and Fisheries
Research Institute
P.O. Box 6
FIN-00721 Helsinki
Finland
martti.hario@rktl.fi

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

Kenton Wohl
U.S. Fish and Wildlife Service
1011 E. Tudor Rd.
Anchorage
Alaska 99503
USA
kent_wohl@mail.fws.gov

Patrick J. Gould
Alaska Science Center
National Biological Service
1011 East Tudor Road
Anchorage, Alaska 99503

Shannon M. Fitzgerald
Alaska Fisheries Science Center
National Marine Fisheries Service
7600 Sandpoint Way N.E.
BIN-C15700
Seattle, Washington 98115

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This Technical Report is a product of the Circumpolar Seabird Working Group of the Conservation of Arctic Flora and Fauna (CAFF) program of the Arctic Council.

Section 1 introduces the topic of incidental take (bycatch) of seabirds in commercial fisheries.

Section 2 describes the fisheries industries, seabird bycatch and impacts in Alaska (USA), Canada, Finland, Greenland, Iceland, Norway and Russia, and provides national recommendations. To summarise:

***Alaska** fisheries are traditionally and economically important and, in 1992, fisheries subject to bycatch monitoring were valued at US$1.538 billion. Bycatch is the major seabird mortality factor and a serious conservation concern. Estimated average incidental mortality (1989-93) in selected fisheries was ca 11,200 birds annually. About 88% of the bycatch was in longline fisheries. Northern Fulmars and albatrosses constituted the bulk of the kill. Alaska has a multi-jurisdictional fisheries observer program but not all fisheries are monitored for seabird bycatch. Recommendations are: to continue collaboration among the various jurisdictions and standardise seabird training for fishery observers, monitor seabird mortality in drift gillnet fisheries and the Pacific halibut longline fisheries, research gear modifications, and participate in the FAO project on longline fisheries bycatch.*

***Canada** is an active fishing nation and has northern fisheries in Arctic Canada and Arctic-influenced waters of Atlantic Canada. The Arctic fishery, primarily Char, is mainly subsistence and native-run. No reports of seabird bycatch could be found. In Atlantic Canada, groundfish, especially Cod, are the cornerstone species. Seabird bycatch was not monitored systematically nor a major concern of the fisheries agency. However, an inshore groundfish monitoring effort from 1981-84 estimated a kill of ca 30,000, mainly Common Murres. Data show a high correlation between kill rate and type of net, vicinity of seabird breeding colonies, and timing. Anecdotal information also suggests high bycatch mortality in the offshore fisheries. Since 1992, there has been a groundfish moratorium and seabird bycatch mortality has plummeted. A limited fishery reopened in 1997 but low bycatch is predicted due to location. Impacts of bycatch on populations are unknown but some estimates are alarming. Seabirds are legally protected but there are no regulations or guidelines on bycatch. Recommendations are: to improve monitoring, investigate gear design modifications, highlight bycatch as an important environmental impact in some fisheries and include bycatch considerations in the regulatory regime of Arctic Char.*

***Finland** has marine fisheries in the Baltic Sea and Gulf of Finland, which, including aquaculture, account for 0.2% of national income. According to 1992 figures, the division of the catch is 80% commercial and 20% recreational. Baltic Herring, Sprat, Salmon and Whitefish are the most important species. There are no official statistics on bycatch and it has not been a major conservation issue. Information available indicates victims are mainly Common Eider and alcids. An increase in Salmon driftnet fishing has not resulted in an increase in bycatch mortality, probably due to scattered occurrence of birds and lack of wintering stocks. Overall, seabird populations have been steadily rising in the Baltic although Black Guillemots in the Gulf of Finland are declining, probably due to mink predation and bycatch mortality. There has been no serious research on seabird bycatch in Finland and there are no monitoring programs. Recommendations are: to assess the*

problem, collect all available information and identify and promote fishing methods that reduce bycatch.

***Greenland** is traditionally dependent on marine resources and an estimated 10% (5500 people) are employed in the fishery or at land-based plants. Fisheries contribute more than 3/4 of the gross national income. Cod was the main target species but is economically replaced by shrimp and Greenland Halibut. Seabird bycatch occurs widely but only the Salmon fishery was investigated. From 1969-71, a major offshore international Salmon fishery, now phased out, had an estimated total average annual kill of 540,000 Thick-billed Murres plus Atlantic Puffin, Dovekie, Greater Shearwater and others. There were vast temporal and spatial differences in the bycatch rate. Today, bycatch is greatly reduced because local quotas are given mainly to small-boat operators that fish outside areas of high murre concentrations. Hunting is now the major seabird mortality factor and is the target of investigations. There remains a small, widespread bycatch. Bycatch is not currently researched or monitored. Recommendations are: to obtain quantitative data on seabird bycatch in the Lumpsucker fishery, avoid early-set Salmon nets that risk murres leaving Southwest Greenland colonies, and avoid opening the Salmon fishery before August 15 or ending it after October 1.*

***Iceland** receives some 70% of its national income from fisheries with Cod being the most economically important species. Seabird bycatch information is scanty and somewhat descriptive. However, it is well known that tens of thousands of alcids, especially Common Murre and Razorbill, drown annually in fishing gear. Some data is available from ringed recoveries and show Black Guillemot as most susceptible proportionally. However, Thick-billed Murre bycatch has not been recorded because of lack of ringing but the probability is that large numbers are caught. Fishing nets, especially Lumpsucker, followed by longlines are the primary cause of mortality. However, the importance of Cod nets is probably grossly under-estimated. Figures show different birds are vulnerable to different types of fishing gear with much seasonal variation in bycatch. Little is known on the impact of bycatch on populations but with the Lumpsucker fishery greatly intensified, it likely is contributing to the decline of some local populations of eider and Black Guillemot. Use of bycatch birds is banned under the Icelandic Wild Bird Act but authorities have not intervened at recent auction sales. There are no existing or planned guidelines for bycatch. Recommendations are: a general survey of bycatch, work on methods to reduce bycatch, research on impacts of bycatch mortality on bird populations and specific projects on selected taxa and species.*

***Norway** fisheries, especially Cod, are traditionally and economically important. In 1993, fish landings were valued at US$ 803,324,473. In 1994, 0.5% of the population was involved in the fishery and in 1995, it constituted 0.7% of the Gross National Product. Incidental take of seabirds has been documented, mostly in net fisheries. Large scale bycatch is known to occur and there have been serious bycatch incidents (e.g. ca 200,000 murres taken in one Cod fishery episode in 1985). Atlantic Salmon driftnet fisheries caused high bycatch mortality until driftnets were banned in 1989 to protect Salmon stocks. Based on ringed bird recoveries, bycatch is estimated as a primary mortality factor for several species and one species, the Common Murre, has shown a marked decline which can be accounted for by mortality in fishing gear. There are no regulations on seabird bycatch, possibly because data is inadequate for management purposes, i.e. data is missing on total bycatch and there is a lack of data to show significant impacts on populations. Recommendations are: to map bycatch and fishing gear used, co-operate with local guards overseeing the Salmon fishery, regulate type of fishing gear for certain areas, allow fishing only where conflicts with seabirds are low and monitor where bycatch might be a problem.*

Russia *has two main northern fishing areas: a western area comprising the Barents and White Seas and an eastern area including the Chuckchi, Bering and Okhotsk Seas. In the western seas, traditional fisheries were Cod, using longlines set from small boats and a Salmon fishery using mesh nets in river mouth areas. Bycatch mortality was low. The industry has shifted to trawling for bottom fish, mainly Cod. No data is available on bycatch. There was a traditional native Salmon fishery in eastern Russia using nets at sea and at river mouths. Hard data are lacking but the assumption is that bycatch numbered under 10,000 birds annually. The situation worsened dramatically when, in 1994, Japanese vessels were permitted to fish Salmon using very long drift nets. Preliminary information from 1996 indicates a seabird bycatch mortality in the order of 200,000 birds in that year, mostly murres, a trend expected to continue through 1997. Such a huge bycatch could be detrimental to seabird populations in a very short time. Urgent recommendations are: take immediate action to reduce the bycatch, research species and age distribution of the kill and main source populations.*

Section 3 summarises key points from the national reports and charts the status of knowledge of important incidental bycatch of seabirds in the Arctic in Table 6.

Section 4 lists the complete set of national recommendations and concludes with a series of general recommendations calling for co-operation with the fishing industry to solve the bycatch mortality problems, identification of source populations and effects of mortality, research and development of fishing gear and deterrent devices that reduce bycatch, adoption of resolutions by the IUCN covering bycatch in fishing nets and a call for the Arctic countries to participate in the FAO efforts on seabird bycatch, including attendance at a meeting in 1998 to discuss the world-wide issue and develop guidelines. It is further suggested that the Arctic countries adopt the guidelines, as appropriate.

Section 5 and the Appendices include References, IUCN Resolutions on Incidental Mortality of Seabirds in Longline Fisheries and Fisheries By-Catch and the scientific names for seabirds and target fishery species mentioned in the Technical Report.

1. INTRODUCTION

Incidental take (bycatch) of seabirds[1] in commercial fisheries is widespread and is a serious conservation concern in the Arctic and globally.

The introduction of new types of nets and increased fishing activity has led to higher numbers of incidental take of seabirds during the last few decades (Atkins and Heneman 1987, Robins 1991). However, fishers seldom report bycatch of seabirds. The reasons may be that there have been no demands for reporting, some see it as an insignificant problem or it may be in their interest to protect the fishery from 'bad press' and further restrictions of their activities.

There are various perspectives to the problem of incidental take, including (mainly after Follestad and Strann 1991):

- Bycatch reduces the number of individuals and may be a threat to a population;
- Bycatch is an ethical problem as birds taken, and eventually their abandoned chicks in the colony, suffer;
- Fisheries become less efficient and profitable because of the time spent by fishers in removing entangled birds, and the lost bait reduces the number of fish harvested;
- Killing seabirds is not good public relations for the commercial fishing industry.

Incidental take of seabirds in fishing gear is an additional, but not necessarily additive cause of mortality in the population, and it is important to evaluate this effect in relation to other natural and human induced mortality factors and to population sizes and trends. In general, seabirds have high adult survival, small clutch size, and delayed maturity. This life history strategy causes the populations to be far more sensitive to adult survival than to breeding failure or survival of the immature birds. It is important to take this aspect into account when evaluating the effects on the populations.

Several initiatives, described below, are dealing with the mortality of seabirds in various types of commercial fisheries.

Worldwide, governments, non-governmental organisations, and commercial fishery associations are petitioning for regulative measures to reduce the mortality of seabirds in longline fisheries in which seabirds are incidentally taken. For example, responding to the need to reduce the incidental mortality of seabirds in commercial fishing in Southern Oceans, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) adopted mitigation measures in 1992 to reduce seabird bycatch by its 23 member countries. Under the auspices of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), Australia, Japan and New Zealand have implemented seabird mitigation measures in their Southern Bluefin Tuna longline fishery since 1992. The U.S. also adopted, by regulation, seabird bycatch reduction measures for its groundfish longline fisheries in the Bering Strait/Aleutian Islands and Gulf of Alaska in 1997, and is considering adopting regulations for its Halibut fishery.

---

[1] *For the purposes of this report, seabirds are taken to mean petrels and allies, (Procellariiformes), cormorants and allies (Pelecaniformes), auks, gulls, terns, and jaegers (Charadriiformes part), and eiders (Anseriformes part). Scientific names of all species mentioned in this report are listed in appendix B.*

In 1996, the International Union for the Conservation of Nature (IUCN) adopted Resolution on Incidental Mortality of Seabirds in Longline Fisheries. The Resolution, supported by 75 national governments, calls upon "the IUCN, its members, all States and regional fisheries institutions to reduce incidental seabird mortality within longline fisheries to insignificant levels for affected species" and to expand the observer programs within longline fisheries (Appendix A).

In 1996, member countries and organisations of the IUCN also adopted a Resolution on Fisheries By-Catch in which they expressed their deep concern for the substantial numbers of fatalities involving, *inter alia*, numerous seabird species and called for a program to substantially reduce all fisheries bycatch in the long-term interests of marine biodiversity conservation and to develop mechanisms to minimise the negative impacts of fishing practices on marine biodiversity (Appendix A).

In 1995, the Food and Agricultural Organisation's (FAO) adopted a Code of Conduct for Responsible Fisheries to promote the protection of aquatic resources. The Code also contains an article promoting management measures to minimise the catch of nontarget, non-fish species. In March 1997 FAO agreed to conduct a meeting in 1998 on the worldwide issue on seabird bycatch. The objective of the FAO meeting is to produce a Plan of Action for implementing mitigation guidelines to reduce incidental catches of seabirds in longline fisheries to be considered for adoption in 1999.

This Technical Report examines the available information on incidental take of seabirds in commercial fisheries in the Arctic countries: USA (Alaska), Canada, Finland, Greenland, Iceland, Norway and Russia. It summarises national recommendations for management and research activities to reduce the magnitude of the incidental take in the future and presents general management recommendations. As will be seen from the national reports, there are large differences in the level of knowledge about incidental take of seabirds in fisheries in the different countries.

This circumpolar incidental seabird mortality project was completed by the *Circumpolar Seabird Working Group (CSWG)*. The working group functions under the auspices of the program for the *Conservation of Arctic Flora and Fauna (CAFF)*, which was initially established under the *Arctic Environmental Protection Strategy (AEPS)* in 1991 and is now part of the *Arctic Council*.

2. NATIONAL REPORTS

Alaska (USA)

Canada

Finland

Greenland

Iceland

Norway

Russia

2.1 INCIDENTAL MORTALITY OF SEABIRDS IN ALASKA

by Kenton D. Wohl[1], Patrick J. Gould[2] and Shannon M. Fitzgerald[3]

[1] U.S. Fish and Wildlife Service
Alaska
[2]Alaska Science Center
Alaska
[3]Alaska Fisheries Science Center
Seattle, Washington

2.1.1 Introduction

Seabird populations in Alaska are large and diverse owing to the extensive and nutrient-rich coastal estuaries and offshore areas, and the availability of large stocks of forage fish and other prey. Such areas in Alaska provide breeding, feeding, and migrating habitat for 66 species of seabirds of which 38 breed in Alaska at about 1600 colonies. Alaska's breeding population of the 38 seabird species is estimated to be 50 million birds which is about 96% of all seabirds breeding in the continental United States. Another 50 million seabirds of 28 species migrate from breeding areas in the central and south Pacific to spend the summer offshore the coast of Alaska (U.S. Fish and Wildlife Service 1992). Seabird breeding populations in the Bering Sea and Gulf of Alaska are estimated at about 22,000,000 and 8,000,000 birds, respectively.

Mortality of seabirds in commercial fisheries in Alaska is a serious conservation issue and has been a concern to the U.S. Fish and Wildlife Service since the early 1970s. On an annual basis, more seabirds are killed incidental to commercial fishing operations than to most other forms of human activities in Alaska combined. Seabirds are known to be incidentally taken in salmon gillnet and groundfish longline, trawl, and pot fisheries in Alaska. A few birds may be killed in the shellfish pot fishery as a result of vessel-bird strikes.

A few studies have been conducted to document the magnitude of the incidental mortality of seabirds in commercial fisheries in Alaska and the North Pacific (Ainley *et al.* 1981, Ogi 1984, DeGange *et al.* 1985, Jones and DeGange 1988, DeGange and Day 1991, Wynne *et al.* 1991, 1992, Byrd *et al.* 1992, Johnson *et al.* 1993 and Ogi *et al.* 1993). Most of these studies have documented the seabird mortality in North Pacific pelagic salmon fisheries, large-mesh pelagic driftnet, billfish and tuna fisheries, large-scale pelagic driftnet squid fishery, Alaskan groundfish longline fisheries and selected nearshore salmon gillnet fisheries. This section of the report summarises information on the incidental mortality of seabirds in the commercial groundfish fisheries and selected salmon fisheries in Alaska.

2.1.2 Types of fisheries in Alaska monitored for incidental mortality of seabirds

Marine fisheries resources of Alaska are a very valuable heritage and commercial fishing is a long-standing tradition. Alaska's marine ecosystems are some of the most productive in the world's oceans supporting many of the world's largest populations of groundfish, salmon, shellfish and marine birds and mammals. There are eight Alaskan fisheries in which seabird mortality is documented as part of an annual observer program including: Bering

Sea/Aleutian Islands groundfish longline, trawl, and pot fisheries; Gulf of Alaska groundfish longline, trawl, and pot fisheries, and the Bering Sea/Aleutian Island King and Tanner Crab pot fisheries (Figure 1).

