

COSEWIC
Assessment and Update Status Report

on the

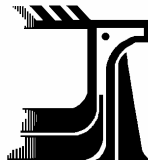
Ivory Gull
Pagophila eburnea

in Canada



ENDANGERED
2006

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA



COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Previous reports:

COSEWIC 2001. COSEWIC assessment and update status report on the Ivory Gull *Pagophila eburnea* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. iv + 10 pp. (www.sararegistry.gc.ca/status/status_e.cfm)

Alvo, Robert and S.D. Macdonald. 1996. Updated COSEWIC status report on the Ivory Gull *Pagophila eburnea* in Canada. Committee on the Status of Endangered Wildlife in Canada. 1-10 pp.

MacDonald, S.D. 1979. COSEWIC status report on the Ivory Gull *Pagophila eburnea* in Canada. Committee on the Status of Endangered Wildlife in Canada. 1-25 pp.

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COSEWIC Assessment Summary

Assessment Summary – April 2006

Common name

Ivory Gull

Scientific name

Pagophila eburnea

Status

Endangered

Reason for designation

Aboriginal Traditional Knowledge and intensive breeding colony surveys over the last four years indicate that the Canadian breeding population of this long-lived seabird has declined by 80% over the last 20 years. This bird feeds along ice-edge habitats in the high Arctic and breeds in very remote locations. Threats include contaminants in food chain, continued hunting in Greenland, possible disturbance by mineral exploration at some breeding locations, and degradation of ice-related foraging habitats as a result of climate change.

Occurrence

Northwest Territories, Nunavut, Newfoundland-Labrador.

Status history

Designated Special Concern in April 1979. Status re-examined and confirmed in April 1996 and in November 2001. Status re-examined and designated Endangered in April 2006. Last assessment based on an update status report.



COSEWIC
Executive Summary

Ivory Gull
Pagophila eburnea

Species information

The Ivory Gull is a medium-sized gull, approximately 10% larger and longer-winged than the Black-legged Kittiwake (*Rissa tridactyla*). It is distinctive at all ages, but is particularly striking in its pure white adult plumage. Recent phylogenetic analysis based on mitochondrial DNA has provided strong evidence that the Ivory Gull is a sister taxon to the Sabine's Gull (*Xema sabini*).

Distribution

The Ivory Gull has a circumpolar, but patchy, breeding distribution across the high arctic. Small, scattered colonies occur in Arctic Canada, Greenland, Spitzbergen, and the northern islands and archipelagoes of Russia in the Kara Sea. The wintering distribution of the Ivory Gull is poorly known but is generally along the southern edge of pack ice. In Canada, the Ivory Gull has a highly restricted range while breeding, nesting exclusively in Nunavut Territory.

Habitat

Ivory Gulls require breeding sites that are safe from terrestrial predators, particularly the arctic fox. They nest in near marine waters that are partially free of ice in late May and early June; colonies are found concentrated around Jones and Lancaster Sounds, with colonies occurring on southeastern Ellesmere Island, eastern Devon Island, and the Brodeur Peninsula of northern Baffin Island.

Biology

Ivory Gulls are thought to first breed after their second year. They usually lay 1-2 eggs.

Population sizes and trends

Until recently, the Canadian Arctic was thought to support 20-30% of the entire global breeding population and to contain colonies of global importance. However,

aerial surveys conducted during the first two weeks of July in 2002, 2003, 2004, and 2005 suggest that the Canadian breeding population has declined. During those years, 31 colony locations were resurveyed where colonies had previously occurred in the 1970s and 1980s. Although recent surveys were conducted at an ideal time of year, under clear weather conditions and using identical methods to previous historical surveys, only 9 of these colonies showed signs of activity in recent surveys.

Further, the number of gulls detected at colonies on Ellesmere, Devon, Cornwallis, Seymour, and Baffin Islands totalled 88, 319, 305, and 210 in 2002, 2003, 2004, and 2005 respectively despite the broadest geographic search effort ever for this species in Canada. These values represent an apparent population decline of approximately 80% since the 1980s.

At-sea surveys provide further evidence for decline; in the High Arctic in August, four times as many Ivory Gulls were seen in 1993 than in 2002. Long-term Inuit residents of four communities in Arctic Canada also report dramatic declines in the number of Ivory Gulls observed at communities and during spring and fall migration along ice edges. There is also evidence from seal hunters that there are fewer Ivory Gulls wintering in the Labrador Sea compared with the late 1970s.

Limiting factors and threats

Although Ivory Gulls winter in association with pack ice in the north Pacific and Atlantic oceans, and nest in extremely remote breeding locations, there are now several confirmed threats to Ivory Gulls in Canada and globally. These include illegal shooting of adults for food (particularly in west Greenland during spring and fall migration), climate change that is altering ice conditions in the circumpolar Arctic, oiling at sea, and escalating diamond exploration and drilling activities on the Brodeur Peninsula of Baffin Island (one of the key breeding locations of the species in Canada). In addition, toxic pollutants that bioaccumulate at high trophic levels are known to occur among Ivory Gulls breeding in Canada.

Existing protection

The Ivory Gull is protected in North America under the *Migratory Birds Convention Act* (1994) and *Migratory Bird Regulations*. It has also been protected in West Greenland since 1977 under the Local Government Order of 21st December on bird hunting in West Greenland. In 1988, hunting regulations were revised and applied to all of Greenland, under the Greenland Home Rule order of 5 May 1988 on protection of birds in Greenland. However, band returns from Ivory Gulls ringed in Arctic Canada suggest that illegal harvest continues. The Ivory Gull is on the Norwegian Red List, in the category 'declining, monitoring' (DM). In Svalbard, it has been protected since 1978, under the Svalbard Environmental Protection Act. In Russia, it is registered as a Category 3 (Rare) species in the Red Data Book of the former USSR.



COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5th 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2006)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.



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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

**Update
COSEWIC Status Report**

on the

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Pagophila eburnea

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2006

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SPECIES INFORMATION

Name and classification

The Ivory Gull (*Pagophila eburnea*) is in a monotypic genus with no known subspecies. Vernacular names for the Ivory Gull vary greatly over time and region, and, in general, these names reflect the physical characteristics of the bird or its habitat association.

In Nunavut, the Inuit refer to the Ivory Gull as either 'Naujavaaq' or 'Kaniq', depending on which community they come from (J. Akearok, pers. comm.). In Greenland, it is referred to as 'Naajavaasuk' (Boertmann & Fjeldsa 1988).

In Labrador, the Inuktitut name is 'Naujarluk', while settlers in that region may also refer to it as 'Ice Gull' (Ryan & Sutton 2004). In Newfoundland, it is or has been known as 'Ice Partridge' (based on a vague resemblance to ptarmigan in winter), 'Snow Gull', 'Ice Gull', 'Slob Gull', 'Winter Gull' (based on its association with pack ice), 'Swile Bird' and 'Seal Bird' (based on its habit of scavenging at seal kills; Montevecchi & Tuck 1987).

Morphological description

The Ivory Gull (Fig.1) is a medium-sized gull, approximately 10% larger and longer-winged than the Black-legged Kittiwake (*Rissa tridactyla*; Cramp & Simmons 1983). It is distinctive at all ages, but is particularly striking in its pure white adult plumage. Immature birds have a dusky face, and black spots on the breast and flanks, tips of the primaries, and tail and outer wing coverts (Grant 1986), although the extent of speckling is highly variable among individuals. The eye is dark (Cramp & Simmons 1983). It exhibits a short period of immaturity for a gull of its size, acquiring adult plumage in its second winter. In adults, the bill is generally slate blue at the base, becoming pale yellow and tipped with red, but is darker in juveniles. The Ivory Gull has relatively short legs, which are black at all ages. Its round chest, short legs, and rolling gait give it a pigeon-like appearance when on the ground. However, although it is a stocky built bird, in the air it has a graceful and agile flight. Overall, the sexes are similar in appearance, and, once maturity is reached, there is little or no seasonal variation in characteristics.



Figure 1. The Ivory Gull.

Genetic description

Recent phylogenetic analysis based on mitochondrial DNA has provided strong evidence that the Ivory Gull is a sister taxon to the Sabine's Gull (*Xema sabini*; Crochet *et al.* 2000). These species are estimated to have diverged early, some 2 million years ago (compared with most other gull groupings, which are estimated to have diverged in the last million years), and differentiation between them is thought to have taken place within the Arctic (Crochet *et al.* 2000). Some authors, mainly Europeans, continue to merge *Pagophila* (as well as *Xema*, *Rhodostethia*, *Rissa*, and *Creagrus*) with other *Larus* gulls (American Ornithologists' Union 1983).

Designatable units

Currently, there is no information on population structure within Canada, nor elsewhere throughout its circumpolar range. Thus, the global population is considered panmictic at present (Haney & MacDonald 1995). The Canadian population is thought to move eastward into Baffin Bay and later southward to Davis Strait. It is possible that birds from the Canadian Arctic and eastern North Greenland, as well as the European Arctic, congregate in Davis Strait (at least in some years, Orr and Parsons 1982). This is supported by a recovery of a bird banded at Franz Josef Land (Russia) and recovered in Labrador in early March (Dementev and Gladkov 1969).

Considering only birds banded in Canada and recovered in Greenland, recovery rates of adult Ivory Gulls banded at more northerly sites (Alert: 0.05, Grise Fiord: 0.03) were significantly higher than those from more southerly sites (Seymour Island and Resolute: both 0.00) (Stenhouse *et al.* 2004). These results suggest that migration routes of birds from northern and southern areas may differ, and perhaps that some population structure may exist among the Canadian colonies (Stenhouse *et al.* 2004; V. Thomas, pers com).

DISTRIBUTION

Global range

The Ivory Gull has a circumpolar but patchy breeding distribution across the High Arctic. Small, scattered colonies occur in Arctic Canada, Greenland, Spitzbergen, and the northern islands and archipelagoes of Russia in the Kara Sea (Fig. 2). The wintering distribution of the Ivory Gull is poorly known. Limited evidence suggests that the Ivory Gull generally winters along the southern edge of Arctic pack ice in the waters of the North Atlantic Ocean (Davis Strait and Labrador Sea), and the North Pacific Ocean (Bering, Chukchi, and perhaps Beaufort seas), although some may remain in northern areas near polynyas (Haney & MacDonald 1995).

