




CANADA'S ARCTIC MARINE ATLAS

This Atlas is funded in part by the Gordon and Betty Moore Foundation.

Suggested Citation:
Oceans North Conservation Society, World Wildlife Fund Canada, and Ducks Unlimited Canada. (2018). *Canada's Arctic Marine Atlas.* Ottawa, Ontario: Oceans North Conservation Society.

Cover image: *Shaded Relief Map of Canada's Arctic* by Jeremy Davies
Inside cover: Topographic relief of the Canadian Arctic

ISBN: 978-1-7752749-0-2 (print version)
ISBN: 978-1-7752749-1-9 (digital version)
Library and Archives Canada

Printed in Canada, February 2018
100% Carbon Neutral Print by Hemlock Printers

COASTAL AND MARINE BIRDS OF THE ARCTIC

COASTAL & MARINE BIRDS
- Geese
- Sea Ducks
- Loons
- Seabirds
- Shorebirds

Ecological significance

Marine birds are found around the globe, from the poles to the tropics, where they live at the interface between air, land, sea, and ice. The harsh conditions that marine birds find in these environments have caused unique adaptations in their physiology and morphology and require enormous flexibility in life-history strategies. Despite the diversity of their diets, marine birds are generally top consumers in marine food webs. They are useful and effective indicators of Arctic marine ecosystem health—revealing shifts in marine food webs, changes in prey distributions, and the accumulation of contaminants—they play an increasingly important role in the assessments of marine health, habitat conservation, and marine spatial planning exercises.

Cultural significance

In general, birds have a broad cultural significance in the Arctic, often considered important harbingers of spring, and are heavily featured in Indigenous folklore and arts. Migratory birds also offer a fresh source of meat and eggs after a long, harsh northern winter, and the skins, bones, and down of marine birds are also used in clothing, as tools, and for ceremonial purposes. The subsistence harvest of marine birds and their eggs has deep roots in the Canadian Arctic, being a long-standing tradition by both Indigenous peoples and European settlers. These days, most marine bird species are protected from harvest by non-Indigenous hunters across Canada, except for a few waterfowl species (eiders, scoters) and murres specifically in Newfoundland and Labrador. Indigenous hunters harvest coastal and marine birds and their eggs wherever they are available, but most often in and around communities located close to large seabird colonies.