Both the Bering Sea/Aleutian Islands and Gulf of Alaska groundfish fisheries are managed under the auspices of each region's Federal fisheries management plan prepared by the North Pacific Fisheries Management Council. The shellfish fisheries in the Bering Sea/Aleutian Islands region is managed primarily by the State of Alaska under the guidance of the Federal fisheries management plan for that fishery.

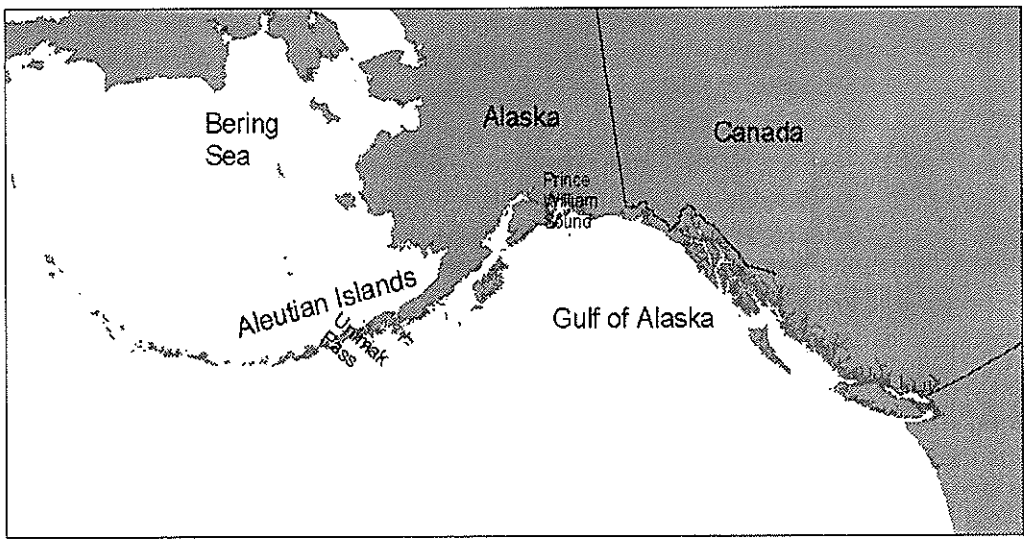

Figure 1. *Map of Alaska with names mentioned in the text.*

The total average yield of groundfish (excluding halibut) in the Bering Sea/Aleutian Islands and the Gulf of Alaska regions is 2.0 million t (metric ton = 1000 kg), respectively (National Marine Fisheries Service 1993). In the Bering Sea/Aleutian Island region, Walleye Pollock represents about 75% of the total yield while Pacific Cod is about 13% of the total. Walleye Pollock and Pacific Cod each represented about 35% of the total yield in the Gulf of Alaska. Alaskan shellfish fisheries harvest 3 species of King Crab (*Paralithodes camtschatica, P. platypus*, and *Lithodes aequispina*) and 2 species of Tanner Crab (*Chionoecetes bairdi* and C. *opillio*). About 99% of the Tanner Crab harvest occurs in the Bering Sea/Aleutian Islands region while almost all the King Crab are harvested in that same region. Five species of Pacific salmon (Chinook, Coho, Sockeye, Chum, and Pink) occur in Alaska.

Since the mid 1980s the groundfish fishery has been a major economic industry in Alaska generating ex-vessel revenues of $658 million in 1992. The 1992 ex-vessel revenue for the King and Tanner Crab fisheries was $305 million. The ex-vessel value of the state-wide harvest of salmon was $575 million in 1992. The total value of fisheries in which the incidental mortality of seabirds occurs was $1.538 billion in 1992.

2.1.3 Fisheries observer program in Alaska

The U.S. Congress recognised the need to assess the incidental mortality of non-target species in domestic fishery activities when it passed the Marine Mammal Protection Act of 1988 (Public Law 92-522) as amended, and the Magnuson Fishery Conservation and Management Act of 1976, as amended (especially the Fishery Conservation Amendments of 1990 [Public Law 101-627]).

An observer program has been an important management tool in Alaskan fisheries for many years. In the 1970s, a special observer program to monitor the incidental mortality of marine birds and mammals in the Japanese mother-ship salmon gillnet fisheries was conducted in the United States' exclusive economic zone in Alaska. Foreign joint venture groundfish fisheries were monitored in the early-to-mid 1980s. As the U.S. groundfish fleet replaced the foreign joint venture fleet, a domestic fisheries observer program was initiated in the late 1980s. High seas driftnet fisheries in the North Pacific were monitored with a multi-national observer program between 1989 and 1991. In 1990 and 1991, an observer program monitored incidental mortality of marine birds and mammals in the Prince William Sound and South Unimak Pass salmon fisheries. In 1994, the crab fishery observer program began to monitor seabird mortality, e.g., bird strikes on vessels.

The U.S. Department of Commerce's National Marine Fisheries Service co-ordinates the implementation of the domestic fisheries observer program and conducts an observer program to monitor the target and non-target fish catch and the incidental mortality of marine birds and mammals in selected domestic fisheries. The Magnuson Fisheries Conservation and Management Act of 1976, as amended, also authorises fishery observer programs under the discretionary provisions of Federal Fishery Management Plans. The National Marine Fisheries Service, U.S. Fish and Wildlife Service and the U.S. Geological Survey's Biological Resources Division have collaborated to delineate data collection duties and protocols for collecting seabird mortality data. Under the groundfish observer program plan, vessels 125 feet or more in length are required to carry an observer at all times while fishing for groundfish. Vessels from 60 to 124 feet in length are required to carry observers during 30% of their days during fishing trips in each calendar quarter of the year in which they fish more than 10 days in the groundfish fishery. Processors (mothership or shoreside) that process 1000 t or more of groundfish during a calendar month are required to have observers at all times. Processors which process 500 to 1000 t of fish must have an observer for at least 30% of the days groundfish are received or processed during that month. Observers are responsible for numerous data collection tasks while monitoring the fisheries catch on vessels or at processors. Although the principal duty of observers is to monitor catch of the target fish, they also monitor the incidental mortality of nontarget species like marine birds and mammals.

Observers record seabirds, which occur in the catch sample, by number, weight, and taxon. Sampling procedures include monitoring the entire haul (usually conducted only when the haul consists primarily of a single species); subsamples including partial haul sampling (i.e., monitoring a predetermined segment of the whole haul); or basket samples (i.e., periodically diverting a small part of the catch into special baskets). Sightings of species that are of special management concern (e.g., endangered and threatened species), opportunistic information relative to the occurrence of birds killed by striking the ship, and all data on banded birds are also recorded.

2.1.4 Incidental mortality of seabirds

Data on the incidental mortality of seabirds in Alaska groundfish and crab fisheries are maintained by the National Marine Fisheries Service and the U.S. Fish and Wildlife Service. These data are currently being computerised and software programs and protocols are being developed to analyse the information. Statistically valid incidental mortality estimates are not yet available. For the purposes of this report, we have assembled a preliminary estimate of the incidental mortality of seabirds in Alaska groundfish and selected salmon fisheries between 1989 and 1993 (Table 1). These data and bycatch data from 1994-96 are presently being analysed in a statistically rigorous manner and will be available in 1998.

Table 1. *Estimated average annual incidental mortality of seabirds in selected Alaska's commercial fisheries, 1989-1993. Effort in days represent the number of days in which sampling occurred. The sampling may have been only a subset of the entire haul for a given day. The percent of catch monitored varied from year to year and only the range (minimum-maximum) is provided in the table.*

Fishery	Observer Effort (days)	Range of % catch monitored	Estimated average annual mortality
Bering Sea groundfish			
Longline (1990-93)	15,932	64-80	7250
Pot (1990-93)	1603	43-64	10
Joint venture trawl	6114	43-56	0
Trawl	48,378	49-69	910
Gulf of Alaska groundfish			
Longline (1990-93)	3704	13-27	1420
Pot	814	3-11	0
Trawl	9714	5-45	10
SUBTOTAL			***9600***
Prince Williams Sound Salmon			
Drift and set gillnet (1990-91)	-	-	1230
Unimak Pass Salmon			
Drift gillnet (1990)	-	-	340
TOTAL			***11,170***

The total average annual incidental mortality of seabirds in the commercial fisheries monitored for this mortality is about 11,200 birds. This should be considered a minimum estimate of mortality in Alaska because some commercial fisheries, especially many salmon fisheries, are not monitored for the incidental mortality of seabirds.

The estimated average annual mortality of seabirds in groundfish longline, trawl, and pot fisheries in the Bering Sea/Aleutian Islands and Gulf of Alaska between 1990 and 1993 was about 9,600 birds. About 85% of the total average seabird mortality in all groundfish fisheries between 1989 and 1993 occurred in the Bering Sea/Aleutian Islands region. This possibly reflects the higher populations or concentrations of seabirds in the Bering Sea compared with the Gulf of Alaska. Although 88% of the groundfish in the two regions are harvested by trawlers, about 88% of the total seabird mortality occurred in the longline fishery. Northern Fulmars were a large percentage (55%) of the total estimated seabird

mortality in the Bering Sea/Aleutian Islands region in 1993 (the only year when species were identified) while Laysan, Black-footed and unidentified albatrosses were a smaller percentage (11%) of the total mortality in the same region. Northern Fulmars and albatrosses were 67% and 17%, respectively, of the total estimated mortality in 1993 in the Gulf of Alaska. Other species incidentally taken in the Bering Sea and Gulf of Alaska longline fisheries in 1993 included Black-legged Kittiwakes, unidentified shearwaters/petrels and unidentified gulls. *Uria* murres and auklets were recorded taken in the Bering Sea only.

Although salmon fisheries in Alaska are widespread, the incidental mortality of seabirds has been monitored in only two: Prince William Sound (1990-91) drift and set gillnet and South Unimak Pass (1990) drift gillnet fisheries. The estimated average annual seabird mortality in the Prince William Sound gillnet fisheries during 1990-1991 was 1230 birds of which 52% were Marbled Murrelets and 27% Common Murres. The estimated mortality in the South Unimak Pass (eastern Aleutians) salmon gillnet fishery in 1990 was 337 birds of which 63% were *Uria* murres. Other species taken in the Unimak Pass fishery were puffins and auklets.

2.1.5 Management recommendations

As stated previously, the incidental mortality of seabirds is a serious conservation issue for the U.S. Fish and Wildlife Service. The National Marine Fisheries Service, the U.S. Fish and Wildlife Service, and the U.S. Geological Survey should continue to collaborate to improve the documentation of the seabird bycatch and to standardise seabird training among the fishery observer programs. For example, improved training in seabird identification could improve the reporting of seabirds to species rather than as "unidentified seabird". It is also suggested that seabird mortality be monitored in Alaska's drift gillnet fisheries, especially in Southeast Alaska and northern Gulf of Alaska salmon fisheries. In addition, the fact that groundfish longline fisheries provide the largest percentage (88%) of incidental seabird mortality would suggest that the other principal longline fishery in Alaska, international Pacific halibut fisheries, be monitored. It is suggested that research concerning gear modifications, longline setting procedures and bycatch reduction measures should be pursued to develop nets and fishing techniques that reduce the mortality of seabirds.

Lastly, the U.S. should actively participate in the FAO project reviewing seabird bycatch in longline fisheries and developing mitigation measures to reduce seabird bycatch.

2.2 REVIEW OF THE SEABIRD BYCATCH PROBLEM IN ARCTIC CANADA

by John W. Chardine

Canadian Wildlife Service
Newfoundland

2.2.1 Introduction to fisheries and seabird bycatch in Arctic Canada

For the purposes of this review Arctic Canada is considered to be the Yukon and Northwest Territories, Nunavut, and marine areas in eastern Canada that are directly influenced by Arctic water such as the east coasts of Newfoundland and Labrador and the north shore of the Gulf of St. Lawrence.

Canada is an active fishing nation with important commercial fisheries in Arctic areas (Parsons 1993). North of 60° N, Arctic fisheries are mainly subsistence in nature and prosecuted mostly by native people. Demersal or ground fish such as Atlantic Cod have been the cornerstone of fisheries in Arctic waters off the east coast of Canada. However, although not significant in terms of landings, the Atlantic Salmon fishery off the east coast has played a role in seabird bycatch (see below). Many changes have occurred in Canadian commercial fisheries on the Atlantic coast over the past few years. A moratorium on most groundfish fishing including Cod has been in place since 1992 for most areas in eastern Canada, and the Atlantic Salmon fishery off insular Newfoundland is closed indefinitely.

A consequence of almost all fisheries is that non-target species of fish and other marine wildlife are caught accidentally in fishing gear. Cetaceans, seals, and seabirds are common victims of bycatch in fishing gear set in Canadian waters (e.g., Piatt and Nettleship 1987). However, relatively little information is available on seabird bycatch in Canada. The only systematic studies published have been those of John Piatt who worked in Southeast insular Newfoundland in the early 1980s (Piatt *et al.* 1984, Piatt and Nettleship 1987).

2.2.2 Incidental take of seabirds in Arctic Canada

Due to particular conditions in the different regions of Canada, data on the seabird species, numbers, and gear type involved in bycatch as well as possible effects on populations are presented separately for the fisheries prosecuted north of 60° N in the Yukon and Northwest Territories, and Nunavut, and those prosecuted in Arctic-influenced waters to the south in Atlantic Canada.

Fisheries north of 60° N in Canada
No reports of seabird bycatch in fishing gear could be found for Arctic Canada. Arctic marine fisheries tend to be local, subsistence operations run by native people, although some are small commercial enterprises. The most important fishery in Arctic Canada is for Arctic Char, which is caught in monofilament gillnets set close to shore, often in the mouths of rivers. Turbot are caught by hook and line off Southeast Baffin Island. Shrimp are caught in a trawler fishery in Davis Strait.

While the potential exists to accidentally capture seabirds such as Thick-billed Murres, Black Guillemots and Common Eider in Arctic Char nets, it is unlikely that seabird bycatch in this

gear is significant. Arctic Char nets are set so close to shore that alcids such as murres would not likely encounter them very often. There is a potential risk of catching Black Guillemots and eiders in char nets because these species do frequent near-shore waters.

Fisheries in Arctic-Influenced Waters of Atlantic Canada

The historic centre of commercial fishing in Canada has been in the Atlantic region and groundfish such as Atlantic Cod has been the cornerstone species of the east coast fishery. Atlantic fisheries can be conveniently divided into inshore and offshore sectors with fish species and fishing gear differences between the two. Groundfish and Atlantic Salmon were fished with passive gear such as gillnets and traps, while offshore fisheries were dominated by mobile trawlers (Parsons 1993).

The only place and situation in Canada in which seabird bycatch in fishing gear has been monitored systematically is in the inshore, summer fishery of Southeast insular Newfoundland from 1981-1984 (Piatt *et al.* 1984, Piatt and Nettleship 1987). Here seabird populations are large (Brown *et al.* 1975, Chardine 1995) and inshore fishing activity has been intensive. Table 2 (adapted from Piatt and Nettleship [1987]) summarises the results of this work. The authors reported an estimated 30,000 seabirds were killed due to bycatch in the area of study over the four years. The overwhelming majority of these (89%) were Common Murres, with Atlantic Puffins (6%) and Greater Shearwaters (3%) ranking second and third in the list of thirteen affected species. Numbers of each species caught in fishing gear generally reflected regional abundance and foraging behaviour. Abundant pursuit divers were caught most frequently.

Piatt and Nettleship (1987) found that most seabirds (97%) were caught in either Cod or Salmon gillnets. Very few were caught in Cod traps or Flounder gillnets. Gillnets set to catch Cod in Newfoundland are made of monofilament nylon of various colours (greens, blues, browns etc.), and typically 5.5" (14 mm) mesh size. Cod nets are usually set at or near the bottom in shoal water. It was illegal to use monofilament gillnets to catch Salmon in Newfoundland and instead gillnets made of braided twine, about 5" mesh size, set close to the surface were used. Cod gillnets accounted for 79% and Salmon gillnets 18% of the seabird bycatch observed. The proportions of each species caught in Cod vs. Salmon gillnets suggest that relatively shallow diving seabirds (e.g. Atlantic Puffin, Black Guillemot, Northern Gannet) were caught preferentially in the shallow-set Salmon nets while deeper diving species such as the Common Murre were caught more often in the deeper-set Cod gill nets. Interestingly, shallow-diving shearwaters were caught more often in Cod gillnets, however most of these may have been caught while scavenging from the nets as they were set or hauled.