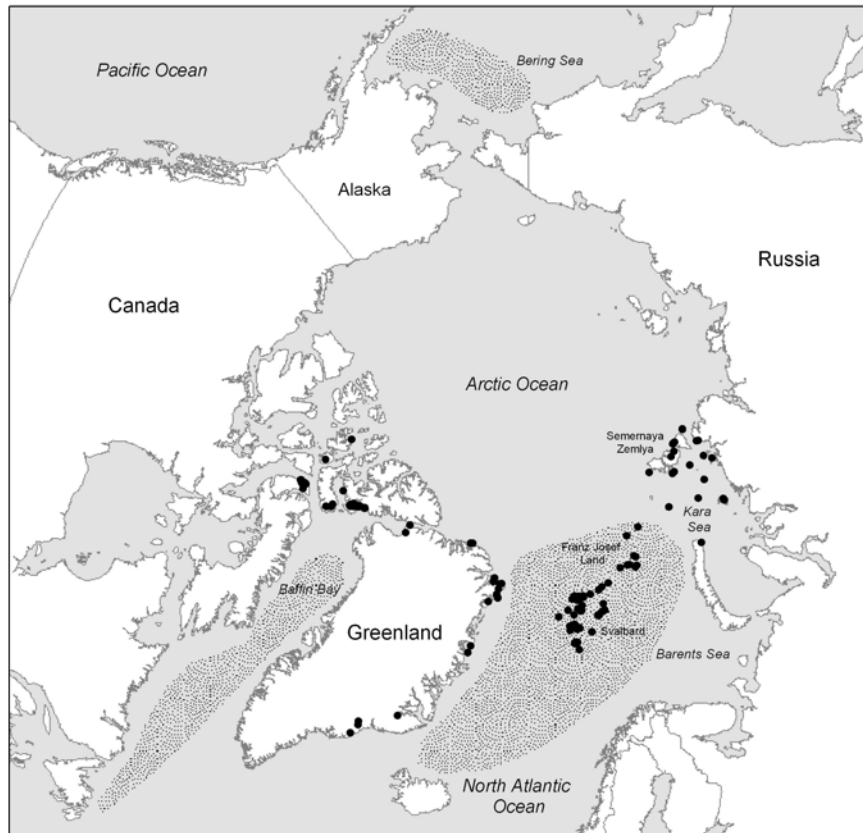


Figure 2. Colony locations (whether active or not) throughout the circumpolar arctic (black dots) and wintering range (stippled areas) of the Ivory Gull.

Canadian range

In Canada, the Ivory Gull breeds exclusively in Nunavut Territory (Fig. 3). Ivory Gulls nest in close proximity to areas of ocean that are partially free of ice in late May and early June, presumably areas that provide them with a reliable marine food source (Haney & MacDonald 1995). Consequently, colonies are found concentrated around Jones and Lancaster sounds, with colonies occurring on southeastern Ellesmere Island, eastern Devon Island, and the Brodeur Peninsula of northern Baffin Island (Fig. 3). One outlying colony exists farther west on Seymour Island, off the northern coast of Bathurst Island. The Seymour Island colony is associated with the Penny Strait Polynya (Mallory & Gilchrist 2003).

Ivory Gulls nested formerly near Meighen Island, in the Polynya Islands, and on Prince Patrick Island (Cape Krabbe in northwest Canada at the eastern margin of the Beaufort Sea). However, these sites have been abandoned since their initial discovery by McClintock in the 1800s (MacDonald and Macpherson 1962).

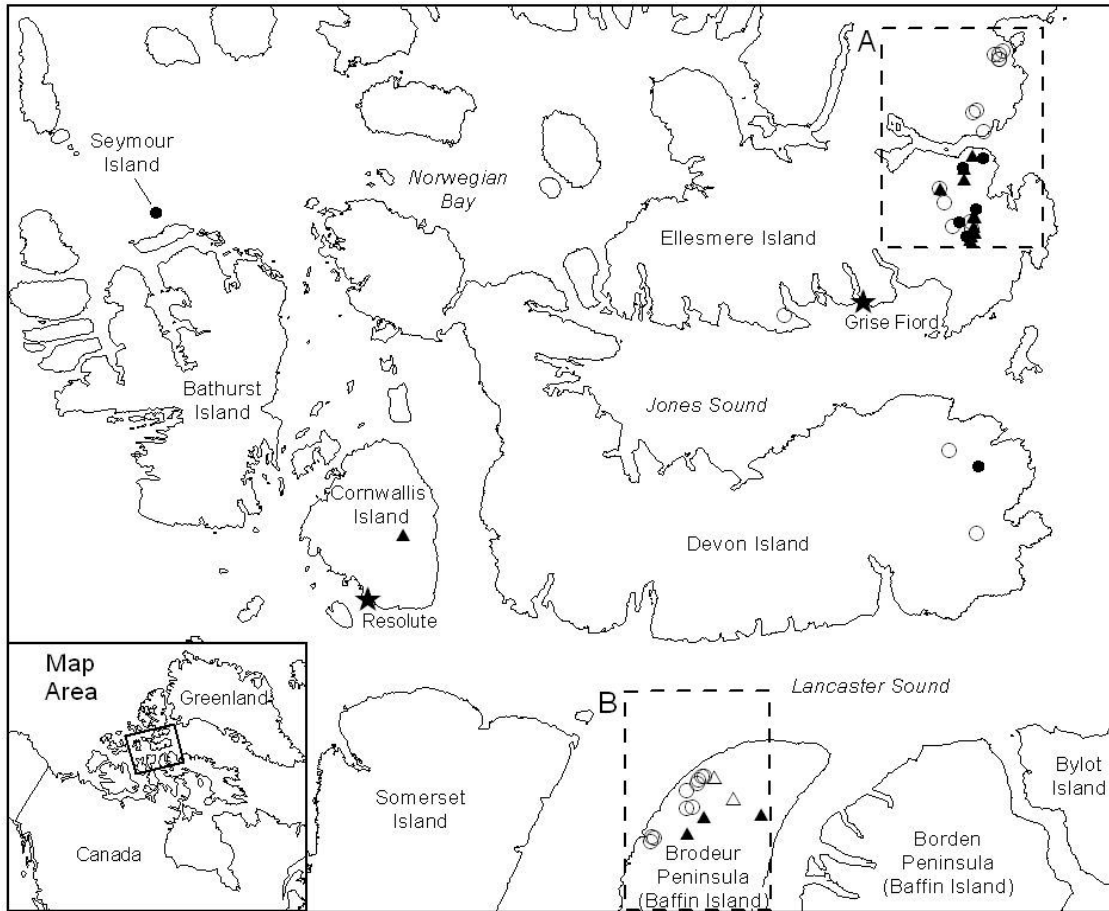


Figure 3. Known breeding locations of the Ivory Gull in Canada.

The Canadian Arctic represents 100% of the North American breeding range, as well as a significant proportion of the global breeding range (Fig. 2). The North American distribution appears to have been shrinking since the late 1800s (Haney & MacDonald 1995). Only one active colony is now known to exist north of Makinson Inlet on southeastern Ellesmere Island. Considerably fewer colonies now exist on the western side of the Brodeur Peninsula, Baffin Island, with none in the area of Jackson Inlet; an area that supported three colonies in the 1980s (Fig. 4; Reed & Dupuis 1983; Gilchrist & Mallory 2005). In early July 2005, no Ivory Gulls were found during surveys of the Brodeur Peninsula (Table 1).

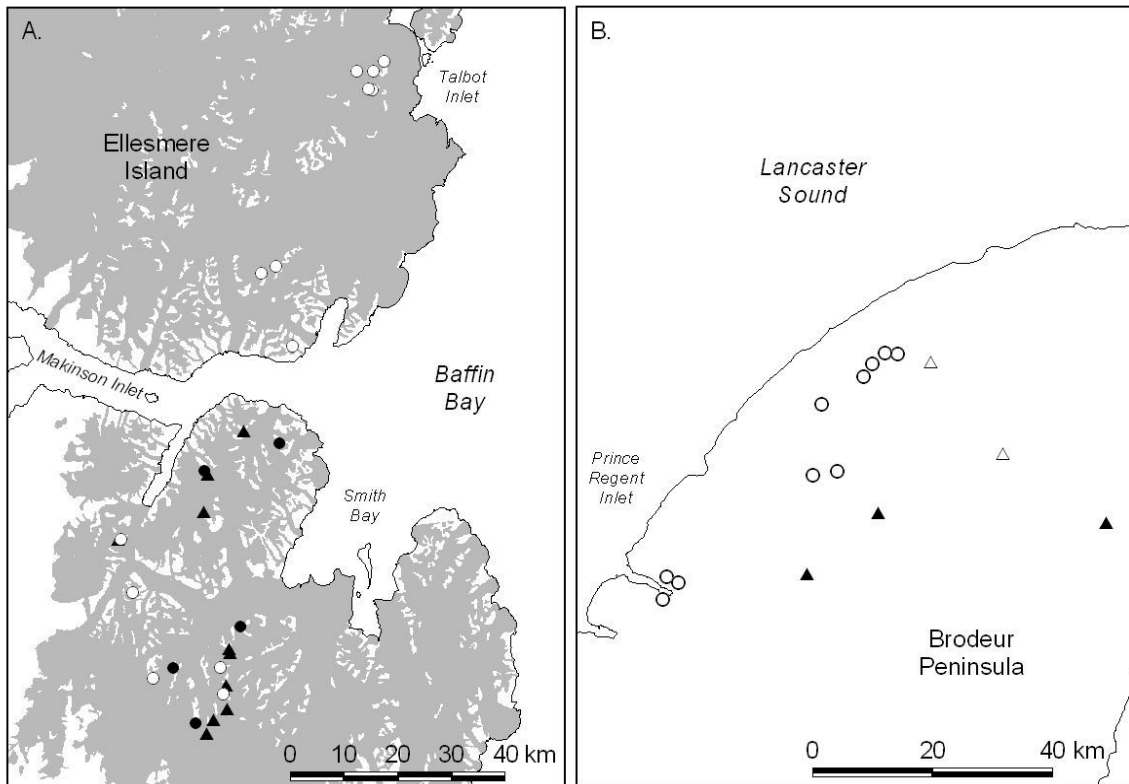


Figure 4. Status of Ivory Gull colonies on a) Ellesmere Island, and b) Baffin Island.

Closed circles = previously known colonies still with birds.
 Open circles = previously known colonies now without birds.
 Closed triangles = new colonies with birds, as found in 2002 and 2003.
 Open triangles = colonies with birds in 2001 but not in 2002 and 2003.

Table 1. Number of adult Ivory Gulls observed at specific colonies in arctic Canada in relation to location, year, and data source. Data known to exist, but not yet available to the authors, is denoted with a (?).