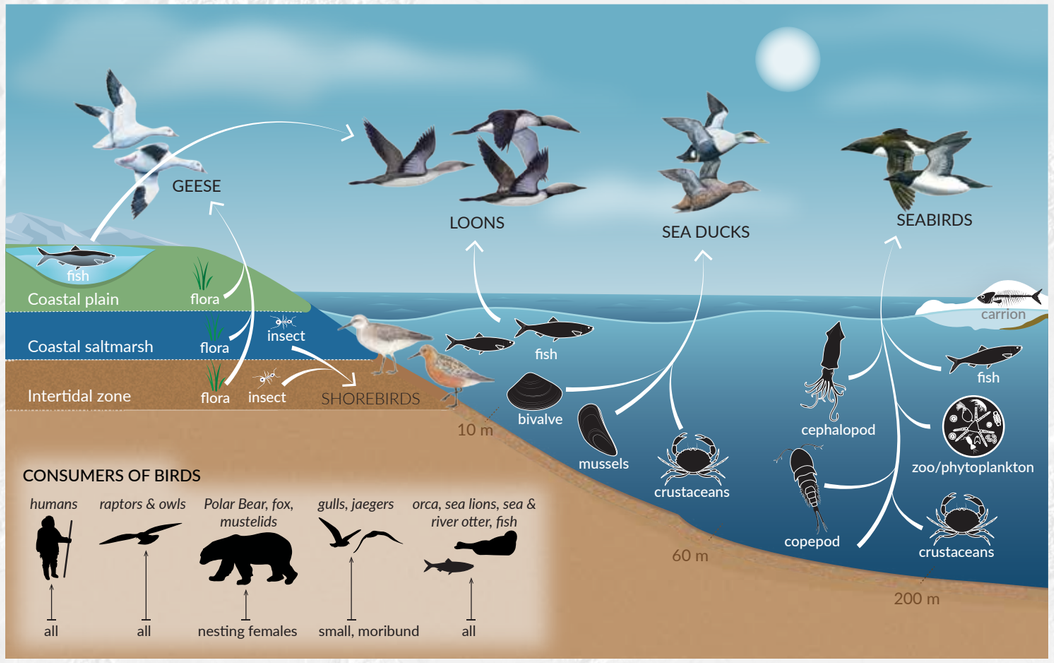
Conservation concerns

Many marine bird species are considered threatened or endangered at both global and continental scales. In fact, marine birds are more threatened globally than are other groups of birds, and their status has deteriorated faster over recent decades. Some of the evolutionary traits that make marine birds well suited to harsh environments also make them vulnerable to extinction.

Around the world, marine birds face multiple ecological and environmental stressors, including habitat loss and alteration, disturbance, hunting, interactions with commercial fisheries, oil spills, persistent pollutants, ocean acidification, and other issues associated with climate change. Many of these pressures are currently evident across the Arctic region.

Ivory Gull on an ice floe edge. (photo: Roberta Olenick)

ARCTIC BIRDS SIMPLIFIED FOOD WEB



This simplified food web shows the movement of energy through key Arctic coastal and marine bird species. The overlapping network of food chains shows how each species is interconnected.

Major concerns

With climate change influencing the Arctic faster than any other region of the globe, rapid changes are affecting Arctic-breeding birds in a number of ways, including the degradation or loss of specific habitats, mismatches in breeding or staging with the timing and availability of ephemeral food resources, and increased occurrence of extreme weather conditions. The associated drastic long-term decline in the extent of annual sea ice may allow year-round shipping and an increase in industrial development for natural resource extraction. Developments of this kind can exacerbate the direct impact of climate change on marine birds, by increasing environmental disturbance, habitat loss, pollution, and other problems.

Gaps in current knowledge

Evaluating the conservation status and trends of bird populations is difficult at the best of times, but gathering reliable data on the abundance and distribution of marine birds at sea is an enormously challenging exercise, especially across an area as vast and remote as the Canadian Arctic. More studies using remote tracking methods, including drones, to follow local foraging movements as well as annual migrations of marine birds around or to and from the Arctic are essential to filling this critical information gap and in identifying important breeding, foraging, and stopover areas, as well as migration corridors and flyways.

Rationale for selected species

Seven distinct marine bird species or species groups are highlighted in this section. These species/groups were specifically selected based on a number of important factors, including their cultural, ecological, and conservation significance, as well as the availability of recent and reliable spatial data for the Arctic region. These species also span a broad range of trophic levels, including herbivores (geese), invertivores (shorebirds), benthivores (eiders, scoters), planktivores (Long-Tailed Duck, Northern Fulmar), piscivores (loons, murres), and scavengers (Ivory Gull).

For further reading, see p. 108.

Left to right: Eider ducklings hatching; Common Eider ducks diving for food. (photos: Joel Heath)

Designated Sites

Coastal and marine Key Habitat Sites and Important Bird Areas in Canada's Arctic

Ross's Goose

These designated sites are Key Habitat Sites and Important Bird Areas that host important aggregations of birds or which support at least 1% of the Canadian population of the species. They may be sites used for colonies, nesting, feeding, brood rearing, molting, staging, migration, or wintering.

Legend

Designated Sites: Key Habitat Sites and Important Bird Areas

DATA SOURCES

- *Key Habitat Sites: Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service. http://publications.gc.ca/collections/collection_2009/ec/CW69-1-114-1E.pdf; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service. http://publications.gc.ca/collections/collection_2011/ec/CW69-1-109-eng.pdf*
- *Important Bird Areas: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

ARCTIC-BREEDING GEESE

Snow Goose, Ross's Goose, and Brant

Natural history

The three species included here all breed exclusively in the Arctic. Two subspecies of Snow Goose are recognized in North America—the mid-continent and western populations, known as the Lesser Snow Goose *(Chen caerulescens)*, and the eastern population, known as the Greater Snow Goose *(Chen atlantica)*. Both Snow Geese and Ross's Geese have two colour morphs: the more common white morph and the less common blue morph. Blue morph Ross's Geese are rare and thought to be the result of hybridization with blue morph Snow Geese. Two subspecies of Brant are also present in North America—the eastern population, known as the Atlantic Brant *(Branta hrota)*, and western population, known as the Black Brant *(Branta nigricans)*.