Most murres and puffins were caught in fishing gear set within 40 km of breeding colonies (see also Piatt *et al.* 1984). Indeed, many of the best fishing grounds are located in the immediate vicinity of large seabird colonies at Cape St. Mary's, Witless Bay, and Baccalieu Island, and it is there that seabird bycatch has been most severe. Highest bycatch rates were recorded over a 6-week period in June-July when Capelin moved inshore to spawn. At this time both seabirds and Cod forage on the spawning Capelin, thus creating a situation where the Cod fishery and seabird foraging overlap in space and time. Use of relatively non-selective and efficient fishing gear such as monofilament gillnets in this situation almost inevitably results in the bycatch of seabirds. Areas of Newfoundland reported by Piatt and Nettleship (1987) to be impacted by seabird bycatch are indicated on Figure 2.

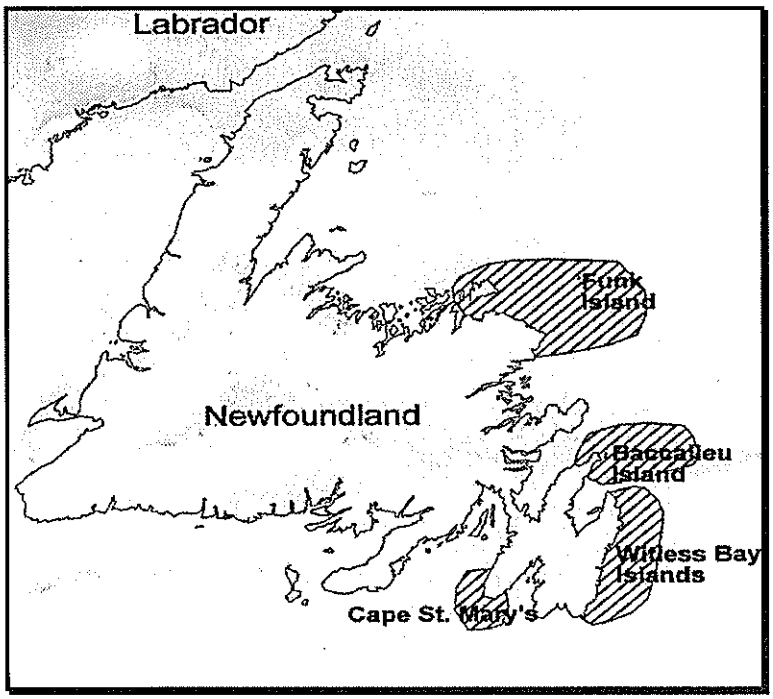

Figure 2. *Map of Newfoundland with areas impacted by seabird bycatch indicated.*

Other fisheries prosecuted in Atlantic Canada, although as yet unstudied, have the potential to kill seabirds through bycatch. Significant offshore gillnet fisheries used to occur on the Grand Banks in the same areas used by over-wintering alcids. Anecdotal information suggests that significant seabird bycatch occurred in these offshore fisheries (Piatt *et al.* 1984). Prior to the groundfish moratorium in Atlantic Canada, Cod traps with sewn-in tops (Japanese traps) were increasingly being used. These traps had the potential to drown seabirds that found their way into the traps but then could not swim out of the tops. The Lumpfish fishery in Newfoundland has expanded dramatically in recent years. This fishery uses 8.5" (22 mm) monofilament gillnets set on the bottom in shallow water close to shore. Anecdotal information suggests that Common Eiders are at risk of being caught in these nets. There is still a significant inshore Salmon fishery off the south-central coast of Labrador (although this may close within the next few years) and it appears that significant numbers of Razorbills breeding at the Gannet Islands are drowned in these nets.

The current moratorium on groundfish fishing in Atlantic Canada has significantly reduced, and in places virtually eliminated, seabird bycatch for the time being. However, some fishing in the inshore still takes place for species such as Flounder, Lumpfish, Herring, and Capelin, and gillnets are still in use for some of these fishes. However, none of the current fisheries has the same potential to entrap and drown seabirds as did the Cod and Salmon gillnet fisheries of just a few years ago.

There is now an indication, 5 years after the start of the groundfish moratorium, that some stocks are rebuilding to commercially fishable levels. In 1997 a limited commercial Cod fishery using gillnets and longlines opened up on portions of the south coast of insular Newfoundland, and this is likely to continue in future years. However, this fishery is not likely to cause significant seabird bycatch because few seabird colonies are located in the immediate vicinity of the fishery. The colony at Cape St. Mary's is located closest to the new fishery and birds there could be vulnerable to bycatch in nets set in Placentia Bay. Most of the major seabird colonies lie on the east coast of Newfoundland and Labrador and there is

presently no indication that groundfish fisheries will open up there in the short or medium terms.

2.2.3 Impact on populations

It should be kept in mind when discussing impacts on populations that impacts can take many forms. In the context of seabird conservation, an impact is traditionally thought of as only implying a decrease in the numbers of breeding individuals in the population. This is erroneous as there are other equally significant effects on populations that could be termed "impacts", but that do not imply decreasing populations or indeed any effects on total numbers of individuals in the population. For example if a particular effect was to increase mortality rate by 2% in a population that was growing at a rate of 5%, then the "impact" in this case would be to slow the rate of growth of the population. In another example the effect of a particular activity on a population may be to change its age structure while leaving the population size intact. Both examples should be considered population impacts. With this broader view of what constitutes an impact on populations, we are forced to conclude that seabird bycatch must impact populations since we know that bycatch causes seabird mortality. The question then is not whether bycatch impacts populations but by how much. Small increases in mortality caused by bycatch may be buffered by non-additive population processes and would be very difficult to detect anyway. Large increases in mortality may simply slow the population growth rate or nudge the population into negative growth. The problem faced by seabird conservation biologists and managers will always be one of teasing out the main effect (in the statistical sense) of bycatch in the face of a complex array of variables that affect the demography of seabird populations. In the end it may rarely be possible to attribute a population impact to bycatch or any other factor alone. However, this should not be used as evidence that bycatch does not impact populations.

Piatt and Nettleship (1987) assessed the impact of bycatch on selected seabird populations where possible, and some of their estimates were alarming. Annual mortality due to bycatch alone was estimated at 9.3% for Funk Island Northern Gannets, 12.4% for Newfoundland Razorbills, 5.7% for Witless Bay Common Murres, and 16.3% for Cape St. Mary's Common Murres. In contrast, bycatch mortality for Atlantic Puffins (0.2%) was not significant. Some of these mortality rates exceed the total mortality a seabird population can withstand and still maintain stability. Thus seabird bycatch at the levels observed in Newfoundland in the early 1980s had the potential to severely affect local populations.

2.2.4 Status of management, regulation and research on seabird bycatch in Arctic Canada

Legal regulation of seabird bycatch in Canada

All Canadian seabirds (with the exception of cormorants) are protected through regulations set out in the Migratory Birds Convention Act (MBCA). In the Act there are no specific regulations preventing the bycatch of seabirds, although there are regulations controlling their possession. Technically, a fisher who catches and then removes seabirds from a fishing net is in possession of those seabirds and as such contravenes a MBCA regulation restricting possession of migratory birds to those with a valid permit. No permit to allow fishers to possess seabirds exists. However, charges are not normally laid in this context as long as the fisher disposes of the seabird carcasses in the water after removal from the net. Charges may be laid if a fisher brings ashore the carcasses for disposal or use, such as human consumption. This enforcement policy is designed to deter a fisher from setting fishing gear

for the express purpose of catching seabirds -- an activity which has been observed in Newfoundland in the past.

Table 2. *Seabirds caught in different types of inshore fishing gear in Southeast insular Newfoundland from Funk Island to Cape St. Mary's, 1981-1984. Data are from Piatt and Nettleship (1987). Estimates of annual bycatch are based on fishing effort for each gear type.*

Species	Total recorded dead in nets	Estimated bycatch per annum	Percent in Cod gillnets	Percent in Salmon gillnets	Percent in Cod trap	Percent in Flounder gillnets
Common Murre	26,814	22,070	81	16	1	2
Greater Shearwater	1025	2232	96	4	0	0
Atlantic Puffin	1674	1180	45	48	7	0
Black Guillemot	185	500	17	81	2	0
Sooty Shearwater	201	438	95	5	0	0
Northern Gannet	40	428	0	100	0	0
Common Eider	23	278	100	0	0	0
Razorbill	48	199	56	44	1	2
Herring Gull	41	97	0	93	7	0
Leach's Storm-Petrel	17	49	0	100	0	0
Black-legged Kittiwake	13	41	0	92	8	0
Thick-billed Murre	6	*	100	0	0	0
Great Black-backed Gull	5	*	0	100	0	0
Cormorant *Phalacrocorax* spp.	2	*	100	0	0	0

* data too few to extrapolate

Institutional history of addressing bycatch

The problem of seabird bycatch in gear set by Canadian fishers generally has been overlooked by the Department of Fisheries and Oceans (DFO), the federal agency responsible for managing marine fisheries in Canada. DFO has been more concerned with bycatch of wildlife species under their direct mandate such as fishes, cetaceans, and seals. The Canadian Wildlife Service (CWS) of Environment Canada, which has a clear mandate to conserve and manage migratory birds in Canada, has for some time recognised seabird bycatch as an important conservation problem and currently considers it a priority issue for Canadian seabirds (Gaston 1989). Progress in co-operating with DFO and fishers was being made just prior to the groundfish moratorium, when a co-operative program was launched with a goal of reducing seabird bycatch in Cod gillnets through experimentation into different net types. This co-operation was considered an important first step in dealing with the seabird bycatch issue, however, the groundfish moratorium has thus far prevented any further work.

Guidelines to reduce seabird bycatch in Canada

There have never been any guidelines in place to reduce bycatch in Canada. Stricter enforcement of MBCA regulations in Newfoundland, beginning in the mid-1980s, has had the effect of reducing the deliberate setting of gillnets to catch birds. Having lost the benefit of using accidentally caught seabirds, fishers generally regard seabird bycatch as a nuisance because it reduces their fishing efficiency due to the time and effort it takes to clear their nets of birds. Because of this many fishers actively avoided setting their nets in areas where they were likely to catch significant numbers of seabirds.

Based on their observations of seabird bycatch in insular Newfoundland, Piatt and Nettleship (1987) recommended the following actions to reduce bycatch there:

1. Regulation of the timing of use of gillnets so as to avoid critical periods, such as when Capelin swim inshore to spawn;
2. Restrictions on the use of gillnets in particularly sensitive areas, such as around major seabird colonies;
3. Use of bycatch quotas for seabirds much the same as is in place for fish bycatch.

Economic and other pressures prevented the implementation of these actions when the inshore groundfish fishery was underway prior to 1992. Since then the groundfish moratorium in the Atlantic region has eased this pressure for the time being and there is now an opportunity to re-assess the use of gear such as monofilament gillnets, which have been shown to be so damaging to non-target species.

Recommendations to improve institutional response to seabird bycatch in Canada

In many Canadian fisheries the level of seabird bycatch or the species involved is unknown:

- Monitoring of seabird bycatch is needed in areas likely to experience problems such as near concentrations of seabirds at breeding colonies and offshore feeding areas;
- Monitoring of seabird bycatch should become an integral part of activities of fisheries observers on vessels fishing in Canadian waters.

Seabird bycatch is recognised as a problem not only for resource managers but also for fishers themselves. Developments in gear design and use may mitigate environmental impacts such as seabird bycatch:

- Canadian Wildlife Service and Department of Fisheries and Oceans should co-operate with fishers and university researchers in the development of modifications to monofilament gillnets that would make them less prone to seabird bycatch. Net colour and the use of alarms may be promising avenues of work.

Seabird bycatch is not often highlighted as an important environmental impact of some fisheries:

- To raise the awareness of seabird bycatch as a conservation problem in some Canadian fisheries, an information/education program should be developed and directed toward fishers and Canadian fisheries management agencies.

Sufficient knowledge exists now to reduce seabird bycatch in Arctic Canada:

- Current knowledge of the spatial and temporal patterns of seabird bycatch should be incorporated into future fisheries regulations such that fishing effort is reduced during periods of the year, and at locations, when and where seabird bycatch is a significant problem;
- The use of monofilament gillnets should be discontinued in areas where seabird bycatch is known to occur and is a particular problem, such as in the vicinity of seabird colonies.

2.3 REVIEW OF INCIDENTAL TAKE OF SEABIRDS IN FISHERIES IN FINLAND

by Martti Hario

Finnish Game and Fisheries Research Institute
Helsinki

2.3.1 Types of fisheries in Finland

Due to the fact that most of the coastal waters and all inland waters freeze over for several months every year, most fisheries in Finland are more restricted in time than anywhere in the rest of Europe. As an example, recreational fishers in inland areas, that take 50% of the inland catch, use gillnets and wire traps for only one month per year on average. In the Finnish sea territory, the Salmon fishing fleet of 200-300 boats fishes for 80-90 days per year, on average. For the driftnet fishing the average period is only approximately 40 days.

More than 90% of the commercial marine catch consists of Clupeoids, viz. Baltic Herring and Sprat. Atlantic Salmon and Whitefish are the next most important species. They are taken mainly with traps (ca. 20% of the catch) and driftnets (55%). In the whole of the Baltic Sea, about 386 vessels registered in the EU were recorded as fishing Salmon with driftnets in 1994 (Anon. 1995a). Of these, 160 were Finnish, 100 were Danish, 123 were Swedish and 3 were German. Nets are usually set near dusk and retrieved near dawn. Fishing is dependent on winds, with speeds over 10 m/s being practically the upper limit for operating.

Fishery Rule 14 of the International Baltic Sea Fishery Commission regulates the number of driftnets per vessel (600 subunits of a maximum length of 35 metres each, totalling 21 km), minimum mesh-size (157 mm), minimum landing size (60 cm) and temporal moratoriums (15 June - 1 July to 15 September, depending on the sea area) (Anon. 1995a). These rules apply to driftnet fishing outside 4 nautical miles from the baselines. In Finland, the average use per boat is ca. 400 subunits during a 40-day period per year.

In addition to driftnets, Salmon (and Whitefish) is taken with traps (22% of the Salmon catch in 1994) and drift line (11%) (Anon. 1995b). The total number of traps along the Finnish coasts ranges around 900-1500 annually. As traps are commonly placed near skerries with seabird colonies, they probably pose an even greater risk for local seabirds than driftnets. The period of Salmon/Whitefish trapping is also longer than that of driftnet fishing, with the annual average ranging from 65 to 80 days (Anon. 1993).

Finland gets only 0.2% of its national income from fisheries, and this includes aquaculture. This share is among the lowest in countries belonging to the European Union. Consequently, the total landings from the commercial marine fisheries, 80,000 t (in 1992), is less than 2% of the catch by current EU member states. However, an additional 20,000 t are taken by recreational fishers. Hence, the total marine catch is about 100,000 t of which recreational fishery takes 20% (Anon 1994).

In contrast, commercial fisheries in inland waters in Finland is more extensive than in any other European country (due to the large size of inland water resources).

2.3.2 Incidental take -- historical and present knowledge, future perspectives

No official statistics exist on locations, species affected and the magnitude of the bycatch in Finland. There are no legal regulatory regimes concerning incidental take of seabirds in fishery. Historically, incidental take has never been considered a major wildlife conservation issue in Finland. This is not to say that there is no need of assessing its impact.

Of the genuine seabirds, known victims are Common Eider and alcids. Loons are also known to get entangled, especially in longlines, and there is scattered information on bycatch mortality of most waterfowl species in Finland. However, being more or less anecdotal the information is difficult to evaluate.

Salmon traps and driftnets are probably most dangerous to seabirds, while Herring nets and trawls pose the least threat. There is no increasing trend in the proportion of alcids reported to have been entangled despite an increase in Salmon driftnet fishing effort in Finland (see below). Scattered occurrence of birds and lack of wintering stocks might be reasons for the apparently low bycatch mortality within the Finnish sea areas compared to the situation in the southern Baltic Sea (e.g. Stempniewicz 1994). Our seabird populations have been steadily increasing during the last decades, and this applies to all alcid populations within the whole of the Baltic Sea (e.g. Razorbills increased by 6-8% per year during the last 20 years, Hildén and Pahtamaa 1992). No apparent crashes in seabird numbers due to bycatch mortality have been announced in the Baltic, in contrast to the situation in many areas in the northern Atlantic. However, Black Guillemot populations are known to be dwindling in the Gulf of Finland, partly due to Mink (*Mustela vison*) predation, and partly due to bycatch mortality on the breeding grounds (Salmon traps). This mortality should be assessed before any conclusions can be drawn regarding the future prospects of the Black Guillemot populations in the Baltic.