	Lat	Long	Source	1974	1975	1976	1977	1981	1982	1983	1985	1990	2001	2002	2003	2004	2005
Ellesmere																	
	76.23	84.58	4, 7	.	.	.	.	.	287	?	.	.	.	0	0	0	0
	76.56	80.31	2, 4, 7	.	.	.	60	.	42	?	.	.	.	0	0	0	0
	79.58	76.55	2, 4, 7	.	.	.	15	.	.	?	.	.	.	0	.	.	0
	77.10	79.20	2, 4, 7	.	.	.	50	.	18	?	.	.	.	0	5	0	0
	77.27	79.14	2, 4, 7	.	.	.	50	.	125	0	.	.	.	0	5	0	0
	78.50	78.11	2, 4, 7	.	.	.	30	.	20	?	.	.	.	0	8	0	0
	78.12	78.50	7	.	.	.	.	.	.	.	.	.	.	.	.	131	91
	77.01	80.34	4, 7	.	.	.	.	.	.	.	.	24	.	0	0	0	0
	76.48	79.55	4, 7	.	.	.	.	.	.	.	.	28	.	0	8	0	0
	76.52	79.45	4, 7	.	.	.	.	.	.	.	.	20	.	5	0	0	0
	76.46	79.53	4, 7	.	.	.	.	.	.	.	.	28	.	1	0	0	0
	76.48	80.25	4, 7	.	.	.	.	.	.	.	.	70	.	0	0	0	0
	76.48	80.57	4, 7	.	.	.	.	.	.	.	.	90	.	6	0	0	0
	76.57	80.08	4, 7	.	.	.	.	.	.	.	.	70	.	10	0	0	0
(new)	76.42	80.04	7	.	.	.	.	.	.	.	.	.	.	11	0	0	1
(new)	76.43	80.01	7	.	.	.	.	.	.	.	.	.	.	2	0	0	0
(new)	76.44	79.54	7	.	.	.	.	.	.	.	.	.	.	2	1	0	0
(new)	76.46	79.53	7	.	.	.	.	.	.	.	.	.	.	1	0	0	0
(new)	76.50	79.51	7	.	.	.	.	.	.	.	.	.	.	9	3	0	0
(new)	77.49	79.50	7	.	.	.	.	.	.	.	.	.	.	20	0	0	0
(new)	77.01	80.37	7	.	.	.	.	.	.	.	.	.	.	1	0	0	0
(new)	77.07	79.54	7	.	.	.	.	.	.	.	.	.	.	1	0	0	0
(new)	77.11	79.35	7	.	.	.	.	.	.	.	.	.	.	4	0	0	2
(new)	77.03	79.57	7	.	.	.	.	.	.	.	.	.	.	.	2	0	0
Baffin Is.																	
	73.32	87.40	10, 9, 7	.	.	.	.	18	.	.	.	.	.	0	0	0	0
	73.32	87.52	10, 9, 7	.	.	.	.	30	13	.	.	.	.	0	0	0	0
	73.39	87.29	4, 9, 7	.	.	.	.	.	.	75	.	.	.	0	0	0	0
	73.39	87.33	4, 9, 7	.	.	.	.	.	.	175	.	.	.	0	0	0	0
	73.37	87.39	4, 9, 7	.	.	.	.	.	.	6	.	.	.	0	0	0	0
	73.38	87.37	4, 9, 7	.	.	.	.	.	.	37	.	.	.	0	0	0	0
	73.34	87.52	4, 9, 7	.	.	.	.	.	45	.	.	.	.	0	0	0	0
	73.29	87.47	4, 9, 7	.	.	.	.	.	13	.	.	.	.	0	0	0	0
	73.28	87.54	4, 9, 7	.	.	.	.	.	84	.	.	.	.	0	0	0	0
	73.18	88.38	4, 9, 7	.	.	.	.	.	.	130	.	.	.	0	0	0	0
	73.18	88.34	4, 9, 7	.	.	.	.	.	.	45	.	.	.	0	0	0	0
	73.16	88.39	4, 9, 7	.	.	.	.	.	.	25	.	.	.	0	0	0	0
	73.31	86.54	6, 7	.	.	.	.	.	.	.	.	.	35	.	0	0	0
	73.39	87.18	6, 7	.	.	.	.	.	.	.	.	.	20	.	0	1	0

	Lat	Long	Source	1974	1975	1976	1977	1981	1982	1983	1985	1990	2001	2002	2003	2004	2005
Baffin Is.																	
(new)	73.19	87.54	7, 8	.	.	.	.	.	.	.	.	.	.	.	55	54	0
(new)	73.25	86.21	7, 8	.	.	.	.	.	.	.	.	.	.	.	26	0	0
(new)	73.25	87.33	7, 8	.	.	.	.	.	.	.	.	.	.	.	7	0	0
Devon Is.																	
	75.28	81.22	3, 7	.	.	.	.	.	25	.	.	.	.	0	0	0	3
	20.45	80.45	3, 7	.	.	.	.	.	30	.	.	.	.	6	0	0	0
	57.12	81.04	3, 7	.	.	.	.	.	30	.	.	.	.	0	0	0	0
	74.46	80.42	3, 7	.	.	.	.	.	6	.	.	.	.	.	.	.	.
Seymour																	
	76.48	101.16	1, 4, 7, 9	340	300	300	.	.	.	225	.	.	.	0	200	120	110
Cornwallis																	
(new)	75.05	94.15	8	.	.	.	.	.	.	.	.	.	.	.	7	.	0
(new)	75.48	90.49	8	.	.	.	.	.	.	.	.	.	.	.	.	.	3

Data sources

1. MacDonald, 1976
2. Frisch and Morgan, 1979
3. Frisch 1983
4. Thomas and MacDonald, 1987
5. France and Sharp, 1992
6. Gaston, pers. com, 2004
7. Gilchrist and Mallory, 2005
8. Mallory and Gilchrist, unpublised data
9. Thomas, pers. com, 2005 (?) "plus an additional 130 adults on the Brodeur at other colonies in 1983".
10. Reed and Dupuis, 1983

Table 2. Number of active colonies observed in arctic Canada in relation to region, year, and search effort.

Survey region	Year	No. of known colony locations searched*	No. active colonies detected	Mean number of gulls present/active colony
Baffin Island	2002	22	13	6.4
	2003	22	6	5.3
	2004	23	1	131
	2005	24	3	31.7
Devon Island	2002	3	1	6
	2003	3	0	0
	2004	3	0	0
	2005	3	1	3
Seymour Island	2002	1	0	0
	2003	1	1	200
	2004	1	1	120
	2005	1	1	110
Brodeur Pen., Baffin Island	2002	12	0	0
	2003	15	3	29.3
	2004	15	2	27.5
	2005	15	0	0

*Does not include the total number of potential alternative habitat sites that were searched, and where no birds were found.

In winter, the distribution of Ivory Gull in Canadian waters is poorly known. However, the Ivory Gull occurs among the pack ice of Davis Strait (Orr & Parsons 1982), the Labrador Sea, Strait of Belle Isle, and northern Gulf of St. Lawrence. Occasionally, it is seen along eastern coasts of Newfoundland and Labrador, particularly the Northern Peninsula of Newfoundland, and on the Lower North Shore of Quebec. The population that winters off the Atlantic Coast may include Ivory Gulls breeding in east Greenland based upon banding recoveries. Ten adult Ivory Gulls banded in early April 1964 and 1966 in the Labrador Sea were recovered shot in Greenland 2-17 years later (Lyngs 2003).

HABITAT

Habitat requirements while breeding

Like other seabirds breeding in the Arctic, Ivory Gulls require breeding sites that are both safe from terrestrial predators (particularly the arctic fox, *Alopex lagopus*), and in close proximity (100-200 km) to open water early in May and early June when Ivory Gulls begin nesting. This latter factor is particularly important in the high Arctic, where the sea is ice-covered in May, June, and in some areas, well into July. Thus, most known nesting locations are associated within 100 km of nearby polynyas and/or recurring leads (see below, compare Figs. 3 and 5). Collectively, the fact that most known nesting sites are located in regions that are both free of predators and in proximity to early season open water restricts the possible breeding locations of Ivory Gulls in the Canadian Arctic (discussed further below).

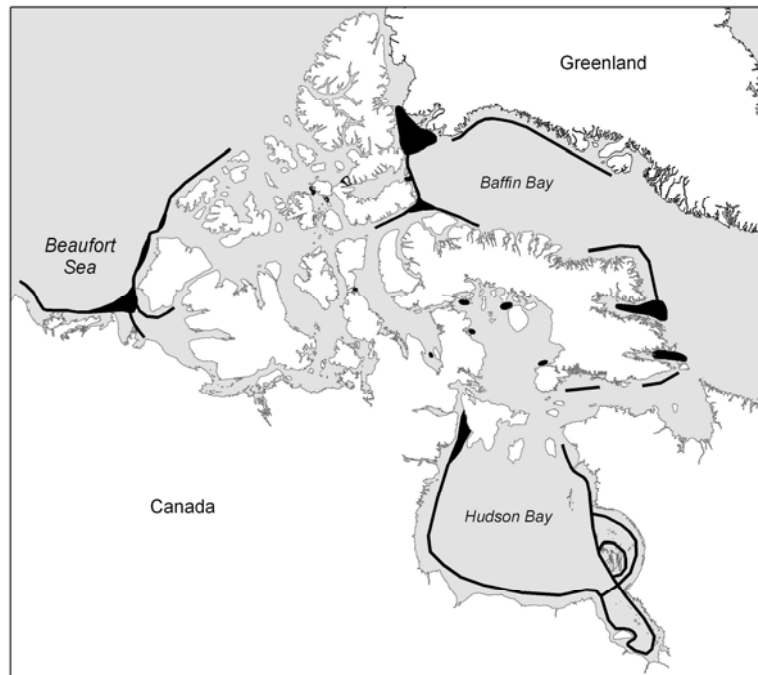


Figure 5. Open water areas (polynyas and shore leads) in the Canadian Arctic during spring.

A recent review which related the geomorphology of Nunavut with colony locations of Ivory Gulls, indicates that there are two predominant habitat types that are consistently used as colony locations; sheer granite cliffs found in glacial terrain of south east Ellesmere and Devon Islands, and vast gravel limestone plateaus devoid of vegetation on the Brodeur Peninsula of Baffin Island, parts of Cornwallis Island, west Devon Island, and northeast Somerset Island (Figs. 3 & 4).

Ivory Gull colonies present on Ellesmere and Devon Islands typically occur 20-50 km inland, and on the steep granite cliffs of mountains protruding from glaciers (termed '*nunataks*'). Several of these colonies occur at the crests of sheer cliffs over 800 m above the glacial ice sheets below (Frisch & Morgan 1979; Gilchrist & Mallory 2005). These locations are devoid of arctic foxes, and are likely rarely visited by avian predators because they are far inland and found so high on cliffs (e.g. Ravens and Glaucous Gulls). Colonies on southeast Ellesmere Island are found within 50-90 km of the Northwater Polynya and open water in May. Colonies on eastern Devon Island are found within 30-50 km of the Northwater Polynya and the floe edge of Jones Sound in late May.

A second habitat type which supports Ivory Gull colonies occurs on limestone gravel plateaus on the Brodeur Peninsula of northern Baffin Island, and two sites on southwest Cornwallis Island. Here, a lack of soil precludes even sparse vegetation from becoming established. In turn, lemmings (*Dicrostonyx* spp., *Lemmus* spp.) and the arctic foxes (*Alopex lagopus*) that prey on them are absent from these expansive gravel plateaus. Extant colonies are also found 20-40 km inland, which likely lowers the

probability that colonies are visited by foxes and polar bears foraging along coasts. In most years, colonies on the Brodeur Peninsula and Cornwallis Island occur within 60-110 km of the Lancaster Sound Polynya and associated floe edges in late May.

Ivory Gulls also nest on a single low-lying island just north of Bathurst Island, named Seymour Island. This is the only known extant Ivory Gull colony found on a small, offshore island in Arctic Canada (Mallory & Gilchrist 2003). Seymour Island is found within 100 km of the margin of the Penny Strait Polynya.

Large expanses of the western arctic and Ellesmere Island are apparently unsuitable for nesting Ivory Gulls because there is no ice-free ocean regularly available in these regions in late May and early June when Ivory Gulls arrive to breed. Furthermore, the flat vegetated landscape of these islands supports lemmings and arctic foxes. Consequently, evidence is growing that the decline in the breeding population of Ivory Gulls detected in Arctic Canada (discussed below) cannot be simply attributed to movement of nesting Ivory Gulls into other alternative nesting areas elsewhere in Arctic Canada.