All three goose species have similar behavioural and ecological traits. All are rapidly maturing (two to four years), large-bodied birds with relatively high reproductive rates and low juvenile survival. In Canada, all three species nest in coastal tundra habitats. Brant are more coastal throughout the year compared to the other two species. Brant nest in saltmarshes and around coastal ponds, estuarine deltas, and braided river valleys, and they winter near intertidal mudflats with extensive eelgrass beds. Snow and Ross's Geese typically nest further from the coast in drier tundra areas and sedge meadows. Historically, Snow and Ross's Geese wintered in coastal marshes, but in the mid-1950s their winter distribution shifted to open agricultural habitats in the southern and central US in response to changing cultivation practices. All three species are all highly gregarious throughout the year. Snow and Ross's Geese nest together in extremely large, dense colonies, and form massive aggregations outside of the breeding season.

Distribution

All three species of geese are broadly distributed across the Canadian Arctic during the breeding season with the exception of Ross's Geese, which are concentrated in the Queen Maud Gulf region. Snow and Ross's Geese use all four continental flyways during migration and are broadly distributed across the US and Mexico during winter months. The winter distribution of Brant is divided between the Pacific and Atlantic coasts of North America. Prior to fall migration, all three species of geese use specific post-breeding sites to moult their wing and body feathers, during which individuals are flightless for several weeks. Snow Geese and Brant also use specific stopover sites during migration, with large numbers of individuals stopping in Hudson Bay and James Bay in spring and fall.

Importance to Inuit

Geese in general are an important part of Inuit subsistence harvesting across the Canadian Arctic, and

Snow Goose *(C. caerulecens)*

Ross's Goose *(C. rossii)*

Brant *(B. bernicla)*

Table 1: The global and national conservation status and continental conservation needs of selected geese.

	Snow Goose (*C. caerulecens*)	Ross's Goose (*C. rossii*)	Brant (*B. bernicla*)
Global Conservation Status[1]	LEAST CONCERN	LEAST CONCERN	LEAST CONCERN
Continental Conservation Needs[2]	ABOVE OBJECTIVE	ABOVE OBJECTIVE	HIGH (ATLANTIC – MODERATELY LOW)
Canada Conservation Status (wildspecies)[3]	SECURE	SECURE	SECURE

[1]IUCN 2015, [2]North American Waterfowl Management Plan 2004, [3]CESCC 2011.

Snow goose pair stand near chicks in the nest. (photo: Sergey Gorshkov)

Snow, Ross's, and Brant Geese are harvested where they are locally available. Adult birds are hunted for meat, eggs are collected for food in early summer, and goose down is used as insulation in winter clothing. All three goose species are also targeted by sport hunters across North America. Sport hunting harvest pressure varies by species and location, and has varied over time. Annual regulations are intended to maintain populations at target levels described in the North American Waterfowl Management Plan 2012.

Conservation concerns

None of these three goose species are considered to be of conservation concern at the global or continental level (see Table). Snow Goose and Ross's Goose numbers have increased dramatically since the 1960s in response to improved winter forage and reduced hunting pressure. Collectively, these "light" geese are now considered overabundant and a management concern because of the extensive and prolonged habitat degradation they can cause. An expanded harvest season and increased bag limits were recently introduced to reduce numbers of light geese, which have been effective for the eastern population, but the mid-continent population has continued to expand. Numbers of Brant have declined since broad-scale winter surveys were initiated in the 1960s. Currently, winter populations appear stable or gradually increasing, whereas some breeding populations have declined or fluctuate markedly perhaps, in part, because sport hunting appears to affect annual mortality.

There are numerous impacts to these geese on their Arctic breeding grounds, including degradation of Snow and Ross's Goose breeding habitats due to overpopulation, and a mismatch in breeding phenology (seasonal cycles) and high-quality forage due to the earlier arrival of breeders. Predation on tundra-breeding birds, including geese, can be extreme in years following lemming population crashes when predators, particularly Arctic Foxes, switch to alternative prey sources. Rates of Polar Bear nest predation have also increased in response to a longer ice-free summer and more time being spent on land. Lead poisoning can also be an issue for many waterbirds. Although lead shot was banned for waterfowl hunting in 1999, geese and other waterbirds can still ingest old, spent lead shot while foraging.