2.3.3 Effects on the populations

Analyses of ringing recoveries of birds entrapped in fishing gear provide some insight to the bycatch problem: Recoveries of Finnish Razorbills and Black Guillemots from fishery activities within the whole of Baltic indicate a steady but relatively low 'bycatch rate'. In Figure 3, the variation of ring recoveries in fishery follows closely the variation of annual ringing totals. Of the 13,266 ringed Razorbills in 1926-93, 446 have been recovered in fishing gear, i.e. 3.4%. From 1960 on, inclusive, the annual 'bycatch rate' (proportion entrapped birds of the yearly ringing totals) has been remarkably stable (range 1.1.-5.7, SD 0.06, mean 2.39%).

Of the 24,162 ringed Black Guillemots there are 748 recoveries of birds reported to have been entangled, i.e. 3.1%. Again, the variation in 'bycatch rate' in 1960-93 is fairly low but, nevertheless, significantly higher than that of Razorbill (range 1.5-11.0, SD 0.62, mean 2.50%; $F = 98.4$, $P < 0.001$). This is mainly due to a few years (e.g. 1975, 1976 and 1978) having exceedingly high recovery rates in these data (8-11%). Of the 405 ringed Common Murres only 9 recoveries of birds entrapped in fisheries (2.2%).

This 'bycatch rate' is only suggestive, however, as we have no information on the reporting rate, i.e. how many of the birds drowned in fishing gear and wearing a ring actually will be reported. Judging from the steady return rate, the bycatch mortality rate has not increased

despite an increase in driftnet fishing effort. Of the different mortality factors in Razorbills, bycatch amounts to 83% among yearlings, 73% among 1-year-olds, 69% among 2-year-olds, and 52% among 3-4-year-old birds (R. Yrjölä/Signildskär Bird Observatory, pers. communication). Thus, bycatch mortality seems to be one of the most important population-regulating factors for Razorbills.

No analysis has so far been made of the bycatch mortality of Common Eider, including duckling mortality in the inner archipelagos. Fine-meshed nylon-nets, commonly used in shallow coastal waters, are probably more dangerous to them than Salmon gillnets.

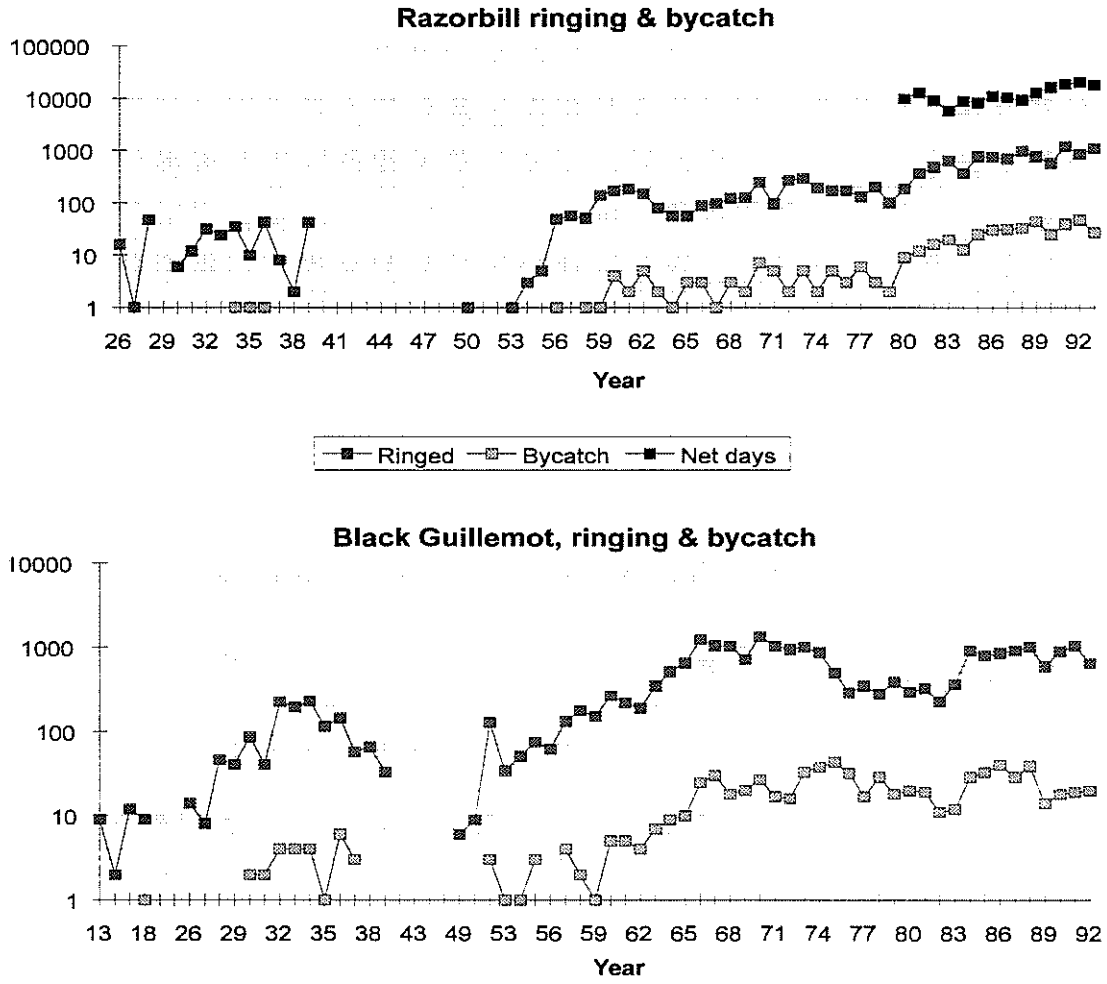

Figure 3. *Yearly ringing totals of Finnish Razorbills and Black Guillemots, numbers of recoveries in the whole of Baltic fishery ("bycatch"), and numbers of net-days (black symbols in upper graph from 1980 onwards) in Finnish Salmon driftnet fishery. Logarithmic scale. The average net days = mean annual no. of subunits x days.*

2.3.4 Status of management, research and monitoring

So far, no attempts have been made to address the issue of seabird bycatch on the basis of serious research in Finland, nor are there any monitoring programs going on.

Recommendations for future research and management

- Assess the problem, notably for the Black Guillemot, and gather all the scientific data available from ringing schemes and population studies;
- With the help of those involved in fisheries, identify and promote new fishery strategies to reduce the impact of methods causing unwanted bycatch.

2.4 REVIEW OF SEABIRD BYCATCH IN GREENLAND

by Knud Falk

Ornis Consult
Copenhagen

2.4.1 Types of fisheries in Greenland

Fishing activities and their importance to local economy

People in Greenland have always been strongly dependent on their marine resources -- mammals, birds and fish. During this century, commercial fisheries have developed rapidly (Mattox 1973), and while foreign fishing fleets took the vast majority of the catch until the late 1960s, Greenland now has its own modern fleet that lands its catch at the fish plants located in most towns and settlements. An estimated 5500 persons, or about 10% of the total population, is employed in the fishery or at the land-based plants, and fishery activities now account for more than 3/4 of the gross national income. Quotas unused by the local fleet are sold to the European Union, providing a substantial income to the national economy.

The main fishing areas are located over the West Greenland banks that are usually ice-free year round (north to about Sisimiut/Holsteinsborg). During the summer, Disko Bay is a major shrimp trawling area. In recent years a summer fishery has taken place further north up to Upernavik, and an offshore prawn fishery was started off East Greenland in the 1980s (see enclosed map for local names used).

In the 1950s and '60s, Cod was the main target species, and up to 400,000 tonnes were landed annually, mostly by non-Greenlandic vessels. But due to climate fluctuations, causing a general cooling of the waters along West Greenland, the Cod stocks are currently at a low, and annual catch now down to a few thousand tonnes.

With the decrease in Cod fishery, Shrimp and Greenland Halibut have gained significance and are now economically the most important species; the catch of the two species in 1995 made up 44,000 t and 15,000 t, respectively. Shrimp harvest peaked a few years ago at 70,000 t.

In the late 1960s, large autumn stocks of Atlantic Salmon of European and Canadian origin were discovered along West Greenland. This spurred an intense international off-shore fishery in the Davis Strait from 1968. International concern for Salmon stocks -- and for a huge seabird bycatch (see below) -- prompted regulation of the Salmon fishery, and from 1976 non-Greenlandic boats were banned from fishing Salmon in the area. Over the years, the total Salmon quotas have decreased considerably from 1952 t in 1973 (total of international and local quotas) to 904 t in 1988 (Falk and Durinck 1991), and in recent years the Salmon fishery has almost ceased: in 1993 and 1994 the small commercial quotas allotted were sold to Canadian sport fishers, and thus no commercial Salmon fishery took place in Greenland (only limited fishery for private consumption). In the autumn of 1995 a quota of 77 t was licensed to small boats, and the quota was met within two weeks from the opening date of 14 August (Greenland Fisheries License Control, unpublished data).

Fishing gear and distribution

Primary types of fisheries in the parts of West Greenland where significant seabird populations occur include (H. Siegstad, pers. comm. 1996):

- Cod are currently mainly fished by bottom set multifilament traps at 10-50 m depth along the shores of the fjords in West Greenland between Paamiut and Maniitsoq; most of the limited fishery takes place in May - June;
- A small catch of Lumpsucker is taken in early spring (March - April) by monofilament pound nets at shallow water (10 m) in South and West Greenland north to about Maniitsoq;
- Salmon for local use is taken in short nets set from shore in the archipelago in Southwest Greenland, whereas the commercial fishery (now very limited, as summarised above) uses 1 - 3 km long monofilament drift nets set in the mouth of the fjords or just outside the archipelago. The same type of gear was used by the larger, foreign vessels fishing further offshore in the early 1970s;
- Greenland Halibut is taken in nets set at great depth, and on longlines, often in icy waters in the northern part of West Greenland;
- A local fishery for Arctic Char takes place near the rivers in the fjords by means of short nets fixed to the shore;
- Shrimp are taken by deep bottom (200-400 m) trawling, mainly at the banks off West Greenland, in Disko Bay, and to a lesser extent in the fjords of Southwest Greenland;
- Scallops are dragged off the bottom at 20-50 m in the fjords and archipelago in West Greenland.

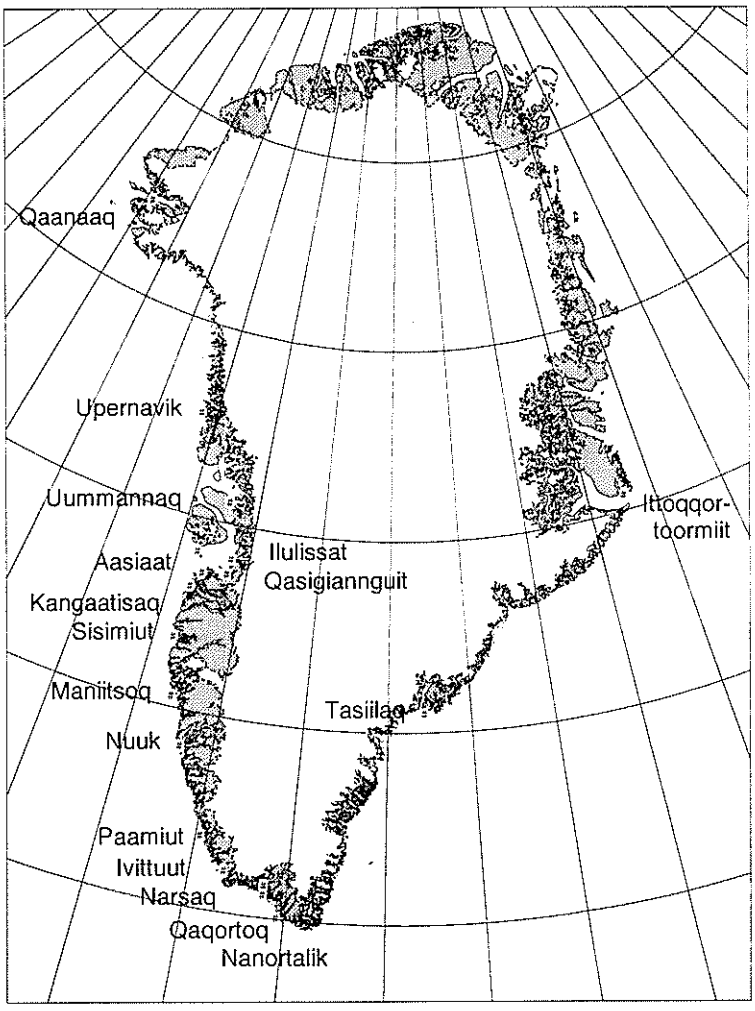

Figure 4. *Map of Greenland with town names mentioned in the text*

2.4.2 Incidental take of seabirds

Historical information

Salmon drift netting is the only fishing activity in Greenland that ever gained attention due to a significant bycatch of sea mammals and birds -- and the only kind of fishery that has been subject to investigations of incidental entanglement. The main Salmon fisheries era for non-Greenlandic boats (from Denmark, Norway and Faroe Islands) lasted a decade from 1965 to 1975. Based on seabird bycatch in test fisheries (aimed at Salmon tagging) from a Canadian fisheries research vessel operating along West Greenland in 1969-71, Tull *et al.* (1972) estimated the total average yearly kill in the commercial drift net fishery at 540,000 Thick-billed Murres -- the only species taken in large numbers (of 994 birds 986 were murres, 4 Black Guillemots, 3 Dovekies, 1 Atlantic Puffin). A more comprehensive study of 4 research vessels and 8 commercial vessels took place in 1972 (Christensen and Lear 1977). They reported a wide range of species taken in the offshore fishery. Christensen and Lear (loc. cit.) used the Salmon/birds ratio in relation to fishing effort to estimate that 223,000 seabirds were caught unintentionally in the commercial fishery in 1972, 93% of them were murres (almost exclusively Thick-billed), 5% Dovekies, 1% Greater Shearwaters, and 1% Black Guillemots. The bycatch rate was 8.5 times higher during night fisheries compared to daylight operations.

There were huge temporal (months between August and October) and spatial (north - south, and distance to coast) differences in the bycatch rates. In August and September, highest bycatch rates for murres occurred 6 - 30 nautical miles (n.m.) from the baseline, whereas in October high rates also occurred near the coast. No Dovekies were recorded in the bycatch in August, but in September they showed up in nets set near the coast around Disko, and far offshore (12-60 n.m.) further south in the Sisimiut-Maniitsoq region. Black Guillemots were caught evenly over the autumn in the coastal waters. Greater Shearwaters were caught between Paamiut and Nuuk in August - the shearwaters leave Greenlandic waters by early September.

Present situation -- Salmon fishery

Large-scale offshore Salmon fishery was phased out by the end of 1975. But based on changes in the Greenlandic Salmon fishing activities and the reported distribution of Salmon landings, Piatt and Reddin (1984) predicted a renewed increase in murre bycatch from the early 1980s, and recommended a re-investigation of the problem. Therefore, Falk and Durinck (1991) assessed the bycatch level in 1988 from interviews with 51 fishers (6% of license holders) and by observing landings in the main harbours. In total, only 848 murres (and 2 eiders) were recorded; extrapolations based on fishing boat type (small or large vessels) and area led to an estimated 3000 murres caught in the 1988 Salmon season, most of them from Nuuk and northwards. The authors concluded that although data were scarce, the likely bycatch was in the order of 10^3 birds, and far from the level of 10^5 reported in the 1970s; several other pieces of information supported that conclusion (see Falk and Durinck 1991). Although a figure of 'thousands' of murres may still appear high compared to reports from elsewhere, it makes up a small proportion of the likely source populations (see below) of approx. 1.4 million birds at the West Greenlandic and high-arctic Canadian colonies (Nettleship and Evans 1985, Kampp *et al.* 1994).

The main reasons for the reduced murre bycatch since the international Salmon fishery was phased out is that the local quota is given mainly to small-boat fishers, who almost exclusively operate inside the archipelago (inside fisheries 'baseline') where few murres occur during the normal fishing period. The timing of the fishery is important: currently the majority of the catch takes place inshore or just outside the baseline in late August and September, well before the murres move close to the coast and inshore about mid October. Murres breeding at colonies situated in fjords near Maniitsoq and in Arsuk Fjord depart from the cliffs in late July (to early

August), and probably 'escape' offshore prior to the opening date of the Salmon fishery (14-25 August in most years).

After the latest survey in 1988, the Salmon quotas have dropped even further (see above). Due to the reduced quotas and, in particular, due to the distribution of the fishery, which, since the late 1970s, has been almost completely separated in time and space from the major murre concentrations, the problems related to incidental bycatch of murres is probably negligible at present.