Habitat requirements in winter

Unlike most other Arctic-breeding seabirds, Ivory Gulls spend the entire year at high latitudes, where they rarely range far from pack ice. They generally winter among pack ice or at persistent areas of open water surrounded by ice, known as 'polynyas' (Haney & MacDonald 1995). They also scavenge on carrion on the ice (Haney & MacDonald 1995). The fact that they winter in sea ice at high latitudes in the Arctic, North Atlantic and Pacific oceans often at low densities, makes detailed study of their ecology in winter extremely difficult.

Habitat trends

Seymour Island is remote, and rarely visited. Similarly, the cliff colonies of Ellesmere and Devon islands are also extremely remote, and can only be visited by helicopter under ideal flying conditions. Although the nunataks on southeast Ellesmere Island were surveyed from the air during a period of intense geological exploration and mapping (1977-1982, Frisch 1988), these sites have been rarely visited since then. In fact, geologists were the first to confirm that Ivory Gull colonies existed on Ellesmere and Devon Islands (Frisch and Morgan 1979).

In contrast to the nesting regions above, the Brodeur Peninsula of Baffin Island has experienced significant and accelerating human activity related to diamond mining exploration in the last 3 years (Department of Indian and Northern Development, 2004). Various mining companies have staked almost the entire Peninsula in search of diamonds (Fig. 6). These activities include aerial surveys and sampling on the ground, the establishment of at least one drilling site, a fuel cache (over 400 drums in 2003), and a summer field camp. The effects of this activity on the three remaining Ivory Gull colonies is unknown; however, the fuel cache is located centrally within 2 km of

previously known, but abandoned colonies. Moreover, the drilling camp is located within 4 km of the largest remaining Ivory Gull colony on the Peninsula (56 birds in 2004), which supported no gulls in July 2005. In fact, no Ivory Gulls were found to nest at any of the known colony locations on the Brodeur Peninsula of Baffin Island in 2005 (Table 1).

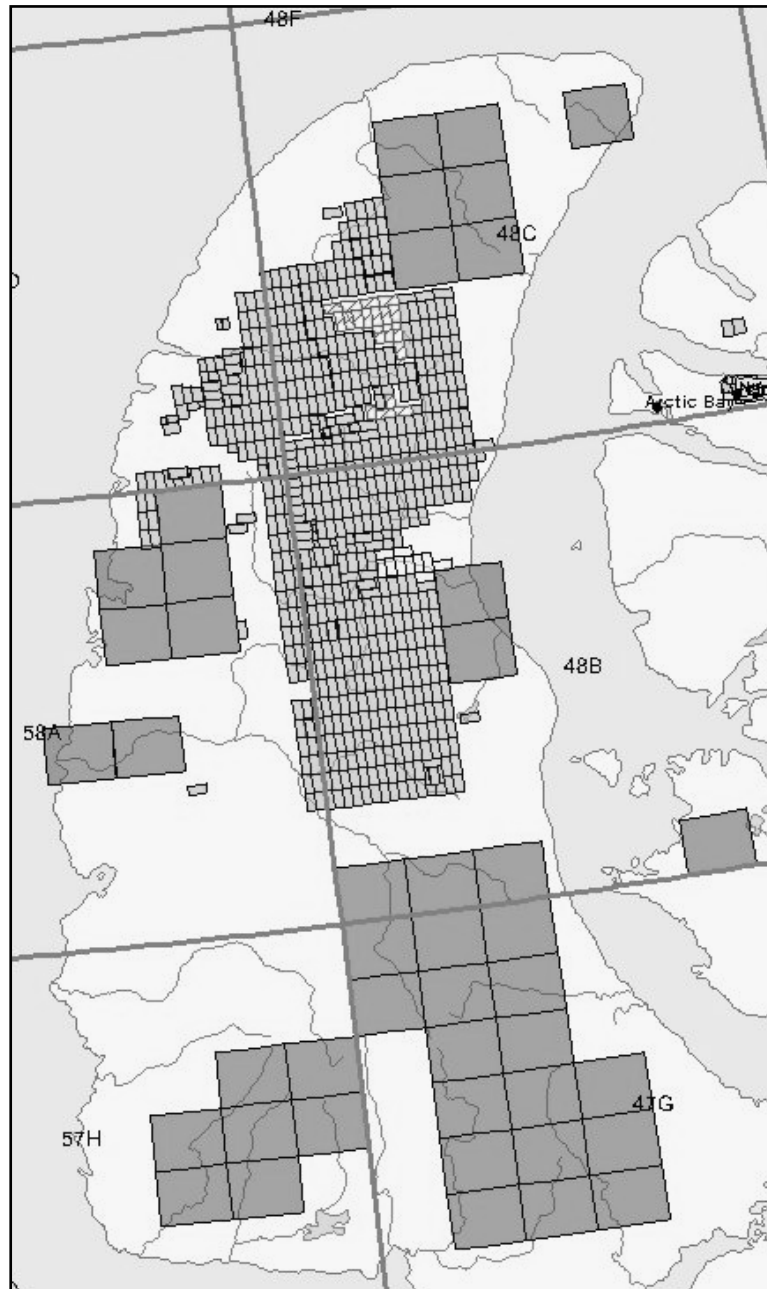


Figure 6. Mining claims (small squares) and areas where prospecting permits (large squares) have been issued on the Brodeur Peninsula of Baffin Island.

Human activities in the vicinity of an Ivory Gull colony may play a significant role in habitat degradation, particularly activities related to resource exploration and extraction. The extreme climate, topography, and isolation of the Arctic require that these activities rely on helicopter, fixed-winged aircraft and in some cases the use of all-terrain vehicles (ATVs). This generates noise and pollution. Furthermore, the presence of semi-permanent drilling camps may attract mammalian and avian predators and scavengers to remote areas where they were previously absent.

At this time, there is an urgent need to assess what impact, if any, these mining exploration activities are having on Ivory Gulls nesting on the Brodeur Peninsula of Baffin Island. Haney & MacDonald (1995) suggested that colonies were quite sensitive to disturbance; although recent information from a number of sources in Canada and Norway contradicts this (see section on Adaptability). Clearly, studies are required to assess the response of Ivory Gulls to helicopter and fixed-wing aircraft, and drilling activity. As well, it is necessary to monitor the presence of potential predators that could be attracted to the region by mining camps and related activities (e.g. arctic foxes, Common Ravens [*Corvus corax*]).

Habitat protection/ownership

At present, Seymour Island is the only Ivory Gull nesting site with any legislative habitat protection. It was designated as a Migratory Bird Sanctuary in 1975, based solely on the existence of a large Ivory Gull colony (MacDonald & Cooper 1979), the only extant colony known to exist in Canada at the time (Brown *et al.* 1975). Habitat protection should be explored for other areas under threat, particularly the Brodeur Peninsula (Fig. 6), where mining, construction (including buildings, gravel pads, and airstrips) and related activities (including low level flying, and use of ATVs) are ongoing within 5-10 km of existing Ivory Gull colonies (compare Fig. 4b and Fig. 6).

BIOLOGY

Life cycle and reproduction

Ivory Gulls are thought to first breed after their second year, based on the fact that they acquire adult plumage in their second winter, and that individuals in less than full adult plumage are rarely seen at breeding colonies (Haney & MacDonald 1995).

Unlike most gulls, which regularly lay 3 eggs, the Ivory Gull usually lays 1-2 eggs. Thus, they typically can only raise a maximum of two chicks per year, although no detailed information currently exists regarding their reproductive rates in Canada (Haney & MacDonald 1995). However, based on the scant information available for this species, their reproductive rate is likely to be relatively low for a gull, and to vary considerably from year to year (see MacDonald 1976, Stenhouse 2003, Stenhouse *et al.* 2001 for related species). For example, Ivory Gulls failed to breed at all on Seymour Island (the largest known Ivory Gull colony in Arctic Canada) in 2002 for unknown reasons (Mallory & Gilchrist 2003).

Predation

Arctic foxes are well-known nest predators, and can destroy entire Ivory Gull breeding colonies found on flat ground in some years (MacDonald 1976, Zubakin 1984). Polar bears (*Ursus maritimus*) will take eggs and young on occasion (Haney & MacDonald 1995). Avian predators such as Common Ravens and Glaucous Gulls are known to depredate the eggs and young of Ivory Gulls, but little is known about the frequency or population-level effects (particularly among colonies found inland on nunatak cliffs) and how predation rates vary by nesting habitat (see Breeding Habitat, above). Therefore, quantifying rates of predation and the extent of variation between years is a priority for research.

Diet and physiology

Like most gulls, the Ivory Gull is an opportunistic feeder. At sea, it is a surface-feeder, foraging primarily on small fish, such as lantern-fish (*Myctophidae*) and juvenile arctic cod (*Boreogadus saida*), and macro-zooplankton, such as amphipods and euphausiids (Haney & MacDonald 1995). Pellets found near nests and containing small bones and hair suggest that, at least during breeding, they also catch small mammals (Bent 1921).

Ivory Gulls are also scavengers of marine mammals killed by large predators, and are reported to forage on marine mammal faeces and placentae (Haney & MacDonald 1995). In doing so, they are potentially subject to a high toxic chemical loading. However, their scavenging behaviour may be influenced by an absence of available open water in which to feed (Stishov *et al.* 1991).

In general, high-latitude seabirds have much higher metabolic rates and daily energy expenditure than expected. Only one Ivory Gull has been measured, but, in this individual, resting metabolic rate (RMR) was 190-220% of the predicted values, based on allometric equations for Arctic-breeding seabirds (Gabrielsen & Mehlum 1989). Due to their high metabolic rates, Arctic-breeding seabirds exhibit high energetic requirements and, therefore, have a greater potential for the bioaccumulation of persistent organic pollutants than other species, even when compared to marine mammals (see Fisk *et al.* 2001). For example, Ivory Gulls collected in the Northwater Polynya of northern Baffin Bay in summer had higher loads of a range of persistent organic pollutants, such as organochlorines and PCBs, than Herring Gulls (*Larus argentatus*) collected from Lake Ontario (Fisk *et al.* 2001) (see Limiting Factors & Threats, Contaminants below).

Dispersal/migration

Ivory Gulls are known to leave their colonies immediately after breeding and disperse to offshore foraging zones (Haney & MacDonald 1995). They generally move just south of permanent, multi-year pack ice and forage along ice edges (Renaud & McLaren 1982). However, the timing and scale of these movements is highly dependent

on inter-annual changes in the extent, location, and movement of sea ice (Haney & MacDonald 1995).

The large number of birds wintering in the pack ice of the Davis Strait and Labrador Sea regions (estimated to be up to 35,000 individuals in March 1978; Orr & Parsons 1982) are of unknown origin. It is thought that the Canadian and Greenlandic breeding populations winter in that area, but large numbers of birds from other geographical regions may also be present there (Orr & Parsons 1982). Affinities between breeding populations and wintering grounds remain unknown.

Recent analysis of banding returns has shown that at least some northern Canadian breeders migrate north up the west coast of Greenland in May and June, returning by the same route in September-November (Stenhouse *et al.* 2004). Ivory Gulls banded in more southerly Canadian colonies likely migrate by some other route, perhaps farther west of the Greenland coast (Stenhouse *et al.* 2004).