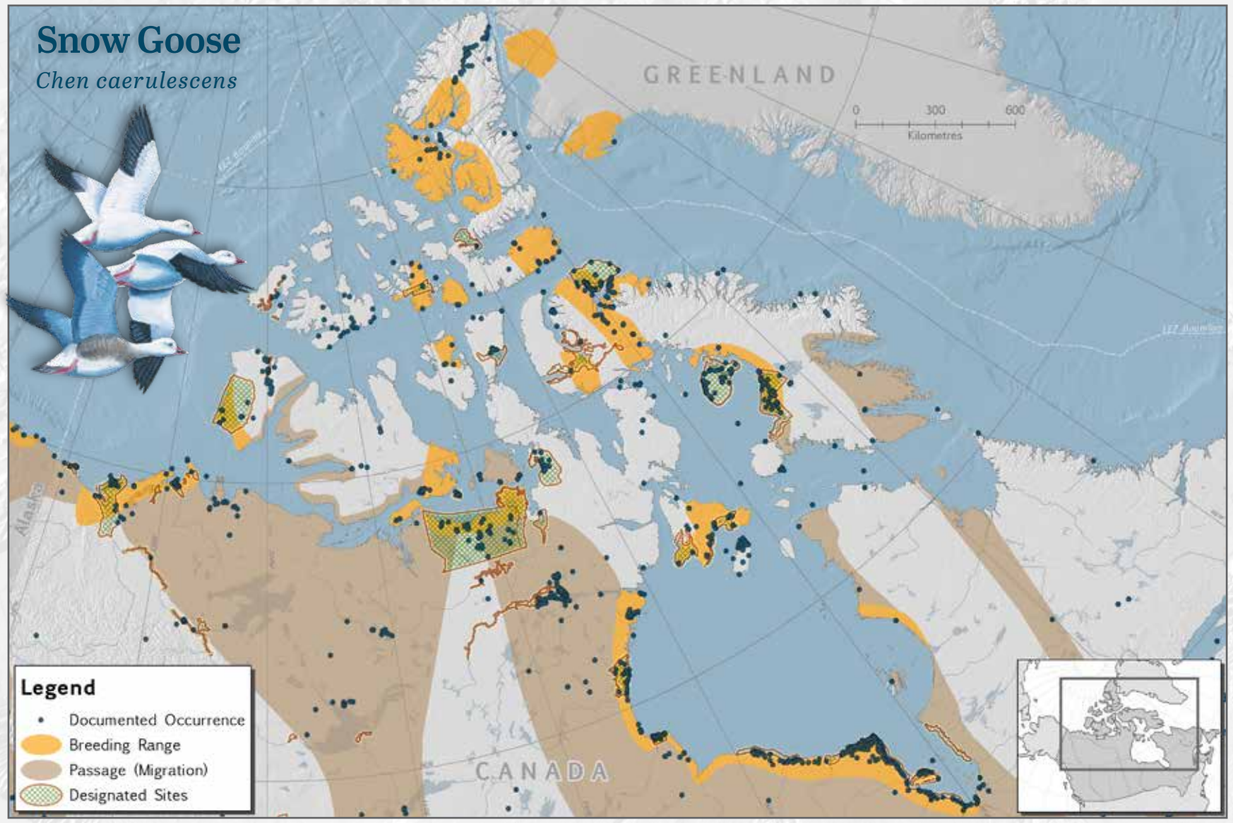
Gaps in current knowledge

Arctic geese, and Snow Geese in particular, are well studied compared to other Arctic-breeding birds. However, knowledge gaps important to conserving Arctic habitats do remain. Chief among these gaps are the long-term impacts of overabundant light geese on tundra ecosystems and whether vegetation recovery rates and trajectories will limit local habitat availability or suitability for geese and other species in the future. Factors supporting overpopulation, estimates of carrying capacity, and potential limiting factors also require further study. Because hunting regulations do not distinguish between Snow and Ross's Geese, continued on-the-ground monitoring is needed to ensure one species is not disproportionately impacted by the expanded harvest. For Brant, discrepancies between local breeding population trends and population estimates from annual mid-winter surveys need to be resolved to prevent local extirpations. Additional demographic and ecological information is also needed from a greater number of colonies across the breeding range. Additional information is also needed on threats to migration and wintering habitats, and on linkages between wintering and Arctic breeding areas and the potential for cross-seasonal effects on demography.