Other species, however, may not have had a similar reduction in bycatch in the Salmon fishing gear. Since most Salmon fishery takes place in coastal waters, Black Guillemots might now be more prone to net-entanglement than murres. In 1988 some fishers reported that they caught Black Guillemots more often than murres in nets fixed to the shore in the archipelago. The Black Guillemot is widespread all year along the coast of West Greenland, and may be caught in small numbers anywhere, but there is no quantitative data available for an evaluation of the problem. Potentially, the Common Eider could have been another candidate for bycatch in the inshore Salmon fishery, but there are only a few breeding sites left within the main Salmon fisheries region that could serve as sources for any bycatch. Furthermore, in the principal Salmon fishing period, wintering birds have not yet arrived in the archipelago in West Greenland (Durinck and Falk 1996).

Other types of fishery

Among the other primary types of fishery currently in use in Greenland, the Cod set nets and traps as well as the Lumpsucker set nets, both used in spring, are the only types that could potentially cause any seabird bycatch. There is no hard evidence on this type of mortality. However, since market sale of all game, including seabirds, is legal and widespread in Greenlandic towns, drowned birds would likely show up at the markets (they are usually easy to distinguish from shot birds). However, despite thorough monitoring of the game market in the largest town, Nuuk, all winter and spring in 1988-89, and again in 1995-96, no drowned birds have been recorded. This may be a hint that bycatch in fishing gear is not presently occurring at a large scale.

2.4.3 Effects on populations

There is no direct evidence that the bycatch has had any effects on the seabird populations in Greenland. There seemed to have been an unfortunate spatial and temporal concurrence of the Salmon fishery that took place in areas where the murres were passing through on their autumn swimming migration from the colonies in the Greenlandic and eastern Canadian Arctic. Band recoveries from the bycatch in the Davis Strait in the 1970s showed that Greenlandic as well as Canadian banded birds were entangled, whereas the absence of Spitzbergen murres in the catch suggests that the driftnet fishery took place too early in the autumn, and too far north, to affect this murre population arriving at South Greenland in late autumn (Kampp 1982, Kampp *et al.* 1994).

It is possible that the huge bycatch did contribute to the decline of the Thick-billed Murre reported from some areas of Greenland (Evans 1984; Evans and Kampp 1991; Kampp *et al.* 1994), not the least because the bycatch took a relatively large proportion of older murres (31.5% adult [6+ years old], 50% immature birds [2-5 years], and 18.5% first-year birds; Kampp 1982).

The current small-scale, inshore fishery for Salmon could have a potential impact on the murre colonies situated in fjords near towns -- i.e. the colonies near Maniitsoq and the colony in Arsuk Fjord in Southwest Greenland -- if the Salmon fishery opens early in the season. The population departs from these colonies in late July or early August. Normally the official opening date for the Salmon fishery is somewhere between 14 and 25 August, but in three years since 1979 (1979, 1980, 1985) the season opened on 1 August, which might have caused local bycatch incidents at these colonies (there are no data to support this speculation).

One may also speculate that the local Lumpsucker fishery in early spring may be an additional source of mortality to eider populations, either wintering/migrating King and Common Eiders visiting West Greenland in large numbers, or local breeding populations of Common Eider. But again, lack of observations of drowned birds in local markets suggests that it may be a minor source of human-induced mortality.

In short, although a small but widespread bycatch in local fishery could add up to a substantial number of birds -- probably mostly Black Guillemots and eiders -- the figures are likely to be much lower than the number of birds shot annually.

2.4.4 Status of management, research and monitoring

There are no current investigations or monitoring of seabird net-entanglement in the Greenlandic fishery, and all seabird population monitoring and management deals with hunting pressure on populations.

2.4.5 Recommendations for future research and management

Since hunting is currently considered the main source of human-induced mortality for seabirds breeding or wintering in Greenland, it is well justified that research and management focus on the direct kill toll. However, as no quantitative data exist on the number of birds caught in Lumpsucker and other local net fisheries, these issues should be included in any future assessments of seabird bycatch in Greenlandic waters, as should the possible local risk of early-set Salmon nets to murres departing from the colonies in Southwest Greenland.

The annual Salmon quota is decided by the Greenland Home Rule Government according to international agreements within the NASCO (North Atlantic Salmon Conservation Organisation); the quota and the timing of the fishery is based on Salmon stock management recommendations, not on bycatch issues. However, since timing is a crucial factor in avoiding at least the murre bycatch, it is recommended that these issues are kept in mind when allocating open seasons for Salmon fishery, especially:

- The Salmon fishery should *not be initiated before 15 August* in order to prevent incidental take of murres swimming from the colonies in SW Greenland; and
- The Salmon fishery should *end no later than 1 October*, in order to reduce the risk of catching wintering murre populations moving towards coastal waters from mid October.

2.5 INCIDENTAL TAKE OF SEABIRDS IN ICELAND

by Aevar Petersen

Icelandic Institute of Natural History
Reykjavik

2.5.1 Types of fisheries in Iceland

Iceland receives some 70% of its national income from fisheries. The most important species are Cod, Haddock, Herring, Capelin, Pollock, Greenland Halibut, Lumpsucker, Catfish, Redfish, Shrimp, and some others. Of these, the Cod is economically the most important species.

2.5.2 Incidental take of seabirds

Information on the species and their numbers taken in fishing gear are rather scanty and somewhat descriptive, since no special surveys have been carried out overall for all fishery practices. Recoveries reported within the Icelandic Bird Ringing Scheme give us some information, both qualitative (species) and quantitative (proportional numbers caught), as seen in Table 3.

Table 3.. Bycatch data, as reflected by ringing recoveries within the Icelandic Bird Ringing Scheme (1932-1994).

Species	Numbers ringed*	Numbers of recoveries	Percent
Red-throated Loon	270	6	2.2
Northern Fulmar	ca. 30,000	5	>0.1
Gannet	ca. 2000	2	0.1
Cormorant	ca. 3000	40	1.3
Shag	ca. 5000	21	0.4
Eider	ca. 8000	15	0.2
Great Skua	ca.10,000	17	0.2
Herring Gull	2800	1	>0.1
Glaucous Gull	2700	1	>0.1
Great Black-backed Gull	2700	1	>0.1
Common Murre	2720	14	0.5
Razorbill	4950	7	0.1
Black Guillemot	ca. 13,000	472	3.6
Puffin	ca. 60,000	1	>0.1

* For some years the total number of birds ringed is not known and therefore the ringing totals are only approximate figures

Fourteen seabird species have been reported caught in fishing gear. Proportionally Black Guillemots are most susceptible, then the Red-throated Loon. These figures do not tell which species are numerically the most common in bycatch which is also reflected by the potential size of populations. These data are also dependent on what species have been ringed. Two species in particular are lacking: Great Northern Loon occasionally get entangled but hardly any birds have been ringed. Thick-billed Murres are probably caught in nets in large numbers, but have only been ringed in small numbers.

Data from bird ringing also give a hint of which types of fishing gear cause high mortality to seabirds (Table 4).

Table 4. *Types of fishing gear in which seabirds are killed, as reflected by ringing recoveries (n = 603) within the Icelandic Bird Ringing Scheme (1932-1994).*

Gear type	Number of recoveries
Fishing net (unspecified)	16
Salmon net	11
Leads for Salmon traps	3
Char net	1
Cod net	8
Flounder net	4
Lumpsucker net (unspecified)	2
Lumpsucker net (for males)	3
Lumpsucker net (for females)	509
Trawl	1
Scallop plough	1
Fishing hook	1
Longline	18
Fishing gear on land	9
Fishing gear (unspecified)	16

Fishing nets are the most important sources of mortality, followed by longline. Of the nets, Lumpsucker appear to be most important by far, then Salmon nets and Cod nets. These fishery practices occur all around Iceland: Lumpsucker, Trout and Salmon fishery in coastal waters, the others usually further away from the coast. The real importance of individual fishing gear types, in terms of numbers of birds caught, may be skewed, as data in Table 4 do not take into account the actual numbers caught. No overview is available, but numbers caught are dependent on the spatial and temporal distribution of different types of fisheries, biology of different bird species, etc. From what is generally known, it appears that the importance of Cod nets is grossly under-estimated in these figures.

The different bird species are vulnerable to different types of fishing gear. The alcids, especially the pelagic Common and Thick-billed Murres, and Razorbill, are particularly caught in Cod nets. Inshore feeders, Eider and Black Guillemot, mainly make up the birds drowning in Lumpsucker nets, while Shag and Cormorant drown mostly in Trout or Salmon nets and, to a lesser extent in Lumpsucker nets. Northern Fulmar and Great Skua are caught

on longlines, while Red-throated Loons drown in nets set in coastal waters, such as Lumpsucker and Trout nets.

Although no general survey has been undertaken of birds in fishing gear, it is well known that alcids are the most abundant taxa. Tens of thousands of these, especially Common Murre and Razorbill, and to lesser extent Thick-billed Murre and Atlantic Puffin, drown every year in fishing gear. As many as 4000 birds have been recorded in nets from one fishing vessel in one day. A part of the bycatch from Cod nets is sold (illegally) at auctions, from where birds find their way to fishmongers and are sold for food to the general public. However, most of the bycatch is consumed locally, either by the fishers themselves or sold outside fish markets, while large numbers of birds also get thrown away or eaten in nets by scavengers, e.g. amphipods.

There is much seasonal variation in bycatch. Figure 5 shows the sale of alcids (Common and Thick-billed Murre, Razorbill) at fish auctions in 1993 and 1994. About 7000 birds were sold this way each year. Bycatch is least during the summer period. This starts to increase in the autumn and further increases throughout the winter period to peak in May. Since these bycatch data are drawn from the Cod fishery, the observed pattern follows the intensity of that fishery superimposed by the seasonal and temporal patterns of alcids in Icelandic waters.

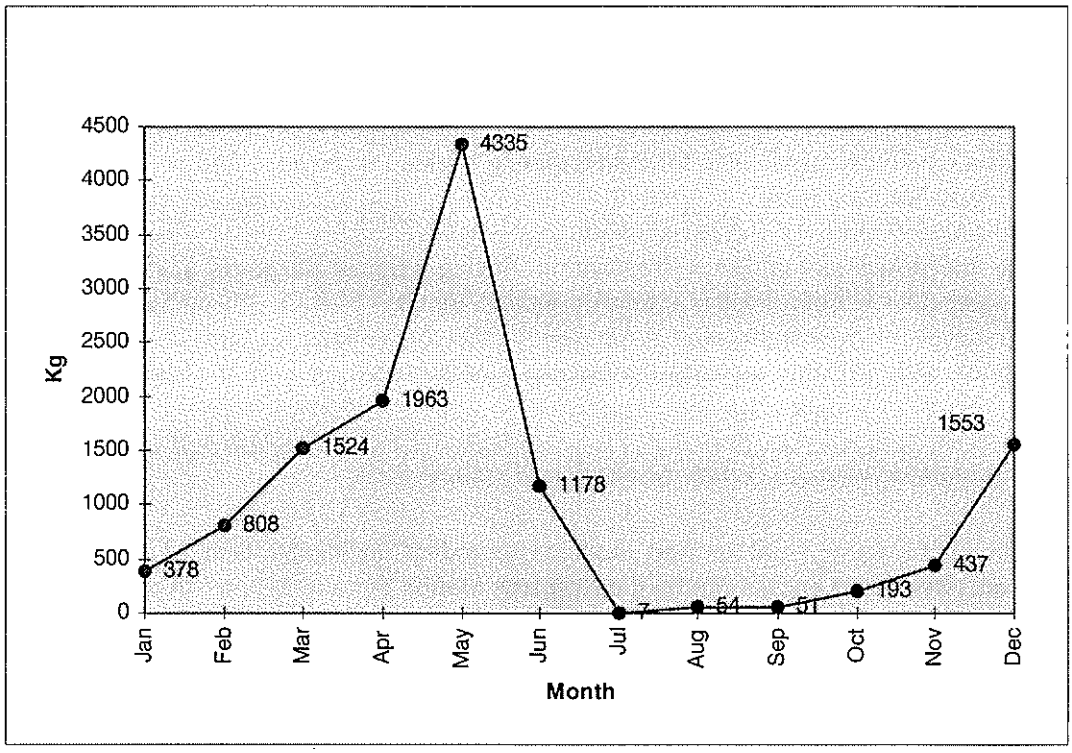

Figure 5. *Sale of alcids at fish auctioneers 1993 and 1994. Each year about 7000 birds are sold (each bird considered 900g)*

2.5.3 Effects on the populations

Only two species have been studied in relation to the bycatch impact on the populations, Common Eider and Black Guillemot. A study of bycatch in Lumpsucker nets was made in 1982, when a total of 1700 birds were estimated drowned in Icelandic waters during the entire fishing season (Hardardottir *et al.*, in prep.). This was estimated to be 0,06% of the

Icelandic Eider population. A similar survey was carried out for Eiders in the years 1984-87, in two regions in W- and NW-Iceland (Thorsteinsson and Marteinsdottir 1992). In the Breidafjordur region 0,3% of the estimated regional Eider population was thought to have drowned in nets, and 1,3% in the Hunafloi region. As a whole, these results can be looked upon as negligible considering a breeding population of some 250-300 thousand breeding pairs, plus unknown numbers of immature Icelandic birds and wintering birds from East Greenland. The sex and age distribution among the birds caught is, however, unknown, and some local effects on colonies are possible.

During the 1977 fishing season, half of the monthly adult mortality of Black Guillemots at one area (Breidafjördur, West-Iceland) was estimated due to Lumpsucker nets. This was about 10% of the annual mortality and not considered very important (Petersen 1981). Since then the fishing effort for Lumpsucker has greatly intensified, and is now probably the main contributing factor in the decline of this same local population (one of the largest breeding colonies in Iceland).

2.5.4 Status of management, research and monitoring

The use of birds from incidental take has been banned under the Icelandic Wild Bird Act since 1954, originally to discourage intentional netting. Nonetheless, fishers have utilised bycatch for home consumption. During the past 10-20 years some of these birds have found their way to fishmongers, and starting a few years ago birds retrieved as bycatch have also been sold at fish auctions, without intervention from law enforcement authorities.

There are no available guidelines for counteracting bycatch in Iceland, and no preparations are in progress for such work.

Although the utilisation of birds drowned in fishing gear is illegal in Iceland, it may counteract another human-induced mortality factor: hunting. Since a substantial part of the bycatch reaches the market this goes some way to meet the demand for birds used for human consumption, thus probably reducing the incentive for hunters to provide the birds.

2.5.5 Recommendations for future research and management

Work should be carried out to find methods to reduce incidental take of birds. Some experiments have been carried out by the Research Station at Lake Mývatn to use buoys for deterring Great Northern Loons from Trout nets (Árni Einarsson, pers. comm.). Research work should also be oriented towards answering if bycatch is likely to have negative effects on populations or not. A thorough literature screening should be conducted to find out if research elsewhere has been aimed at any of these practical problems, for example a Norwegian solution to reduce Fulmars getting hooked on longlines.

Several projects can be mentioned as needed for development of further recommendations on the bycatch issue in Iceland and management implications. First of all, a general survey of bycatch needs to be carried out for Iceland, addressing species, spatial and temporal distribution, and possible effects, country-wide or local.

More specific projects include for instance:

- *Pelagic alcids (Razorbill, Common and Thick-billed Murre, Atlantic Puffin):* As a first step, there is a need for a detailed survey of numbers caught, their spatial and temporal distribution around the country, and age distribution. A second step could be relating the

birds caught to specific populations (Icelandic or other), and to individual breeding colonies.

- *Divers (loons, Cormorant, Shag):* A survey needs to be directed towards the numbers caught. The populations of the two loons, Red-throated and Great Northern Loon, are small, especially the latter. It does not breed anywhere in Europe except Iceland which therefore has a special responsibility for the conservation of this species. The Cormorant population has declined significantly over the past two decades, and the Lumpsucker fishery may be responsible, probably more through indirect (colony disturbance) than direct effects (as bycatch).
- *Black Guillemot and Common Eider:* Research into the effect of Lumpsucker nets on the Black Guillemot population needs to be carried out, as there are strong indications that the population is declining at least locally. A country-wide survey is needed, and population trends should be monitored in more than just one region. The Common Eider is economically the most important bird species in Iceland (down collection), and any general or local effects from bycatch need to be assessed.
- *Northern Fulmar:* Because of their sheer numbers Northern Fulmars get hooked on longlines in large numbers, probably with no influence on the population. Such capture is, however, cruel to the birds as well as leading to economic loss for the fishers. That should be a sufficient incentive to develop methods to prevent capture on longlines.