Any links between the eastern Canadian Ivory Gull population and those breeding in eastern Greenland are unknown (Fig. 2). However, these unresolved issues have important management implications. Despite an overlap in their wintering range, and possibly similar migration routes, there may be little interchange between Ivory Gulls breeding in Canada and those breeding in Greenland. Furthermore, there is weak evidence to suggest that Ivory Gulls breeding in Canada should not necessarily be treated as a single demographic unit (Stenhouse *et al.* 2004), because birds banded at specific Canadian colonies have never been observed to move among them (V. Thomas, pers. comm., 2004).

Interspecific interactions

Ivory Gull colonies are generally small and isolated, so the opportunity for interaction with other species is limited, at least during the breeding season. It is assumed that Ivory Gulls nest in extremely remote locations (often 20-30 km inland) to avoid interactions, particularly with species that could prey on their eggs and chicks (Haney & MacDonald 1995). For example, the intensity of their response toward predators, such as arctic foxes, at colonies appears to be weak, and they are certainly not as aggressive towards humans as other small to medium-sized gulls, such as the Sabine's Gull (Day *et al.* 2001).

Little is known about Ivory Gull behaviour and ecology away from the colony. They appear to be relatively solitary at sea or occasionally form small groups of 20-30 individuals (Cramp & Simmons 1983). They are reputed to be extremely bold while scavenging on marine mammal carcasses. In these situations, they have been seen to drive off larger gulls such as Iceland and Glaucous Gulls (Ian Stirling, pers. comm.)

Adaptability

There are conflicting reports relating to the sensitivity of Ivory Gulls to disturbance while breeding. Generally, it is considered to be sensitive to disturbance by air and ground traffic near breeding colonies (Haney & MacDonald 1995). However, this is based largely on a single source which reported that a single low flying aircraft caused the complete abandonment of a colony (Cramp & Simmons 1983). Further research is required to determine whether this was an isolated incident or is a common response.

In contrast to this single report, several independent observations by seabird researchers in Canada and Norway suggest that Ivory Gulls may be more tolerant of disturbance than many other seabirds (e.g. Sabine's Gulls and Arctic Terns). In each case, researchers from Norway and Canada flew over Ivory Gull colonies by helicopter, then landed within 500-1000 m of them. Ivory Gulls returned to their nests even before the rotors of the helicopters stopped, and most birds incubated quietly when human visitors sat within 3 m of their nests (A.J. Gaston, V. Baken, H. Strom, pers. comm., 2005).

“The [ivory] gulls appeared to settle down within 10-15 minutes of the [helicopter] disturbance and no robbing of eggs or interference with other nests was noted. This general behavior was typical of all colonies visited”. (Reed and Dupuis, 1982).

Collectively, these latter qualitative reports concur with the experience of S. MacDonald and 2 field assistants who lived on Seymour Island, Canada, while researching Ivory Gulls over 4 consecutive summers (S. MacDonald 1976, pers. comm., 2004). Despite a research team living among them on an island only 900 m long, Ivory Gulls did not desert the colony due to human activities (S. MacDonald, pers. comm., 2005).

These contradictory findings emphasize the need to quantify the sensitivity of Ivory Gulls during an entire breeding season to various sources of disturbance including researcher visitation, air traffic, ATVs, and mining activity.

POPULATION SIZES AND TRENDS

Search effort

Prior to the surveys conducted in 2002-2005, 33 Ivory Gull colonies were known to exist based upon a literature review and interviews with scientists and Inuit (Thomas & MacDonald 1987, Haney & MacDonald 1995, Mallory *et al.* 2002). This provided 14 colony locations on Ellesmere Island, 4 on Devon Island, 14 on the Brodeur Peninsula of Baffin Island, and one on Seymour Island (Table 1).

Owing to the remote locations of colonies, the 2002-2005 surveys used a helicopter (as did the previous surveys) flown between 0900 and 1700 EDT in the second week of July each year (incubation stage), the same period as most surveys conducted in the 1980s. In 2003, sites at the Brodeur Peninsula, Seymour Island and one colony on Ellesmere were also traversed by foot. Weather was sunny and clear during the surveys in each year. Mountain nunataks were surveyed by flying 80-100 m from cliff faces at 40-60 km/h in a Bell 206 L4 helicopter. The team flew from one nunatak to the next, assuming that no birds nested on the glacial ice in between them (Haney & Macdonald 1995). Ivory Gulls were easily spotted. At the approach of the helicopter, some Ivory Gulls remained on their nests, white against the dark rock, while others flew off cliffs and circled over the colony, bright against the blue sky. When Ivory Gulls were spotted, the helicopter slowed to a hover so that all three crew members could count individual Ivory Gulls sitting on cliff ledges or flying (Gilchrist & Mallory 2005).

In every region where surveys were conducted, the survey team flew over alternative areas (at least within a 10-20 km radius of suitable habitat) to determine if Ivory Gulls had moved to nest elsewhere. Information on non-colony locations was required to determine whether population changes at colonies (if detected) were a result of colony redistribution or numerical declines in the number of nesting birds. Surveys were flown over more than 300 alternate cliffs or nunataks in 2002, 2003, 2004, and 2005 on Devon and Ellesmere Islands in addition to the known colony locations (Gilchrist & Mallory 2005).

In July 2003, surveys were also expanded on the Brodeur Peninsula in search of new colonies by flying 8 aerial transects across the width of the peninsula at intervals of approximately 3 minutes latitude (roughly 3 miles apart) in a DeHavilland Twin Otter fixed wing aircraft. Transects were flown at an altitude of 400-500 feet and at 200 kph groundspeed, with three observers looking for colonies. The colonies that were found ($n = 3$) were subsequently revisited the next day by helicopter.

In 2003, 2004, and 2005, 16 small islands were also surveyed in the vicinity of Seymour Island in the Penny Strait Polynya (Mallory & Gilchrist 2003, Mallory and Gilchrist, unpublished data).

Collectively, these aerial search efforts encompassed almost all known colony locations, and approximately 60-70% of suitable habitat (80% of nunataks on south east Ellesmere and Devon Islands, and 50-60% of the Brodeur Peninsula; see discussion on habitat requirements).

Population trend

General findings

Two-tailed, matched-pairs t -tests were applied to the survey data to determine if colony sizes had changed significantly between 2002 and 2003 surveys and when the

colonies were first discovered in the 1980s. These analyses were constrained because some of the original information was presented as data pooled for a region (notably for the Brodeur Peninsula), limiting the number of possible pair-wise colony comparisons. No population trend data could be determined for colonies discovered for the first time (Table 1).

In July 2002 and 2003, locations where colonies had previously occurred on Ellesmere (19), Devon (3), and Baffin Islands (12) were resurveyed. Irrespective of location or nesting characteristics (e.g. nunatak or gravel plateau), the number of Ivory Gulls present had declined (Table 1). The mean number of Ivory Gulls present at colonies (pooled for some sites) was lower in both 2002 (1.6 ± 3.1 SD birds, $n=17$) and 2003 (0.3 ± 1.2 birds, $n=16$) compared to the mean number found at the same colonies surveyed in the 1980s (86.9 ± 139.5 ; 1980s-2002, $t_{16} = -2.5$, $P = 0.02$; 1980s-2003, $t_{15} = -2.5$, $P = 0.02$). Several colonies supported no gulls in either 2002 or 2003, including the one on the Sydkap Glacier (previously 275 birds).

Ellesmere and Devon Islands

Despite comprehensive survey coverage on Ellesmere and Devon Islands, only 9 new colonies were located in 2002 and one new colony in 2003 (Table 1). Whether these colonies reflect new nesting locations, or were missed in the original surveys is unknown; however, it is unlikely that colonies were missed in prior surveys due to the aerial coverage and visibility of Ivory Gull colonies (V. Thomas, pers. comm., 2004). However, the number of birds detected at colonies on Ellesmere and Devon Islands was small, totalling 89, 32, 131, and 97 individuals in 2002, 2003, 2004, and 2005 respectively.

Seymour Island

In 2002, no Ivory Gulls nested on Seymour Island, and there was no obvious sign of nesting attempts (e.g. nesting material). In contrast, approximately 200, 120, and 110 gulls were observed on Seymour Island in 2003, 2004, and 2005. The number of gulls observed in these four consecutive years remain below the 300-340 Ivory Gulls reported each year over three consecutive years in the early 1970s (MacDonald 1976, MacDonald, pers. comm., 2004).

No Ivory Gulls were found on any of the 16 islands near Seymour Island in, or on the margins of, the Penny Strait polynya (2002-2005, Mallory & Gilchrist 2003, Mallory and Gilchrist, unpublished data).

Brodeur Peninsula and Cornwallis Island

On the Brodeur Peninsula (where data were pooled in previous studies), no Ivory Gulls were observed between 2002-2005 at 12 known colony locations that previously supported 730-830 birds (previous colony size ranging from 12-300 gulls, Thomas and MacDonald 1987). Despite the loss of sample size due to pooling, there was a

significant decline in the number of Ivory Gulls present across all colonies in both 2002 and 2003 when compared to historical data (1980s-2002, $t_{17} = -2.8$, $P = 0.01$; 1980s-2003, $t_{16} = -2.8$, $P = 0.01$). Similarly, no Ivory Gulls were found at these sites in either 2004 or 2005.

On the Brodeur Peninsula in 2002-2005, no new nesting locations were discovered while surveying intensively in the area of previously known colonies (western half of the Brodeur Peninsula), but three new colonies were found farther inland in 2003 (55, 26, and 7 gulls observed at the 3 colonies respectively). It is unknown whether these colonies existed in 1985, because they were located outside of the original survey area (Thomas & MacDonald, 1987). Only one colony of 54 gulls was found in 2004, and no Ivory Gulls were found on the Brodeur Peninsula at all in 2005 (Table 1).

Cornwallis Island

Seven gulls were found nesting at a single new colony on the interior of Cornwallis Island in 2004 (Table 1), and another colony of 3 gulls was discovered in 2005 (Mallory and Gilchrist, unpublished data). These colonies occurred in similar habitat to those found on the Brodeur Peninsula (i.e., limestone gravel plateaus)

Summary of survey data

Collectively, 47 colony locations were visited on Ellesmere, Devon, Baffin, Cornwallis, and Seymour Islands over four consecutive years, 15 of which are new discoveries and most found in the vicinity of previously known colonies (Table 1). Despite this survey coverage and including colonies found for the first time, only 88, 319, 305, and 210 individuals were observed at colonies in 2002, 2003, 2004, and 2005 respectively. This is in contrast to the following reported by Thomas and MacDonald (1987):

“The number of adult ivory gulls observed at active breeding sites from 1982 to 1985 at Seymour Island, Ellesmere Island and Brodeur Peninsula is about 1800-1900. These figures do not include the almost 300 adult breeding ivory gulls reported collectively at eastern Devon Island (Frish 1983)” (Thomas and MacDonald 1987).

It is also worth noting that 36 and 240 adult Ivory Gulls were banded at Resolute Bay and Grise Fiord respectively from 1982 to 1984 (Thomas and MacDonald 1987), whereas no adult Ivory Gulls have been reported at either community between 2002-2004. In 2005, some Ivory Gulls were observed in the autumn at Resolute Bay (Higdon and Romberg 2006), and during consultations in the communities in January 2006, local residents reported that they were seeing a few more birds near the communities than they had the past few years (M. Mallory, unpublished data).

Colony occupation

No Ivory Gulls were present in early July at Seymour Island in 2002, but 200, 120, and 110 individuals were present and nesting on the Island in 2003, 2004, and 2005 respectively. Similarly, 11 colonies in southeastern Ellesmere and Devon Islands that supported nesting Ivory Gulls in 2002 had no gulls in 2003 (Table 1). In contrast, 4 colonies that were uninhabited in 2002 collectively supported 28 nesting gulls in 2003 (Table 1).

These findings confirm that colony occupation by Ivory Gulls may be intermittent at some locations, due either to years of skipped breeding, movements among colonies, or both. However, at other locations the complete absence of any breeding attempts over four consecutive years suggests that 19 of 33 historical breeding sites that were previously occupied are no longer used (e.g. Sydcap Glacier site on Ellesmere Island, 12 locations on the Brodeur Peninsula), and that the number of active colonies in Canada may have declined since the 1980s.

Preliminary observations from recent surveys also suggest that locations on flat ground may be more ephemeral than colonies occurring on cliff nunataks. This suggestion is based on the observation that several cliff sites in the interior of both Ellesmere and Devon Islands supported extensive vegetation on cliff ledges (some ledges occurring 800 m above glacial ice sheets below). This vegetation is presumably a direct result of nutrient input by nesting Ivory Gulls over time (as it is for other seabird colonies in the high Arctic), and likely represents repeated (if intermittent) use of these sites as colonies over hundreds of years.

By contrast, colony locations on the Brodeur Peninsula occurred on rounded hill tops and flat ground on gravel plateaus. Their exact locations may be influenced by snow conditions each year in May when Ivory Gulls arrive to breed in the region. Presumably, colonies would become established on hill tops blown free of snow, the exact locations of which may change each year. However, it should be noted colony movements of this scale (perhaps in response to regional snow conditions) would have been detected by the recent surveys of the area.

Intermittent breeding at some colonies complicates the estimation of the Canadian breeding population, and it remains unknown whether the degree of intermittent breeding has increased in Arctic Canada in recent years. The intermittent breeding detected at some colonies emphasizes the need to conduct surveys over consecutive years to estimate population size (as has been done, Table 1). Four years of consecutive surveys under ideal weather conditions have never detected more than 319 individuals in any given year. Further, 19 of 33 historical sites (representing colonies from across the breeding range) have never been occupied during these four consecutive years, and can be considered extirpated.

Abundance

The global breeding population of Ivory Gulls has been estimated at around 14,000 pairs (Volkov & de Korte 1996). However, this figure incorrectly included 2,400 *pairs* estimated to be breeding in Canada in the 1980s, when the original estimate was in fact 2,400 *individuals* (1,200 pairs; Thomas & MacDonald 1987). This global estimate likely also included an over-estimate for the Russian population (i.e. ~10,000 pairs; Volkov & de Korte 1996).

Currently, the Canadian breeding population is estimated at approximately 500-600 individuals, based on surveys conducted between 2002-2005 in which no more than 319 gulls were detected at colonies in any given year (Gilchrist & Mallory 2005; Table 1). This represents a total decline of 80% and an annual rate of decline of approximately 8.4% over the last 18 years when recent survey data are compared to published historical estimates of the breeding population (Table 1, Thomas and MacDonald 1987). If this decline is real and was to continue at a steady rate, the Canadian breeding population is expected to decrease by a further 62% over the next 10 years, to a total of approximately 190 birds.

Ivory Gulls are also known to winter in Canadian waters, although the percentage of the global population to do so remains unknown. A single study in March 1978, based on aerial transects in the Davis Strait and Labrador Sea, estimated approximately 35,000 individuals in that region (Orr & Parsons 1982). However, the authors acknowledged that the resolution of this survey was weak for this species (i.e. wide confidence limits) because few gulls were actually observed during the surveys, and that the results were extrapolated over the entire survey region. Although it is questionable whether this estimate should be used to generate estimates of global population size (e.g. Burger and Gochfeld 1996), these results nevertheless suggest that Canada supports a large proportion of the global population in marine waters in winter during some years.

Although there is no comparable survey on the scale of Orr & Parson's (1982) there is weak evidence that that fewer birds are wintering in Canadian waters compared with the late 1970s. A recent marine bird survey conducted within the pack ice off the coast of Newfoundland and Labrador in March 2004 observed few Ivory Gulls (0.02 per 10 min watch), compared with 1978, when Ivory Gulls were commonly observed at that time of year in this region (0.69 per 10 min. watch; Stenhouse & Wells, unpubl. data).

Fluctuations and population trends

Global estimates

The current status of the global Ivory Gull population is essentially unknown (Burger and Gochfeld 1996). Long-term declines have been suggested for various parts of the breeding range including Norway (Bateson & Plowright 1959, Cramp & Simmons 1983, Glutz von Blotzheim & Bauer 1982, Haney 1993). The trend of the

ivory gull population in Svalbard is uncertain. Many colonies disappeared as early as the 1950s. Some new ones have been discovered, but in general it seems that the population has decreased (Anker-Nilssen *et al.* 2000). Declines have only been well documented in Spitzbergen (Bateson & Plowright 1959, Birkenmajer 1969), and recently in Canada (Gilchrist & Mallory 2005a). Populations appear to be stable in east Greenland based upon a single survey conducted in 2003 (O. Gilg, pers. comm.).

Aerial surveys in summer

Until recently, the eastern Canadian Arctic was thought to support 20-30% of the Ivory Gull breeding population, and to represent colonies of continental and global importance (Haney & MacDonald 1995). However, aerial surveys conducted during 2002-2005 suggest that the Canadian breeding population has declined since the early 1980s (Gilchrist & Mallory 2005a, review Table 1).

Marine surveys in summer and winter

Other evidence suggests that Ivory Gulls have experienced a population decline in Canada. The number of Ivory Gull observed during at-sea surveys carried out from research vessels has declined (Fig. 7). In the High Arctic in late summer, four times as many Ivory Gulls were seen in 1993 than in 2002 (Chardine *et al.* 2004). The authors saw a total of 74 ivory gulls in 1993 and 17 in 2002. Corrected for effort (number of 10-minute watches in each year) four times more birds were seen in 1993 than 2002 (1993: 0.42 birds per watch; 2002: 0.11 birds per watch. Even if the 34 Ivory Gulls seen at Grise Fiord in 1993 are eliminated from the comparison, twice as many birds were seen proportionately in 1993 (0.23 birds per watch) than in 2002. In 1993, Ivory Gulls were seen on 16 of 176 watches (9.1%) compared to 4 of 149 watches in 2002 (2.6%, Fisher Exact Test, $p = 0.02$) (Chardine *et al.* 2004).

In 1993, most of the Ivory Gulls seen on the cruise were flying. In the area around Grise Fiord, ivory gulls were heard vocalizing when they followed the ship or when flying around it while it was stationary. On three of the four occasions when the ship encountered a polar bear, Ivory Gulls were also present. In contrast, in 2002 no Ivory Gulls were present at any of the seven sightings of polar bears or at two apparent kills by polar bears. All Ivory Gulls were observed in small areas of open water in large expanses covered with mostly solid sea ice. In this context, Ivory Gulls were loafing on ice pack at the edge of openings (Chardine *et al.* 2004).

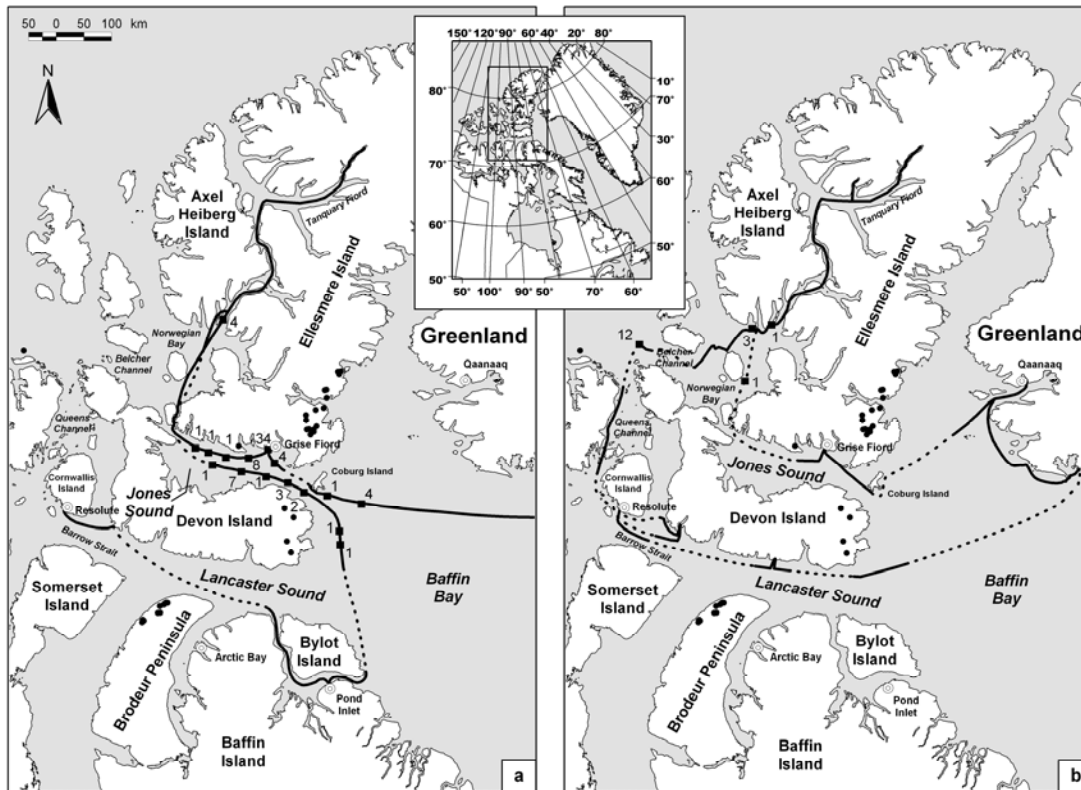


Figure 7. Route of the icebreaker Kapitan Khlebnikov 4-13 August 1993 (a) and 16-29 August 2002 (b) through the eastern high Arctic. Solid lines show those parts of the route where observations were made and the dotted lines those parts where no observations were made (usually between midnight and 0600 h or because of heavy fog). The number of locations (squares) of Ivory Gulls observed from the ship are given along the route. Dots indicate locations of breeding colonies of Ivory Gulls in the vicinity of the cruise path that have been reported in the literature in the last 30 years.

There are also preliminary indications that there are now fewer Ivory Gulls wintering in the Labrador Sea, a key wintering area, compared with the late 1970s (Stenhouse & Wells, unpublished data). A recent marine bird survey conducted within the pack ice off the coast of Newfoundland and Labrador in March 2004 (during the seal whelping period) observed few Ivory Gulls (0.02 per 10 min watch) compared with 1978, when Ivory Gulls were commonly observed at that time of year in this region (0.69 per watch; Stenhouse & Wells, unpubl. data).