2.6 INCIDENTAL TAKE OF SEABIRDS IN NORWAY

by Vidar Bakken

Norwegian Polar Institute
Oslo

2.6.1 Types of fisheries in Norway

Fishing has a long tradition in Norway, and remains important for the country. The value of the fish landings in 1993 was NKR 6,105,266,000 (US$ 803,324,473). In 1995, the fishery constituted about 0.7% of the gross national product (Statistical Yearbook 1996). In 1994, 22,920 people were involved in the fishery, which is about 0.5% of the total population in Norway (Statistical Yearbook 1996).

Norwegian fisheries are prosecuted along the entire coastline, but are most intensive in the northern part of Norway. The Cod fishery is the most important both in terms of commercial value and weight, although in some years the weight of Capelin landings from the Barents Sea has been larger.

2.6.2 Incidental take of seabirds

In Norway there are only a few publications on incidental take of seabirds in fishing gear (Holgersen 1961, Myrberget 1961, 1980, Vader and Barrett 1982, Røv 1982, Brun 1979, Løkkeborg 1990, Strann *et al.* 1991). Follestad and Runde (1995) have analysed the recoveries of ringed seabirds to evaluate the significance of the incidental take for the species involved. This was a part of a project initiated by the Norwegian Institute of Nature Research in 1986, which focused on collecting birds caught in fishing gear for studies of biometry, diet and physical condition throughout the year (Follestad and Strann 1991).

Types of fisheries where incidental take has occurred in Norway.

The information presented below is mainly from Follestad and Strann (1991). Most of the documentation of extensive incidental take is from fisheries with nets, especially for Lumpsucker in shallow water, Cod in winter, nets in shallow water for Cod, flatfish, Coalfish and Herring, closing nets for Salmon, and driftnets (Follestad and Strann 1991). Bow-nets are known to take a lot of Shags, while longlines mainly hook Northern Fulmars, Gannets, Black-legged Kittiwakes, Common Murres and Atlantic Puffins (Follestad and Strann 1991).

Strann *et al.* (1991) reported an extensive incidental take of murres outside Troms county (Figure 6) in the spring of 1985. About 40 fishing vessels took part in a fishery for Cod close to the coast. Both Cod and seabirds fed heavily on the Capelin in the area, and the fishing nets also caught seabirds. Based on the number of birds caught by two boats, it is estimated that at least 200,000 Common Murres were killed during this particular incident. The Capelin schools migrate to the coast in spring to spawn, but the actual area differs from year to year. Such bycatch incidents do not happen regularly, but depend on the place of spawning, the population status for Cod, and whether or not the area is accessible for fishery activities. Most of the birds caught were immature birds from many colonies in Europe, hence the effect on the local murre population may not have been significant.

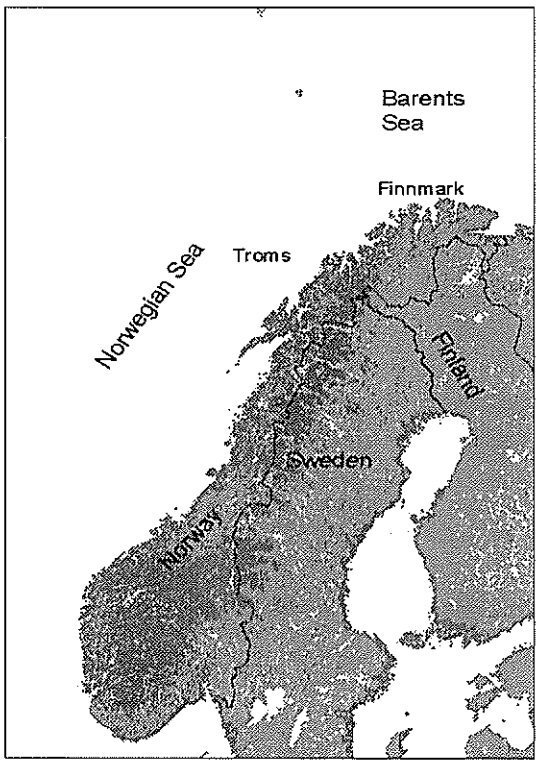

Figure 6. *Map of Norway with names mentioned in the text*

Another type of fishery which previously caused high seabird mortality was driftnet fisheries for Atlantic Salmon (Strann *et al.* 1991). This fishery mainly took place in June-August close to the coast. In some cases large numbers of seabirds, mostly Common Murres from local colonies, got entangled and daily maxima of 3000-4000 birds were reported (Strann *et al.* 1991). Also, pond-nets for Salmon are known to have caused major bycatch incidents: During one season a fisherman hauled as many as 10,000 puffins and 1000 auks (Common and Thick-billed Murres, and Razorbill) in five pond-nets outside one seabird colony in Norway (Strann *et al.* 1991). The use of Salmon driftnets was banned in 1989, and this fishery is no longer a threat to the seabird populations. The driftnet ban was introduced in order to protect the Salmon stocks, not the seabirds.

2.6.3 Effects on the populations

Follestad and Runde (1995) have analysed the recovery data of ringed seabirds, showing that incidental take in fishing gear was an important cause of death for several species. Bycatch in fishing gear was the primary mortality factor for Cormorant (81%), Shag (55%), Common Eider (42%), Common Murre (60%) and Black Guillemot (49%; Table 5). It is difficult to evaluate the effects on the populations based on recovery data with inherent bias. However, for some of the species with declining populations, the data may suggest that incidental take is one of the most important mortality factors.

The population of Common Murres has shown a marked decline along the Norwegian coast (Vader *et al.* 1990). Along the western coast of the Barents Sea, populations have decreased

about 5% per year since colonies were first counted (Brun 1971, Barrett and Vader 1984, Strann *et al.* 1991). The large decrease in the population in Troms and West Finnmark can be explained by drowning in Salmon nets alone (Strann *et al.* 1991).

No populations other than Common Murres are suspected to have suffered a major decrease as a result of incidental mortality in fishing gear. However, there are many observations of seabirds taken in fishing gear, especially Cormorant and Shag (see also Røstad 1982).

Table 5. Proportion of selected seabird species killed in fishing gear and shot, respectively, estimated from recoveries of birds ringed in Norway.

Species	Total number of recoveries	% taken in fishing gear	% shot
Cormorant	290	64	20
Shag	4445	48	37
Common Murre	446	55	18
Thick-billed Murre	170	0	87

2.6.4 Status of management, research and monitoring

There are no regulations concerning the incidental take of seabirds in Norway. The Salmon driftnet ban was introduced in 1989 to protect the Salmon stock, not the seabirds. The main reason for the lack of regulations is probably a lack of data proving that incidental take may have a significant negative effect on the populations.

The lack of data is discussed by Follestad and Strann (1991). Although large scale bycatch is known to occur in fishing gear, the data are inadequate for management purposes. Important gaps in knowledge are:

- The total loss of seabirds caused by incidental mortality in fishing gear; and
- The seasonal distribution and information on the seabird population segments caught in fishing gear.

Possible initiatives to improve the level of information are:

- Collect seabirds caught in fishing gear for mapping species, age, and seasonal distribution of the kill as well as types of fishing gear used, for instance by the aid of the inspectors onboard the fishing vessels;
- Interviews of fishers to sample local knowledge concerning bycatch;
- Introduce a 'bycatch logbook' to be kept by fishers interested in collaborating in solving bycatch problems; and
- Analyses of ring recoveries of seabirds.

Proposed management initiatives include:

- Initiate co-operation with the local guards overseeing the Salmon fishery, in order to have them patrol areas close to seabird colonies, and remove any nets jeopardising the local birds;
- Promote regulations that allow fishing only in areas where the conflicts with seabirds are low (spatial and temporal separation);

- Introduce regulations for type of fishing gear to be applied in certain areas where specific gear is known to cause significant bycatch.
- Promote the notion that such stipulations are included in the international fisheries regulations.

Proposals for monitoring include:

- Monitoring seabird populations in areas where bycatch might be a problem to assess the short and long term effects on the populations; selected parameters could be breeding population trends and survival rates of immature and adult birds.

2.7 NOTES ON SEABIRD BYCATCH IN RUSSIA

by Alexander Golovkin

All-Russian Institute of Nature Protection
Moscow

2.7.1 Types of fisheries, and incidental take in Russia

Incidental seabird bycatch problems occur in two main northern fishing areas in Russia: a western area comprising the Barents and White Seas, and an eastern area including the Chukchi, Bering and Okhotsk Seas.

In the western area, a traditional Cod fishery used longlines set from small boats. The lines were dropped into the water directly from onboard, which prevented any birds from getting caught on the hooks. This type of fishery was common until the 1950s, and caused no conflicts with marine birds. A Herring net fishery was also common, but probably caused little bycatch problems due to the small mesh size used in the nets.

The only type of fishery that could cause seabird net-entanglement was a Salmon fishery with large mesh nets. However, these nets were only set in river mouth areas, reducing the number of species at risk. In my own experience, Oldsquaw, Common Scoter, Velvet Scoter and eiders were the species most commonly encountered in nets, and immature birds appeared to be trapped in relatively higher proportions than adults. Bycatch in Salmon nets occurred in the vicinity of small as well as medium sized rivers. The total number of birds caught is not known, but it could be as many as some hundred individuals annually.

Monofilament nets are more dangerous to the birds than multifilament nets, and nets with one "wall" are less dangerous than "three-wall-nets".

Since the 1950s, the marine fishery has been re-oriented towards trawling for Cod and other bottom-fish. We have no information on any conflicts between trawling activity and seabird bycatch.

In the eastern parts of Russia, native people have traditionally set nets for Salmon at sea (not only in rivers). There are no data available, but one could account incidental take in this case as some thousands (less than 10,000) annually, caught in during summer and autumn.

Although hard data are lacking, one could suspect that the numbers (and variation) of seabirds caught in Chukchi and Bering seas were somewhat larger than in the western area, but this bycatch does not seem very important.

Until 1994, the types of commercial fisheries in the eastern area were similar to those in the western area. From 1994, some Japanese fishing vessels were allowed to fish for Salmon in open sea waters within the Russian economic zone. The Japanese fleet uses very long (several km) drifting gillnets, and the problem of seabird bycatch has arisen accordingly.

Some Russian observers from the Federal Kamchatka Fishing Commission worked on Japanese vessels during one season. Preliminary information from 1996 shows that more than 200,000 seabirds, mostly murres, were caught, and it seems that the bycatch in 1997 will not be reduced.

2.7.2 Management Recommendations

The huge bycatch occurring recently in the eastern area could be detrimental to populations within a very short time span, in particular if a large proportion of the entangled birds are adult breeders. Hence, there is:

- An immediate need to initiate activities to immediately reduce the bycatch.

Halting this bycatch has highest priority. But since there are no data on which to base an assessment of the potential impact on populations, there is also an urgent need for further research into:

- Identifying the species and age distribution of the kill;
- Identifying the main source populations for the most abundant species in the bycatch.

SECTION 3

IMPORTANT INCIDENTAL TAKES OF SEABIRDS IN THE ARCTIC

The national reports presented are characterised by much uncertainty and lack of data concerning incidental take of seabirds (see summary in Table 6 below). However, some investigations have documented significant bycatch in certain types of fishery in Alaska (Ainley *et al.* 1981, Ogi 1984, DeGange *et al.* 1985, Jones and DeGange 1988, DeGange and Day 1991, Wynne *et al.* 1991, 1992, Byrd *et al.* 1992, Johnson *et al.* 1993, DeGange *et al.* 1993), Canada (Piatt *et al.* 1984, Piatt and Nettleship 1987), Greenland (Tull *et al.* 1972, Christensen and Lear 1977, Falk and Durinck 1991), Norway (Strann *et al.* 1991) and Finland (Stempniewicz 1994). Some of these studies show that large numbers of birds have been caught in fishing gear, and in some instances may have had a significant negative effect on the populations (Piatt *et al.* 1984, Strann *et al.* 1991).

One method to evaluate the importance of bycatch cases is to analyse recoveries of ringed birds, and some data are presented by Greenland, Iceland, Finland and Norway. For many species the ratio of recovered birds reported as entangled in fishing gear is very high, although it is often difficult to interpret these (biased) data. However, such data may provide a good indication of significant bycatch which can be investigated in more detail by more direct observations.

One of the main difficulties in detecting and evaluating the effects of incidental take is that heavy mortality often occurs within short periods, depending on changes in the type of fishery and the distribution of the target fish species. Such irregularity poses a challenge to the management of the seabirds and fisheries.

With the exception of Alaska, there are no specific regulations introduced with the aim to prevent seabird bycatch. In Canada, however, it is illegal for fishers to keep seabirds that have been incidentally caught in fishing gear. This enforcement policy is designed to deter fishers from setting fishing gear for the express purpose of catching seabirds. In Iceland, use of birds from incidental take has been banned since 1954, originally to discourage intentional netting. However, use is occurring with impunity.

In the Arctic, seabird entanglements have mainly occurred with different kinds of nets and traps. In contrast to the Antarctic, longline fisheries do not seem to be as important in the Arctic areas. Alaskan fisheries are a notable exception where there are important albatross and Northern Fulmar bycatch problems. Northern Fulmars are also hooked on longlines elsewhere in the Arctic, but this bycatch is probably not a threat to the populations.

A most critical bycatch problem has emerged in eastern Russia: Japanese Salmon driftnet vessels entrapped an estimated 200,000 birds, mainly murres, in 1996. There are no indications that the impact should be less severe in 1997, and the sheer number of birds involved makes significant effects on source populations highly likely. This calls for immediate actions to reduce this mortality factor and -- at the same time -- initiate further investigations as noted in the next Section.

Table 6. *Status of knowledge of important incidental bycatch of seabirds in the Arctic.*

ATPU=Atlantic Puffin, AUKL=Auklets sp., BLAL=Black-footed Albatross, BLGU=Black Guillemot, BLKI=Black-legged Kittiwake, BLSC=Black Scoter, COEI=Common Eider, COMU=Common Murre, CORM=Cormorant, DOVE=Dovekie, GBBG=Great Black-backed Gull, GRSH=Greater Shearwater, HERG=Herring Gull, KIEI=King Eider, LAAL=Laysan Albatross, LSPE=Leach's Storm-Petrel, LOON=Loons sp., MAMU=Marbeled Murrelet, MURR=Murres (Uria lomvia and Uria aalge), NOFU=Northern Fulmar, NOGA=Northern Gannet, OLSQ=Oldsquaw, RAZO=Razorbill, SHAG=Shag, SOSH=Sooty Shearwater, TBMU=Thick-billed Murre, WWSC=White-winged Scoter.

Country	Region	Type of fishery	Type of fishing gear	Important species	Significant effect on the population ?	Bycatch occurring now ?
Alaska	Bering Sea/Aleutian Islands	Groundfish	Longline	LAAL	Unknown	Yes
				BLAL	Unknown	Yes
				NOFU	Unknown	Yes
	Gulf of Alaska	Groundfish	Longline	LAAL	Unknown	Yes
				BLAL	Unknown	Yes
				NOFU	Unknown	Yes
	Bering Sea	Groundfish	Longline	BLKI		
	Prince William Sound	Salmon	Net	COMU	Unknown	Yes
				MAMU	Unknown	Yes
	Eastern Aleutians	Salmon	Net	MURR	Unknown	Yes
				AUKL	Unknown	Yes
				ATPU	Unknown	Yes
Canada	Atlantic Canada, Newfoundland Inshore	Salmon and Cod	Net and traps	GRSH	No	No*
				SOSH	No	No
				LSPE	No	No
				NOGA	Yes	No
				CORM	No	No
				HERG	No	No
				GBBG	No	No
				BLKI	No	No
				COEI	No	Probably
				BLGU	No	No
				RAZO	Yes	Probably*
				ATPU	No	No*
				TBMU	No	No
				COMU	Yes	Probably*
	Atlantic Canada, Grand Banks, offshore	Cod and Salmon	Net	Shearwaters	No	Probably
				Alcids	Yes	Probably
	Atlantic Canada, inshore	Lumpfish	Net	COEI	Unknown	Yes
Green-land	Western coast	Salmon	Net	GRSH	No	No
				COEI	No	Unknown
				BLGU	No	Unknown
				DOVE	No	No
				TBMU	Yes	No
	Western coast	Lumpsucker	Net	COEI	Unknown	Yes
				BLGU	Unknown	Yes

Table 6 cont.