Local Ecological Knowledge of Inuit

Observations by long-term Inuit residents of four communities in arctic Canada (Arctic Bay, Grise Fiord, Resolute Bay, Pond Inlet) also report declines in the number of Ivory Gulls observed at communities and during spring and fall migration along ice edges (Mallory *et al.* 2003, Gilchrist and Mallory 2005b). Local Ecological Knowledge (LEK) was gathered in Inuktitut regarding Ivory Gull observations from residents of four arctic communities. Although this gull was always considered uncommon, Inuit reported

that the numbers of Ivory Gulls that they were observing were declining, particularly as compared to 25 years ago. This is despite the fact that garbage disposal and the discard of marine mammal carcasses at the margins of the communities have not changed and continue to attract Glaucous and Iceland Gulls, and Ravens (Mallory *et al.* 2003, Chardine *et al.* 2004). In addition, nonsystematic surveys by local wildlife officers at two communities corroborated the LEK data (Mallory *et al.* 2003).

During community consultations in January 2006, elder (> 50 year old) residents of Grise Fiord indicated that the Ivory Gull was so common when they were young that it was sometimes difficult to sleep out on the sea-ice because the birds made so much noise in the spring. This was not the case anymore, although residents in Grise Fiord and Resolute Bay did say that they were seeing a few more birds in 2004 and 2005 than they had for nearly 20 years.

It is also worth noting that local residents believe that the Ivory Gull decline is related to the banding efforts near those communities in the 1970s and 1980s, because they observed far fewer birds near the community in the years following banding work. They contend that disturbing and especially handling wild birds (gulls, eiders) leads to population declines.

Rescue effect

The closest known Ivory Gull colonies to Canada are located in northeast and northwest Greenland (Evans 1984, Boertmann 1994). The Greenland population may offer a possible source for recolonization and/or recovery in Canada. However, although some Ivory Gulls banded in the Labrador Sea in winter migrated to Greenland (Lyngs 2003), potential links between the Canadian and Greenlandic breeding populations that could contribute to a 'rescue effect' have not been established.

Although there is limited information available on the current size of all Greenland colonies (Boertmann 1994, Lyngs 2003), it is presumed to be somewhere in the region of 1,000-1,500+ pairs (i.e. 2,000 individuals; Evans 1984, Burger & Gochfeld 1996, Greenland Seabird Colony Database 2005). This population is thought to be stable or at least not dramatically declining based upon aerial surveys in 2003 (O. Gilg, pers. comm.). These population trends are based on only a few censuses; however, it has been established that some colonies disappeared between 1993 and 2003 while others increased; the largest known colony, however, remained stable during this period (Falk *et al.* 1997; O. Gilg, pers. comm.). In addition, several large colonies (i.e. with several hundred pairs) have been recently discovered but have not yet been surveyed by seabird biologists (O. Gilg, pers. comm., Greenland Seabird Colony Database 2005).

LIMITING FACTORS AND THREATS

Survival, reproduction and productivity

Ivory Gulls have an adult survival rate comparable with other gulls (0.86; Stenhouse *et al.* 2004), and may experience high post-fledging mortality (Haney & MacDonald 1995). Like most gull species, the Ivory Gull displays delayed sexual maturity and is believed to breed for the first time when 2-3 years old, although data are lacking (Haney & MacDonald 1995). They also show a relatively low productivity rate, with a clutch size of normally 2 eggs, and sometimes 1 (more rarely 3), compared with the more usual 3-egg clutch seen in most other gulls.

In Canada, colony surveys indicate that Ivory Gull colonies fail to produce any young in some years due to intermittent breeding (see Table 1), and at Seymour Island, fox predation (MacDonald 1976). Human disturbance at breeding colonies may influence productivity, although this has not been documented (see Adaptability, above).

Illegal shooting

A recent analysis of Ivory Gulls banded in Canada indicates that they are still at considerable risk of mortality due to hunting (Stenhouse *et al.* 2004). Canadian Inuit are permitted to harvest Ivory Gulls throughout the year pursuant to their land claim agreements, but this is rarely done (Nunavut Harvest Study 2002). In contrast, residents of west Greenland apparently harvest Ivory Gulls regularly, particularly during spring and fall migration. It is also worth noting that 35 Ivory Gulls were easily purchased from hunters in 1984-1986 in Thule, Upernavik, and Uummanak regions of western Greenland with no advanced notice, as part of a contaminants study of Arctic seabirds (Nielsen & Dietz 1989). This is despite the fact that Ivory Gulls have been fully protected in Greenland since January 1st, 1978. At that time existing hunting regulations were changed so that a species without a specified open hunting season was fully protected by law (A. Mosbech, pers. comm.).

Of 1,526 bands placed on Ivory Gulls between 1971 and 1999 in Canada, 26 have been recovered (0.02, Stenhouse *et al.* 2004). Most of those recovered were shot in northwest Greenland ($n = 17$), while others were shot in Canada ($n = 5$), (Stenhouse *et al.* 2004).

These band recovery rates in west Greenland are comparable to those reported for legally harvested Thick-billed Murres and Common Eider Ducks. By comparison, an ongoing study of Northern Common Eider Ducks banded in Arctic Canada and recovered in west Greenland has provided a recovery rate of roughly 0.02 between 1996 and 2003 (50 recoveries/ 2,611; Gilchrist *et al.*, pers. comm.). A similar band recovery rate for Ivory Gulls suggests that harvest in west Greenland could have negatively affected Ivory Gulls breeding in Canada in the past, and that it may continue to do so (Stenhouse *et al.* 2004). Although new harvest regulations established in 2002 have apparently reduced harvest of murres and eiders in Greenland, they may have

had little direct influence on Ivory Gull harvest because Ivory Gulls were already fully protected under the law prior to that (i.e. 1978).

Predation

It is believed that Ivory Gulls nest in remote and inaccessible locations (often 20-30 km inland high on mountain peaks) to avoid avian and mammalian predation of their eggs and chicks (Haney & MacDonald 1995). The response of Ivory Gulls towards arctic foxes at colonies appears to be relatively weak, and certainly not as aggressive towards humans as other small to medium-sized gulls (see Stenhouse *et al.* 2004). Consequently, they appear vulnerable to factors that increase the number of predators near colonies.

Industrial activities

In general, Ivory Gulls are most vulnerable to direct human activities during breeding (*but see*, Oil Pollution and Toxics below). In Canada, colonies on Ellesmere and Devon Islands are rarely visited by people because they can only be accessed by helicopter and only during favourable weather conditions (Gilchrist & Mallory 2004). In fact, many of the colonies located in the 1980s and early 1990s were discovered by geologists conducting geological studies in the region (Frisch 1988), or by adventure skiers (France & Sharp 1992).

The colony on Seymour Island, just north of Bathurst Island, is protected as a Migratory Bird Sanctuary. Consequently, visits to the island by people are rare and require a permit from the Canadian Wildlife Service, Environment Canada. However, Seymour Island lies just south of the Sverdrup Basin, a marine area known to contain significant oil and gas reserves that may be exploited in the future.

In Canada, industrial activities pose the greatest threat to Ivory Gulls nesting on the Brodeur Peninsula, Baffin Island. There, intensive diamond exploration has been ongoing and escalating since 2002 (Fig. 6). Activities include the placement of fuel caches (>400 barrels annually), gravel landing sites for fixed-wing aircraft, seasonal camps, and one drilling site. Collectively, these activities must generate substantial helicopter and Twin Otter flying activity in the region during summer. The effects of these activities on nesting Ivory Gulls are unknown but should be investigated immediately.

In addition, industrial activities that establish long-term camps supporting workers often attract mammalian and avian predators to regions where they are typically absent. For example, the diamond mines established recently in the Northwest Territories are known to have attracted predatory birds (e.g. Black-billed Magpies, *Pica hudsonia*, Common Ravens) and mammals (red foxes) to the region where they were previously rare or entirely absent. These changes have occurred despite concerted efforts by industry to manage waste and potential food sources for wildlife (A. Armstrong, pers. comm., 2004). Thus, similar and ongoing industrial activities on the Brodeur Peninsula have the potential to attract large gulls, Common Ravens, arctic foxes, and polar bears

inland to the gravel limestone plateaus where Ivory Gulls nest (apparently to avoid them).

Research and monitoring activities

It is possible that annual visits to Ivory Gull colonies (although extremely brief; < 5 minutes in most cases) have resulted in recent colony abandonment or intermittent breeding at some sites in Canada (Table 1). The authors and several international researchers of Ivory Gulls consider this unlikely for the following reasons.

First, available information regarding the sensitivity of Ivory Gulls to helicopters is contradictory. Generally, it is considered to be sensitive to disturbance by air and ground traffic near breeding colonies (Haney & MacDonald 1995). However, this is based largely on a single source which reported that a single low-flying aircraft caused the complete abandonment of a colony (Cramp & Simmons 1983). Further research is required to determine whether this was an isolated incident or a common response by Ivory Gulls. In contrast to this single report, several independent observations by seabird researchers in Canada and Norway suggest that Ivory Gulls may be more tolerant of disturbance than many other seabirds (e.g. Sabine's Gulls and Arctic Terns). In each case, researchers from Norway and Canada flew over Ivory Gull colonies by helicopter, and then landed within 500-1,000 m of them. Ivory Gulls returned to their nests even before the rotors of the helicopters stopped, and most birds incubated quietly when human visitors sat within 3 m of their nests (A.J. Gaston, V. Baken, H. Strom, pers. comm., 2005). Collectively, these latter qualitative reports concur with the experience of S. MacDonald and 2 field assistants who lived on Seymour Island, Canada, while researching Ivory Gulls over 4 consecutive summers (S. MacDonald 1976, pers comm., 2004). Despite a research team living among them on an island only 900 m long, Ivory Gulls did not desert the colony due to human activities (S. MacDonald, pers. comm., 2005).

Second, the largest active colonies (and perhaps the least ephemeral) have supported breeding Ivory Gulls in consecutive years despite annual colony visits (Table 1).

Third, intermittent breeding in response to survey visits cannot explain the low numbers of Ivory Gulls detected in the first year of the survey (2002), nor the continued absence of nesting Ivory Gulls from several historical colonies (e.g. those on the Brodeur Peninsula and the Sydcap Glacier of Ellesmere Island which previously supported hundreds of birds), sites in which gulls have not experienced helicopter visits due to their complete absence.

Regardless, the response of Ivory Gulls to a single colony visit should be studied over the course of an entire breeding season (i.e. over several weeks), so that the influence of helicopter surveys (if any) can be quantified. If deleterious effects are detected, survey approaches in Canada and globally should be modified immediately and their effects on survey results considered.

Climate change

In arctic regions, considerable data now suggest that sea-surface temperatures are increasing, while sea-ice thickness and distribution are diminishing (e.g. Parkinson *et al.* 1999; Grumet *et al.* 2001). The distribution of sea-ice and the duration of the open water season are critically important to the annual cycle of Arctic marine wildlife (Stirling 1997), and thus changing sea-ice conditions are expected to have a variety of effects on marine birds and other biota. Indeed, several studies have found that reproduction of polar marine birds varies in response to annual ice conditions (e.g. Gaston and Hipfner 1998; Barbraud and Weimerskirch 2001; Jenouvrier *et al.* 2003, Gaston *et al.* 2005a, Gaston *et al.* 2005b).

Recent evidence also indicates that conditions on North Atlantic wintering grounds of Thick-billed Murres (*Uria lomvia*), which may be similar with that of the Ivory Gull, can influence the numbers of birds returning to breeding colonies synchronously, even though breeding colonies may be distant from each other and experience different climatic conditions during the breeding season (Gaston 2003). During the breeding season, marine birds should incur higher energetic costs in years with more extensive sea-ice due to higher commuting costs to and from the colony to feeding areas, and perhaps increased costs of finding food during less productive seasons (i.e. increased ice cover and reduced light penetration resulting in lower productivity in the marine zone; Welch *et al.* 1992).