Iceland	All around the country	Cod	Net	RAZO	Unknown	Yes
				PUFF	No	Yes
				TBMU	No	Yes
				COMU	Unknown	Yes
	Western coast	Lumpsucker	Net	COEI	No	Yes
				BLGU	Probably	Yes
Finland	Finnish part of the Baltic Sea	Salmon	Net and traps	COEI	No	Yes
				BLGU	Probably	Yes
				RAZO	Probably	Yes
				COGU	No	Yes
Norway	Northern and Central Norway	Lumpsucker	Net	SHAG	Unknown	Yes
				COEI	Unknown	Yes
				KIEI	Unknown	Yes
				BLGU	Unknown	Yes
	Northern Norway	Cod, winter	Net	TBMU	No	Yes
				COMU	Yes	Yes
	All along the Norwegian coast	Cod, Herring, Haddock and flatfish	Net	LOON	Unknown	Yes
				COEI	Unknown	Yes
				KIEI	No	Yes
				BLGU	Unknown	Yes
				RAZO	Unknown	Yes
				TBMU	No	Yes
				COMU	Yes	Yes
	Northern and Central Norway	Salmon	Net and traps	COMU	Yes	No
	All along the Norwegian coast	Cod	Traps	CORM	Unknown	Yes
	All along the Norwegian coast	Cod, flatfish	Longline	NOFU	No	Yes
				NOGA	No	Yes
Russia	The Barents and the White Sea	Salmon	Net	COEI	No	No
				OLDS	No	No
				WWSC	No	No
				BLSC	No	No
	Eastern Russia	Salmon	Net	MURR	Unknown	Yes

*) Bycatch of these species will occur once gillnet fishery for Atlantic Cod starts up again on the east coast of Newfoundland.

SECTION 4

RECOMMENDATIONS FOR MANAGEMENT AND RESEARCH

4.1 NATIONAL RECOMMENDATIONS

It is in the interests of both seabird conservation and the fishing industry to reduce seabird bycatch as much as possible. There is a great challenge for all countries to implement regulations that can serve to reduce serious incidental takes. It is probably impossible to eliminate bycatch altogether, but it should be feasible to considerably reduce this source of impact of fisheries to a level where it does not pose a threat to seabird populations. Some countries have proposed actions to be taken in order to gain more information on the bycatch issue and reduce the incidental take. Below is a short summary based on the national reports.

The United States initiated a fisheries observer program in the 1970s. Today, the aim is to monitor the target and nontarget fish catch and the incidental mortality of marine birds and mammals in selected domestic fisheries. The observer program is probably transferable also to other countries. This type of program does not solve the problem, but provides important information applicable in management and future research activities. USA also suggests that research concerning gear modifications and longline setting procedures should be pursued to develop nets and fishing techniques that can reduce the mortality of seabirds.

In ***Canada,*** The Canadian Wildlife Service (CWS) has launched a co-operative program with the Department of Fisheries and Oceans (DFO) and fishers with the goal of reducing seabird bycatch in Cod gillnets through experimentation into different net types. However, a general groundfish moratorium has so far prevented any further work.

Piatt and Nettleship (1987) recommended the following actions to reduce bycatch in insular Newfoundland:

- Regulate the timing of use of gillnets so as to avoid critical periods such as when capelin swim inshore to spawn;
- Restrictions on the use of gillnets in particularly sensitive areas such as around major seabird colonies;
- Use of bycatch quotas for seabirds much the same as in place for fish bycatch.

Canada also proposes:

- Monitoring of seabird bycatch is needed in areas likely to experience problems such as near concentrations of seabirds at breeding colonies and offshore feeding areas;
- Monitoring of seabird bycatch should become an integral part of activities of fisheries observers on vessels fishing in Canadian waters.
- Canadian Wildlife Service and Department of Fisheries and Oceans should co-operate with fishers and university researchers in the development of modifications to monofilament gillnets that would make them less prone to seabird bycatch. Net colour and the use of alarms may be promising avenues of work.
- To raise the awareness of seabird bycatch as a conservation problem in some Canadian fisheries, an information/education program should be developed and directed toward fishers and Canadian fisheries management agencies.
- Current knowledge of the spatial and temporal patterns of seabird bycatch should be incorporated into future fisheries regulations such that fishing effort is reduced during

periods of the year, and at locations, when and where seabird bycatch is a significant problem;
- The use of monofilament gillnets should be discontinued in areas where seabird bycatch is known to occur and is a particular problem, such as in the vicinity of seabird colonies.

As no quantitative data exist on the number of birds caught in Lumpsucker and other local net fisheries, ***Greenland*** proposes that this issue should be included in any future assessments of seabird bycatch in Greenlandic waters, as should the possible local risk of early-set Salmon nets to murres departing from colonies in Southwest Greenland. Regarding the Salmon fishery, Greenland proposes the following specific actions:
- the Salmon fishery should not be initiated before 15 August in order to prevent incidental take of murres swimming from the colonies in SW Greenland; and
- the Salmon fishery should end no later than 1 October, in order to reduce the risk of catching the wintering murre populations moving towards coastal waters from the middle of October.

Iceland proposes work to reduce the incidental take of birds, and mentions also that experiments with using buoys for deterring Great Northern Loons from Trout nets have been carried out. They also propose research to evaluate the effects of bycatch on the populations. Other projects proposed are:
- A general survey of bycatch in Iceland;
- For Common Murre, Razorbill and Thick-billed Murre, a survey directed towards the numbers caught, including age distribution as well as spatial and temporal distribution within the country;
- Same as above for loons, Cormorant and Shag, with special emphasis on the Great Northern Loon which does not breed anywhere in Europe except Iceland;
- For Black Guillemot and Common Eider, research into the possible effect of Lumpsucker nets;
- Develop methods to avoid Northern Fulmars getting caught on the longlines.

So far there have been no analyses or monitoring of seabird bycatch in ***Finland***. Proposals are:
- To assess the problem, notably for the Black Guillemot, and gather all the scientific data available from ringing schemes and population studies;
- With the help of those involved in fisheries, identify and promote new fishery strategies to reduce the impact of methods causing unwanted bycatch.

Norway has the following proposals to improve the knowledge of incidental take (from Follestad and Strann 1991):

Possible initiatives to improve the level of information are:
- Collect seabirds caught in fishing gear for mapping species, age, and seasonal distribution of the kill as well as types of fishing gear used, with, for instance, the aid of the inspectors onboard the fishing vessels;
- Interviews of fishers to sample local knowledge concerning bycatch;
- Introduce a 'bycatch logbook' to be kept by fishers interested in collaborating to solve bycatch problems; and
- Analyses of ring recoveries of seabirds.

For management plans:
- Initiate co-operation with the local guards overseeing the Salmon fishery, in order to have them patrol areas close to seabird colonies, and remove any nets threatening the local birds;

- Promote regulations that allow fishing only in areas where the conflicts with seabirds are low (spatial and temporal separation);
- Introduce regulations for type of fishing gear to be applied in certain areas where specific gear is known to cause significant bycatch.
- Promote the notion that such stipulations be included in the international fisheries regulations.

In ***Russia*** there is only scant information on previous and current bycatch problems. But to address a recent huge bycatch problem, there is:

- An immediate need to initiate activities to immediately reduce the bycatch.

There is also an urgent need for further research into:

- Identifying the species and age distribution of the kill;
- Identifying the main source populations for the most abundant species in the bycatch.

4.2 GENERAL RECOMMENDATIONS

There is a general agreement amongst Arctic countries on the actions that need to be taken to reduce the problem of seabird bycatch, of which the most important are summarised below.

- To reduce the incidental take, close co-operation between the fishing industry and the authorities responsible for the management of the seabird populations is required - both on a national and an international level. However, many areas have local fishery techniques and traditions, and therefore seabird-fisheries conflicts often must be solved locally.

- In co-operation with the fishing industry, a more detailed determination of the geographic extent and magnitude of the bycatch in various fisheries should be conducted. A better understanding of the extent of the bycatch is essential for improving future management and directing problem-solving research efforts.

- Effort should be put into identifying source populations and analysing the effects of major bycatch mortality on the populations involved. This is very important in order to develop management strategies addressing the specific fishery activities that have significant negative effects on the populations.

- Effort must be put into research and development of fishing gear and deterrent devices which reduce the bycatch. As an example, Løkkeborg (1997) has tested different setting methods in the autoline fishery in the North Atlantic and found that compared to traditional methods, alternative methods all reduced the bycatch risk to seabirds.

- In some countries, i.e. Norway, the coast guard can intervene in fisheries if the bycatch of certain fish species, or the proportion of young fish, exceeds pre-defined limits. Similar regulations should also be applicable to serious cases of seabird bycatch elsewhere.

- The International Union for the Conservation of Nature (IUCN) has adopted a resolution on 'Incidental Mortality of Seabirds in Longline Fisheries' in 1996 (Attachment A). It mainly focuses on albatrosses, petrels and shearwaters. Some of these species are also affected in the Arctic. Similar resolutions should also be adopted for bycatch in fishing nets.

- In March 1997, the Food and Agriculture Organisation agreed to sponsor a meeting in 1998 to discuss the world-wide issue of seabird bycatch in longline fisheries and develop guidelines to reduce seabird bycatch. It is suggested that the Arctic countries participate in this important effort and adopt the bycatch mitigation guidelines as appropriate for each country.

REFERENCES

Ainley, D.G., DeGange, A.R., Jones, L.L. and Beach, R.J. 1981. Mortality of seabirds in highseas salmon gillnets. Fish. Bull. 79:800-806.

Anon. 1993. Kalatalous ajassa. Official Statistics of Finland. Environment 1993:11. Helsinki. 138 pp. (In Finnish.)

Anon. 1994. Finnish fisheries in the European perspective. Official Statistics of Finland. Environment 1994:10. Helsinki. 165 pp.

Anon. 1995a. STECF Subgroup on Drift-net Fisheries for Salmonids and Other species. Commission staff working paper. Commission of the European Communities. Brussels 1995.

Anon. 1995b. Fish and game by region. Official Statistics of Finland. Environment 1995:12. Helsinki. 174 pp.

Atkins, N. and Henemann, B. 1987. The dangers of gill netting to birds. American Birds 41: 1395-1403.

Barrett, R. and Vader, W. 1984. The status and conservation of breeding seabirds in Norway. Pp. 323-333 *in* Croxall, J.P., Schreiber, R.W. and Evans, P.G.H. (eds). Status and Conservation of the world's Seabirds. ICBP Technical Publication No. 2, Cambridge.

Brown, R.G.B., Nettleship, D.N., Germain, P. Tull, C.E. and T. Davis. 1975. Atlas of Eastern Canadian Seabirds. Ottawa: Canadian Wildlife Service.

Brun, E. 1971. Populasjonsendringer hos noen sjøfuglarter in Sør-Norge (Changes in population size of some seabird species in the southern part of Norway). Sterna 10: 35-56.

Brun, E. 1979. Present status and Trends in Population of Seabirds in Norway. Pp. 289-301 *in* Bartonek, J. and Nettleship, D.N. (eds.) Conservation of Marine Birds of Northern North America. US Dept of Interior, Fish Wildl. Serv. Res. Rep. 11.

Byrd, V., Williams, J. and Walder, R. 1992. Status and biology of the tufted puffin in the Aleutian Islands, Alaska, after a ban on salmon driftnets. Unpubl. Rep. U.S. Fish and Wildlife Service, Adak, AK.

Chardine, J.W. 1995. The distribution and abundance of aquatic birds in Canada in relation to the threat of oil pollution. Pp. 23-36 *in* Frink, L., Ball-Wehr, K. and Smith, C. (eds). Wildlife and Oilspills. Response, Research and Contingency Planning.. Tri-State Bird Rescue and Research. Sheridan Press, Hanover.

Christensen, O. and Lear, W.H. 1977. Bycatches in salmon driftnetss at West Greenland in 1972. Meddr Grønland 205:1-38.

DeGange, A.R, Forsell, D.J. and Jones, L.L. 1985. Mortality of seabirds in the Japanese high seas salmon mothership fishery, 1981-1984. Unpubl. Rep. U.S. Fish and Wildlife Service. Anchorage, AK.

DeGange, A.R. and Day, B. H. 1991. Mortality of seabirds in the Japanese land based gillnet fishery for salmon. Condor 93:251-258.

DeGange, A.R, Day, R.H. , Takekawa, J.E. and Mendenhall, V.M. 1993. Losses of seabirds in gillnets in the North Pacific. Pp. 204-211 *in* K. Vermeer *et al.* (eds). The Status, Ecology, and Conservation of Marine Birds of the North Pacific. Can. Wildl. Serv. Spec. Publ. Ottawa, Canada.

Durinck, J. and Falk, K. 1996. Seabird distribution along West Greenland, autumn and winter 1988-1989. Polar Research 15:23-42.

Evans, P.G.H. and Kampp, K. 1991. Recent changes in Thick-billed Murre populations in West Greenland. Can. Wild. Serv. Occ. Pap. 69:7-14.

Evans, P.G.H. 1984. The seabirds of Greenland: Their status and conservation. Pp 49-84 *in* Croxall, J.P., Evans, P.G.H., and Schreiber, R.W. (eds). Status and Conservation of the World's seabirds. Int. Counc. Bird Preserv. Tech. Publ. 2. Cambridge, U.K.

Falk, K. and J. Durinck 1991. The by-catch of Thick-billed Murres (*Uria lomvia*) in salmon drift-nets in West Greenland, 1988. Can. Wild. Serv. Occ. Pap. 69:23-28

Follestad, A. and Runde, O. 1995. Sjøfugl og fiskeredskaper: gjenfunn av ringmerkede fugler (Seabirds and fishing gears: recoveries of ringed birds). NINA Oppdragsmelding 350: 1-26.

Follestad, A. and Strann K.-B. 1991. Sjøfugl og fiskegarn. Problemets omfang og karakter i Norge. (Seabirds and fishing nets. The extent of characteristics of the problem). NINA Oppdragsmelding 78:1-14.

Gaston, A.J. 1989. Conservation issues and Canadian Wildlife Service priorities for marine birds. CWS manuscript report. 34 pp.

Hardardottir, M., Gudmundsson, J. and A. Petersen. [Bird mortality in Lumpsucker fishing nets]. In prep. (Icelandic).

Hildén, O. and Pahtamaa, T. 1992. Development of the Razorbill population of the Quark in 1957-90. Ornis Fennica 69:34-38.

Holgersen, H. 1961. Norske lomviers vandringer (The migration of Norwegian Common Guillemots). Sterna 4: 229-240. (Norwegian).

Johnson, D.H., Shaffer, T.L. and Gould, P.J. 1993. Incidental Catch of marine birds in the North Pacific High Seas Driftnet fisheries in 1990. North Pacific Commission Bull. 53 (111): 473-483.

Jones, L.L. and DeGange, A.R. 1988. Interactions between seabirds and fisheries in the North Pacific Ocean. Pages 269-291 *in* J. Burger (ed.). Seabirds and Other Marine

Vertebrates: Competition, Predation, and Other Interactions. Columbia Univ. Press. New York.

Kampp, K. 1982. Den Kortnæbbede Lomvie *Uria lomvia* i Grønland - vandringer, mortalitet og beskydning: en analyse af 35 års ringmærkninger. M.Sc. Thesis, Zoological Museum.

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

Løkkeborg, S. 1990. Sjøfugl i fiskeredskap (Seabirds in fishing gear). Vår Fuglefauna 13: 200-204.

Løkkeborg, S. 1997. Seabird by-catch and bait loss in long-lining using different setting methods. *ICES J. mar. Sci. 54: in print.*

Mattox, W.G. 1973. Fishing in West Greenland 1910-1966. The development of a native industry. Meddr Grønland 197(1):1-334 + 125 p. app.

Myrberget, S. 1961. Fuglenotater fra Nordland (Bird notes from Nordland). Sterna 4: 258-259.

Myrberget, S. 1980. Registrering av sjøfugl drept under laksefiske 1978 (Registrations of sebirds killed in connection with the salmon fishery in 1978). Vår Fuglefauna 3: 45-48.

Nettleship, D.N. and Evans, P.G.H. 1985. Distribution and Status of the Atlantic Alcidae *in* Nettleship, D.N. and Birkhead, T.R. (eds.). The Atlantic Alcidae. Academic Press. 53-154.

National Marine Fisheries Service. 1993. Our living oceans, report on the status of U.S. living marine resources, 1993. NOAA Tech. Memo. NMFS F/SPO 15. Washington, D.C. 156 pp.

Ogi, H. 1984. Seabird mortality incidental to the Japanese salmon gillnet fisheries. Pages 705-715 *in* Croxall, J.P., Evans, P.G.H., and Schreiber, R.W. (eds). Status and Conservation of the World's seabirds. Int. Counc. Bird Preserv. Tech. Publ. 2. Cambridge, U.K.

Ogi, H., Yatsu, Y, Hatanata, H and Nitta, A. 1993. The mortality of seabirds by dritnet fisheries in the North Pacific. Int. North Pac. Fish Comm. Bull. 53: 499-518.

Parsons, L.S. 1993. Management of marine fisheries in Canada. Can. Bull. Fish. Aquat. Sci. 225: 1-763.

Petersen, A. 1981. Breeding biology and feeding ecology of Black Guillemots. University of Oxford, D.Phil. thesis. xiv + 378 p.

Piatt, J. F. and Nettleship, D.N. 1987. Incidental catch of marine birds and mammals in fishing nets off Newfoundland, Canada. Marine Poll. Bull. 18: 344-349.

Piatt, J. F., Nettleship, D.N. and Threlfall, W. 1984. Net-mortality of Common Murres and Atlantic Puffins in Newfoundland, 1951-81. Pp.196-206 *in* D. N. Nettleship, G. A. Sanger, and P. F. Springer (eds). Marine birds: their feeding ecology and commercial fisheries relationships. Supply and Services Canada, Ottawa.

Piatt, J.F. and Reddin, D.G. 1984. Recent trends in the West Greenland salmon fishery, and implications for Thick-billed Murres. In: Nettleship, D.N., G.A. Sanger and P.F. Springer (eds). Marine birds: Their feeding ecology and commercial fisheries relationships. - Canadian Wildlife Service Special Publication, Ottawa, 208-210.

Robins, M. 1991. Synthetic gill nets and seabirds. The Royal Society for the Protection of Birds, Bedfordshire. 68pp.

Røstad, O.W. 1982. Mortalitet hos storskarv vist ved ringmerkings-gjenfunn (The mortality of Cormorants as shown by recoveries of ringed birds). Viltrapport 21: 36-41.

Røv, N. 1982. Negative faktorer som truer sjøfuglbestandene (Negative factors threatening the seabird populations). Viltrapport 21: 3-5.

Statistical Yearbook 1996. 1996. Statistics Norway, 479 pp.

Stempniewicz, L. 1994. Marine birds drowning in fishing nets in the Gulf of Gdansk (southern Baltic): numbers, species composition, age and sex structure. Ornis Svecica 4:123-132.

Strann, K-B., Vader, W., Barrett, R. 1991. Auk mortality in fishing nets in north Norway. Seabird 13: 22-29.

Thorsteinsson, V. and Marteinsdottir, G. 1992. [Mortality of Eiders in Lumpsucker fishing nets]. Hafrannsóknastofnun. Unpubl. Rep. 21 p. (Icelandic).

Tull, C.E., Germain, P. and May, A.W. 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. Rep. U.S. Fish and Wildlife Service. Anchorage, Ak. 102 pp.

Vader, W., Anker-Nilssen, T., Bakken, V., Barrett, R. and Strann, K-B. 1990. Regional and temporal differences in breeding success and population development of fisheating seabirds in Norway after collapses of herring and capelin stocks. Trans. 19th IUGB Congr. (Trondheim 1989): 143-250.

Vader, W. and Barrett, R.T. 1982. Negative factors affecting the seabird populations in Troms and Finnmark. Viltrapport 21: 6-10.

Wynne, K., Hicks, D., and Munro, N. 1991. 1990 Salmon gillnet fisheries observer programs in Prince William Sound and South Unimak Pass Alaska. Final Rep. Saltwater Inc. Anchorage, AK. 70 pp.

Wynne, K., Hicks, D., and Munro, N. 1992. 1991 Marine mammal observer program for salmon driftnet fishery of Prince William Sound, Alaska. Final Rep. Saltwater Inc. Anchorage, AK. 55 pp.

APPENDICES

Appendix A: IUCN Resolutions with respect to bycatch[2]:

1. **Incidental Mortality of Seabird In Longline Fisheries**

RECALLING Recommendations 19.61, 19.62, and 17.38 of the 19th and 17th Sessions of the IUCN General Assembly;

ALSO RECALLING the provisions of the UN Convention on the Law of the Sea (UNCLOS), in Article 61, paragraph 4, relating to the obligations of States to consider the effects of fishing operations on "species associated with or dependent upon harvested species with a view to maintaining or restoring populations of such associated or dependent species above levels at which their reproduction may become seriously threatened;"

ALSO RECALLING that the UN Agreement for the Implementation of the Provisions of the UN Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (1995), in Article 5, requires coastal States and States fishing on the high seas to "minimise pollution, waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species, and impacts on associated or dependent species, in particular endangered species, through measures including, to the extent practicable, the development and use of selective, environmentally safe and cost-effective fishing gear and techniques";

AWARE that at least 13 species of seabirds, including albatrosses (family Diomedeidae), petrels and shearwaters (family Procellariidae), are suffering from significant incidental mortality by being hooked and drowned within longline fisheries;

CONCERNED that the seabird mortality caused by longlining is producing a significant decline in populations of several seabird species;

FURTHER CONCERNED that such declines may be of particular significance for certain species that have evolved a life strategy involving delayed maturity, high natural survival rates and low reproductive rates, due to the long recovery periods required to make up the loss of a large number of individuals;

FURTHER CONCERNED that several of the seabird species affected by longlining are considered to be globally threatened with extinction, including the short-tailed albatross (*Diomedea albatrus*), the wandering albatross (*D. exulans*), and the Amsterdam albatross (*D. amsterdamensis*);

CONSCIOUS that the overall use of longlines is increasing significantly worldwide;

COMMENDING the efforts now underway by some longline fishers to reduce incidental mortality of seabirds, and encouraging fishers' increased involvement in developing and implementing effective measures for reducing incidental mortality of seabirds;

---

[2]From IUCN 1997. Resolutions and Recommendations: World Conservation Congress, 13-23 October 1996, Montreal Canada.

COMMENDING the Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR) for adopting conservation measures that call for minimizing the incidental mortality of seabirds on longlines in Antarctic waters at its 14th Meeting 24 October - 3 November 1995;

NOTING AND COMMENDING the Australian government's listing of longline incidental mortality as a Key Threatening Process and the government's intention to prepare a subsequent Threat Abatement Plan under the Commonwealth Endangered Species Act of 1992;

CONCERNED that current regulatory measures and voluntary practices are insufficient to reduce substantially the significant mortality of seabirds caused by longline fisheries;

NOTING that this is a problem of international scope, involving countries from every continent, and therefore demanding international attention and cooperation;

RECOGNIZING the urgent need to implement conservation measures that do not shift the incidental mortality problem to, or increase the incidental mortality of, other marine species;

RECOGNIZING FURTHER that an array of practical measures, such as the use of weighted lines, streamer lines, night setting and underwater setting, have been developed to reduce seabird mortality in longline fisheries without compromising fishing efficiency and without increasing the incidental mortality of other species;

NOTING that when strictly implemented these mitigation measures have helped reduce seabird mortality;

RECOGNIZING that fish stocks will contribute in important ways to the nutritional needs of future generations, and further recognizing that incidental mortality of seabirds diminishes the efficiency of longline fisheries;

AWARE that adequate conservation measures have not yet been widely implemented by longline fisheries;

EMPHASIZING that if conservation measures are not widely implemented, longline fisheries will continue to cause significant seabird mortality;

AWARE that delayed action could lead to the extinction of certain seabird populations or species;

The World Conservation Congress at its 1st Session in Montreal, Canada, 14-23 October 1996:

1. CALLS UPON the IUCN, its members, all States, and regional fisheries institutions to reduce incidental seabird mortality within longline fisheries to insignificant levels for affected species:

2. URGES IUCN, its members, all States and regional fisheries institutions to encourage longline fishing nations and fishery management institutions:

   a) to continue and expand the use of measures to reduce incidental mortality of seabirds within longline fisheries as a matter of urgency;

b) to collaborate with one another in the development of other modified fishing techniques aimed at substantially reducing seabird mortality, in addition to those recommended by the CCAMLR Convention;

c) to expand observer programmes within longline fisheries to aid in the documentation of seabird mortality, as well as the education of fisheries personnel, and the development and implementation of conservation measures;

d) to educate longline fisheries personnel on currently available measures that reduce, if not eliminate, seabird mortality;

3. REQUESTS the IUCN Species Survival Commission and BirdLife International through their Seabird Specialist Group to collaborate with other qualified scientists, managers and industry to study the problem of incidental seabird mortality by longline fishing operations and to assist such groups in developing recommendations;

4. URGES IUCN, its members, all States, and regional fisheries institutions to support education and conservation programmes to assist in the implementation of this Resolution;

5. REQUESTS that IUCN members report to the Director General prior to or at the next meeting of the World Conservation Congress on progress made within their Exclusive Economic Zones toward reducing incidental seabird mortality;

6. CALLS UPON the Director General to report on the progress made toward implementing this Resolution at the next World Conservation Congress and make further recommendations as appropriate and necessary to fully implement this Resolution.

Note: This Resolution was adopted by a show of hands. The delegation of the State member Japan made a statement against the Resolution, that it was inappropriate to attribute seabird depletion primarily to longline fishing, reported in more detail in the Proceedings volume.

2. Fisheries By-Catch

RECALLING Recommendations 19.61 and 19.62 of the 19th Session of the IUCN General Assembly;

RECOGNIZING that the world's marine biological diversity is of inestimable value to the world community and that the multitude of marine ecosystems represented are essential in the maintenance of the healthy planet;

FULLY CONSCIOUS that marine biodiversity is declining significantly and that the threats to marine biodiversity are increasing, particularly in relation to the global fisheries catch, due to overfishing, pollution and marine habitat destruction;

RECOGNIZING the need for urgent conservation action;

RECOGNIZING that there is ongoing and significant wastage resulting from unwanted by-catch where effective by-catch reduction devices and strategies are not used;

ACKNOWLEDGING the obligations of the global community to conserve natural resources through ecologically sustainable development, as underpinned by the UN Convention on the Law of the Sea, the Convention on Biological Diversity, the Agreement for the Implementation of the Provisions of the UN Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (1995) (UN Fish Agreement) and the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) among others;

DEEPLY CONCERNED by the increasing rate of destruction of threatened wildlife species through fisheries by-catch in most fisheries in all oceans of the world, graphically illustrated by the continuing substantial numbers of fatalities involving numerous seabird species, particularly albatrosses, and all marine turtle species;

ALARMED at the slow progress globally in effectively tackling fisheries by-catch issues and of the imminent threats posed to a number of vertebrate species and populations;

NOTING the slow progress being made by Parties to the Convention for the Conservation of Southern Bluefin Tuna in adopting measures similar to CCAMLR's to reduce seabird by-catch;

RECOGNIZING the responsibility of stewardship towards all marine life forms on the planet that rests upon humankind and the rights of species to exist;

RECOGNIZING the efforts in some nations to reduce by-catch in their fisheries;

IN THE BELIEF that the cost incurred for the conservation of wild marine resources should be shared and, in particular, that the users of marine resources must contribute to these costs, and that international efforts are necessary to properly recover and conserve most marine threatened vertebrate species;

RECALLING the resolution of the First International Workshop on Albatross-Fisheries Interactions held in Hobart Australia in August 1995;

The World Conservation Congress at its 1st Session in Montreal, Canada, 14 - 23 October 1996:

1. REQUESTS the Director General, within available resources, after having evaluated current international arrangements for mitigating the effects of fisheries by-catch and relevant species conservation efforts, to develop and implement transparently an IUCN programme using expertise in all of IUCN's Commissions, and the broad membership of IUCN, to substantially reduce, and eventually reduce to insignificant levels of all fisheries by-catch in the long-term interests of marine biodiversity conservation;

2. URGES that this programme should, in particular:

   a) establish in consultation with interested member a special IUCN task force to advance the IUCN by-catch programme;

   b) develop regional contacts to contribute to the IUCN task force to ensure effective and cooperative arrangements;

c) call on Parties to the Convention on Biological Diversity (CBD) to investigate the potential for promoting the development of mechanisms, including legal instruments, to minimize the negative impacts of fishing practices on marine biodiversity;

d) investigate the potential for gaining financial and other support and collaboration from relevant bodies to contribute to an IUCN programme to mitigate impacts;

e) investigate the potential for IUCN and CBD and other relevant bodies to develop jointly and expeditiously a global list of species and marine habitats particularly threatened by fishing operations, including fin-fish species that suffer losses through wastage;

f) actively encourage motions to support the listing of all albatross and other impacted seabird species on the appendices to the Convention on the Conservation of Migratory Species of Wild Animals, and to urgently develop regional conservation agreements;

g) consider drafting in consultation with members a further resolution on by-catch problems for consideration by the UN General Assembly Annual Session on Oceans in 1997:

h) develop a handbook on by catch mitigation measures for use by fishing fleets globally;

i) investigate the potential for minimizing by-catch problems through the provisions of the UN Agreement Relating to Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks;

j) call upon all countries to sign and ratify the UN Agreement Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks;

k) support efforts in the Committee on Trade and Environment of the World Trade Organization to ensure that trade measures used to support genuine environmental objectives are not challenged in the future, and openly to support such conservation measures;

l) take particular and strong action through the Convention on the Conservation of Antarctic Marine Living Resources (CCALMR) to mitigate by-catch problems in the Southern Oceans;

m) promote globally a coordinated international observer and monitoring programme to fully establish the ongoing and detrimental effects of by-catch to marine biodiversity;

n) call upon members to report to the next World Conservation Congress on progress made within their EEZs on reducing seabird and other by-catch to insignificant levels;

3. REQUESTS the Director General to report on the progress made with this programme at the next session of the World Conservation Congress and to make further specific recommendations as appropriate and necessary to fully implement this Resolution:

Note: This Resolution was adopted by a show of hands. The delegation of the State member Japan made a statement against the Resolution, that it was inappropriate to attribute seabird depletion to longline fishing, reported in more detail in the Proceedings volume. The delegations of the State members Norway and the United States indicated that they had voted against.

Appendix B: Scientific names for seabirds and target fishery species mentioned in this report (alphabetical order of common English names)

Common name	Scientific name
Seabird species	
Atlantic Puffin	*Fratercula arctica*
Black Guillemot	*Cepphus grylle*
Black Scoter (Common Scoter)	*Melanitta nigra*
Black-footed Abatross	*Diomedea nigripes*
Black-legged Kittiwake	*Rissa tridactyla*
Common Eider	*Somateria mollissima*
Common Murre (Common Guillemot)	*Uria aalge*
Cormorant	*Phalacrocorax carbo*
Dovekie (Little Auk)	*Alle alle*
Gannet	*Sula bassana*
Glaucous Gull	*Larus hyperboreus*
Great Black-backed Gull	*Larus marinus*
Great Northern Loon (Great Northern Diver)	*Gavia immer*
Great Skua	*Stercorarius skua*
Greater Shearwater	*Puffinus gravis*
Herring Gull	*Larus argentatus*
King Eider	*Somateria spectabilis*
Laysan Albatross	*Diomedea immutabilis*
Leach's Storm-Petrel	*Oceanodroma leucorhoa*
Marbled Murrelet	*Brachyramphus marmoratus*
Northern Fulmar	*Fulmarus glacialis*
Oldsquaw (Long-tailed Duck)	*Clangula hyemalis*
Razorbill	*Alca torda*
Red-throated Loon (Red-t. Diver)	*Gavia stellata*
Shag	*Phalacrocorax aristotelis*
Sooty Shearwater	*Puffinus griseus*
Thick-billed Murre (Brünnich's Guillemot)	*Uria lomvia*
White-winged Scoter (Velvet Scoter)	*Melanitta fusca*
Target fishery species	
Arctic Char	*Salvelinus alpinus*
Atlantic Salmon/Salmon	*Salmo salar*
Atlantic Cod/Cod	*Gadus morhua*
Capelin	*Mallotus villosus*
Catfish	*Anarchichas lupus*
Coalfish	*Gadus virens*
Flounder	*Platichthys flesis*
Greenland Halibut	*Reinhardtius hippoglossoides*
Haddock	*Melanogrammus aeglefinus*
Herring	*Clupea harengus*
King Crabs	*Paralithodes camtschatica, P. platypus*, and *Lithodes aequispina*
Lumpsucker/Lumpfish	*Cyclopterus lumpus*
Pacific Cod	*Gadus macrocephalus*
Pacific salmon/salmon (5 species)	*Oncophynchus* spp.
Pollock	*Pollachius virens*
Redfish	*Sebastes marinus*
Scallop	*Chlamys islandica*
Shrimp (Most common commercial species)	*Pandalus borealis*
Sprat	*Sprattus sprattus*
Tanner Crab	*Chionoecetes bairdi* and C. *opillio*
Trout	*Salmo trutta*
Turbot	*Psetta maximus*
Walleye Pollock	*Theragra chalcogramma*
Whitefish	*Coregonus lavaretus*