Given the Ivory Gull's strong and year-round association with pack ice, it is possible that some large-scale ecological perturbation, such as a change in the extent or thickness of ice cover, has caused degradation of their foraging and wintering habitat in Baffin Bay and Davis Strait. However, no data exists to establish a causative relationship. Alternatively, depending on the pattern of ice cover loss, it may temporarily increase foraging habitat availability, especially early in the breeding season.

Contaminants

Given their position in marine food webs (i.e. ivory gulls feed at around trophic level 4 as determined by Fisk *et al.* (2001)), contaminants have been proposed as one stressor which could be affecting this species. Although levels of DDE, PCBs, oxychlordanes, dieldrin, heptachlor epoxide and 2,3,7,8-TCDD increased between 1976 and 1987 in eggs of Ivory Gulls collected from Seymour Island (Noble 1990; Elliott *et al.* 1992), data from 2004 (CWS, unpublished data) seem to indicate no significant changes or significant decreases (DDE, chlordanes) during 1976 to 2004. Current concentrations of the legacy organochlorines in Ivory Gulls from the Canadian Arctic (Buckman *et al.* 2004, CWS, unpublished data) do not appear to exceed toxicological threshold levels reported in the literature (Fisk *et al.* 2003).

Mercury concentrations in livers and kidneys of Ivory Gulls collected off the coast of western Greenland during 1984-86 (Nielsen and Dietz 1989) also did not exceed toxicological threshold levels reported in the literature (Thompson 1996).

Concentrations of total mercury in eggs of Ivory Gulls collected from Seymour Island in the western Canadian Arctic (CWS, unpublished data), however, have steadily increased between 1976 and 2004 to levels which are now among the highest measured in seabird eggs (see Barrett *et al.* 1996, Sydeman and Jarman 1998, Sanchez-Hernandez 2000, Thyen *et al.* 2000, Becker *et al.* 2001, Braune *et al.* 2002, Christopher *et al.* 2002, Cifuentes *et al.* 2003, Burger and Gochfeld 2004) as well as piscivorous avian species including raptors (see Elliott *et al.* 1996, 2000, Anthony *et al.* 1999, Wayland *et al.* 2000, Nygård and Gjershaug 2001, Scheuhammer *et al.* 2001, Bischoff *et al.* 2002). Based on a review of the literature, Thompson (1996) suggested that concentrations in eggs of 0.5 to 2.0 µg/g wet weight were sufficient to induce detrimental effects including impaired reproductive success in birds, although pelagic seabirds appear to have a higher tolerance to mercury. Five of the six Ivory Gull eggs collected in 2004 exceeded 0.5 µg/g wet weight and two out of the six eggs collected exceeded 2 µg/g wet weight (Braune *et al.*, unpublished data). This would suggest cause for concern and further investigation.

Oil pollution

Chronic oil pollution is a serious conservation concern in Atlantic Canada, where about 300,000 murrelets (mostly Thick-billed) and Dovekies (*Alle alle*) are estimated to be killed every winter (Wiese & Robertson 2004). Mortality estimates are not available for other species due to smaller numbers of corpses found and/or imprecise knowledge of their wintering range, but well over 20 species, including a number of gull species, have been found oiled on the beaches of Newfoundland (Piatt *et al.* 1985, Wiese & Ryan 2003).

Gulls are also considered to be highly vulnerable to oil pollution (Camphuysen 1998). Ivory Gulls, a species which is more pelagic than most other gull species, may be particularly vulnerable, although they tend to range farther north than most shipping lanes. Currently, incidences of oiled Ivory Gulls have not been noted, but given the offshore range of this species along eastern Canada, oiled Ivory Gulls would not be expected to reach land and/or be recovered. To summarize, the quantitative impact of oil pollution on Ivory Gulls wintering in Newfoundland and Labrador is not known, but there is every reason to believe that Ivory Gulls are at risk from oil pollution at sea.

SPECIAL SIGNIFICANCE OF THE SPECIES

Recent phylogenetic analysis based on mitochondrial DNA has provided strong evidence that the Ivory Gull is a sister taxon to the Sabine's Gull (*Xema sabini*; Crochet *et al.* 2000). These species are estimated to have diverged early, some 2 million years ago (compared with most other gull groupings, which are estimated to have diverged in the last million years), and differentiation between them is thought to have taken place within the Arctic (Crochet *et al.* 2000). Thus, the Ivory Gull is in a unique phylogenetic position because it is the sole member of its genus.

The existence of the Ivory Gull in Canada has no monetary value *per se*. Rather, its worth is principally derived from an aesthetic standpoint, and in its contribution to biodiversity.

The Ivory Gull was traditionally hunted for food in both breeding and wintering areas around the circumpolar Arctic. However, due to their relatively small numbers, unpredictable presence, and the remote nature of their colonies (particularly on Ellesmere and Devon Islands), harvest of this species was likely always opportunistic in nature and it is unlikely that Ivory Gulls ever provided a major food source for subsistence hunters (see Mallory *et al.* 2003). The Inuit regard this species with great affection, and appear to consider its decline in Canada as an ominous indicator of a greater systemic ill in the northern environment (see Mallory *et al.* 2003).

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The Ivory Gull was designated as a species of Special Concern in Canada (COSEWIC 2001), based on an update status report by Alvo and MacDonald (1995). The Ivory Gull is a non-game species, and as such is protected in North America under the *Migratory Birds Convention Act* (1994) and *Migratory Bird Regulations*.

It has been protected in West Greenland since 1977 under the local government order of 21st December on bird hunting in West Greenland (Landsraadsvedtaegt af 21. December 1977 om jagt paa fugle i Vestgroeland). In 1988, hunting regulations were revised and applied to all of Greenland, under the Greenland Home Rule order of 5 May 1988 on protection of birds in Greenland (Hjemmestyrets bekendtgoerelse af 5. May 1988 om fredning af fugle i Groenland; D. Boertmann, pers. comm.).

The Ivory Gull is on the Norwegian Red List, in the category DM, which stands for 'declining, monitoring' (Directorate for Nature Management 1999). In Svalbard, it has been protected since 1978, under the Svalbard Environmental Protection Act (H. Strøm, pers. comm.).

In Russia, it is registered as a Category 3 (Rare) species in the Red Data Book of the former USSR (Haney 1993).

TECHNICAL SUMMARY

Pagophila eburnea

Ivory Gull
NU, NL, NT

Mouette blanche

Extent and Area information	
<ul style="list-style-type: none"> • <i>extent of occurrence (EO)(km²)</i> Calculated by including approximate areas of all colony locations (whether active or not) using GIS mapping software. 	TOTAL ~ 350000 km ²
<ul style="list-style-type: none"> • <i>specify trend (decline, stable, increasing, unknown)</i> 	Decline
<ul style="list-style-type: none"> • <i>are there extreme fluctuations in EO (> 1 order of magnitude)?</i> 	No
<ul style="list-style-type: none"> • <i>area of occupancy (AO) (km²)</i> Calculated by selecting all colonies and a 50-km radius "buffer zone" around each using GIS mapping software. 	TOTAL ~ 52000 km ²
<ul style="list-style-type: none"> • <i>specify trend (decline, stable, increasing, unknown)</i> 	Decline
<ul style="list-style-type: none"> • <i>are there extreme fluctuations in AO (> 1 order magnitude)?</i> 	No
<ul style="list-style-type: none"> • <i>number of extant locations</i> Based upon aerial surveys 2002-2005 	Total of 28 (2002-2005); 14 intermittently and 14 annually
<ul style="list-style-type: none"> • <i>specify trend in # locations (decline, stable, increasing, unknown)</i> 	Decline
<ul style="list-style-type: none"> • <i>are there extreme fluctuations in # locations (>1 order of magnitude)?</i> 	Unknown
<ul style="list-style-type: none"> • <i>habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat</i> 	Unknown. Quality likely declining on Baffin Island due to industrial mining exploration activity.
Population Information	
<ul style="list-style-type: none"> • <i>generation time (average age of parents in the population) (indicate years, months, days, etc.)</i> 	Ca. 7 years (adults can live 20 years)
<ul style="list-style-type: none"> • <i>number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)</i> 	Estimated 500-700, assuming some adult birds not detected by surveys (i.e. at sea). Number of gulls detected annually at extant colonies over four consecutive years: 88, 319, 305, and 210.
<ul style="list-style-type: none"> • <i>total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals</i> 	Decline, magnitude uncertain.
<ul style="list-style-type: none"> • <i>if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)</i> 	Decline of 80% in last 18 years based upon comparisons with historical published estimates, and recent survey results (2002-2005). Decline of 62% expected over next 10 years, based upon recent published trends
<ul style="list-style-type: none"> • <i>are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?</i> 	No, although the number of gulls breeding at colonies can vary considerably by year.
<ul style="list-style-type: none"> • <i>is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., < 1 successful migrant / year)?</i> 	Probably not, though no interchange has been detected between colonies despite banding efforts.

• <i>list each population and the number of mature individuals in each</i>	
• <i>specify trend in number of populations (decline, stable, increasing, unknown)</i>	
• <i>are there extreme fluctuations in number of populations (>1 order of magnitude)?</i>	Unknown
Threats (actual or imminent threats to populations or habitats in order of threat)	Contaminants, hunting, disturbance caused by accelerating mining activity in one breeding area, climate change.
Rescue Effect (immigration from an outside source)	
• <i>does species exist elsewhere (in Canada or outside)?</i>	Yes, outside Canada
• <i>status of the outside population(s)?</i>	Unknown, but thought to be in decline based upon published reports.
• <i>is immigration known or possible?</i>	Possible
• <i>would immigrants be adapted to survive here?</i>	Yes
• <i>is there sufficient habitat for immigrants here?</i>	Yes
Current Status COSEWIC: Endangered (2006) Special Concern (2001)	

Status and Reasons for Designation

Status: ENDANGERED	Alpha-numeric code: A2a, C1
<p>Reasons for Designation: Aboriginal Traditional Knowledge and intensive breeding colony surveys over the last four years indicate that the Canadian breeding population of this long-lived seabird has declined by 80% over the last 20 years. This bird feeds along ice-edge habitats in the high Arctic and breeds in very remote locations. Threats include contaminants in food chain, continued hunting in Greenland, possible disturbance by mineral exploration at some breeding locations, and degradation of ice-related foraging habitats as a result of climate change.</p>	
Applicability of Criteria	
<p>Criterion A: (Declining Total Population): Meets Endangered A2a because of observed declines in breeding population (80% in 3 generations)</p> <p>Criterion B: (Small Distribution, and Decline or Fluctuation): Not applicable (population not known to be fragmented, no extreme fluctuations in population).</p> <p>Criterion C: (Small Total Population Size and Decline): Meets Endangered C1 because of small population (<2500 mature individuals) and projected decline of 64% over next 10 years.</p> <p>Criterion D: (Very Small Population or Restricted Distribution): Meets Threatened D1 because of small population (<1000 individuals)</p> <p>Criterion E: (Quantitative Analysis): not done</p>	

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