Harvesting goose and Brant eggs. (photo: Trevor Taylor)

Snow Goose

Chen caerulescens

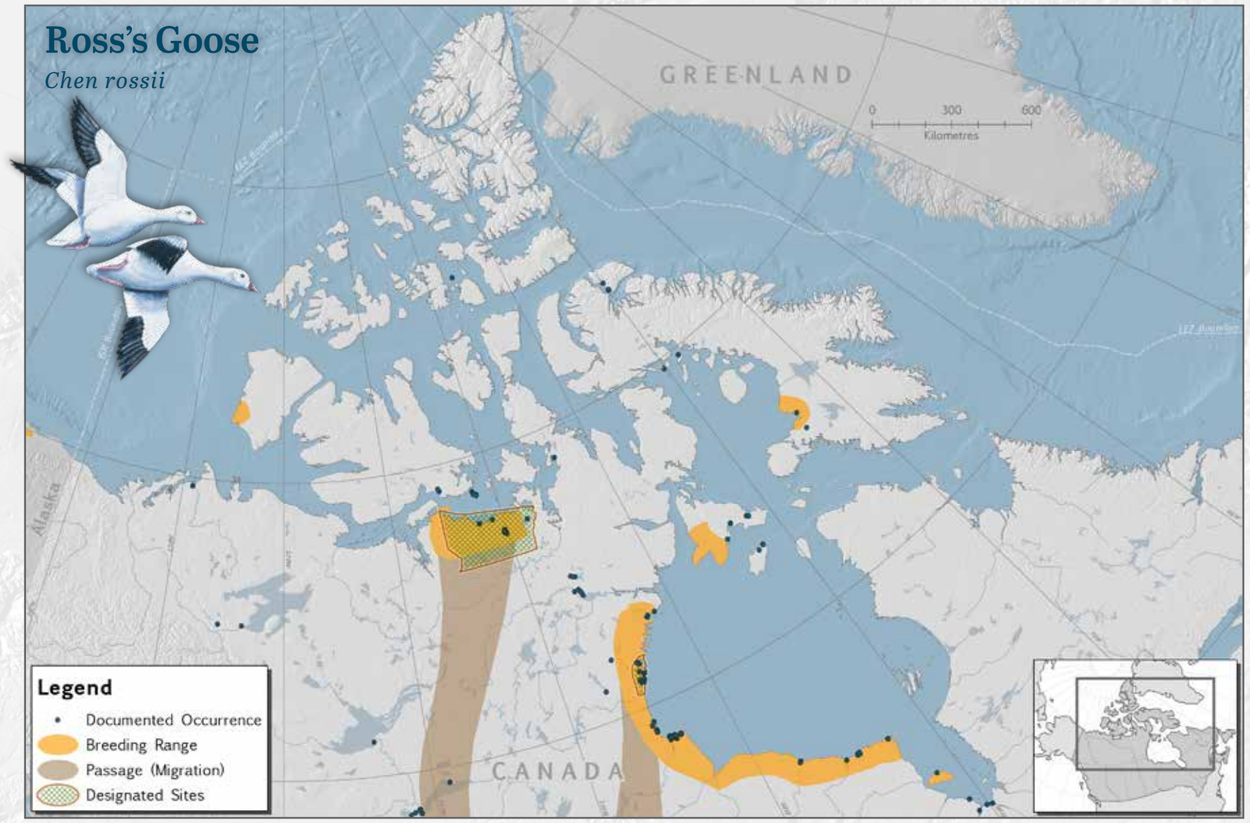


SNOW GOOSE DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Accessed: 17/02/2016. http://www.iobis.org; GBIF (Global Biodiversity Information Facility) (2016). Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

Ross's Goose

Chen rossii

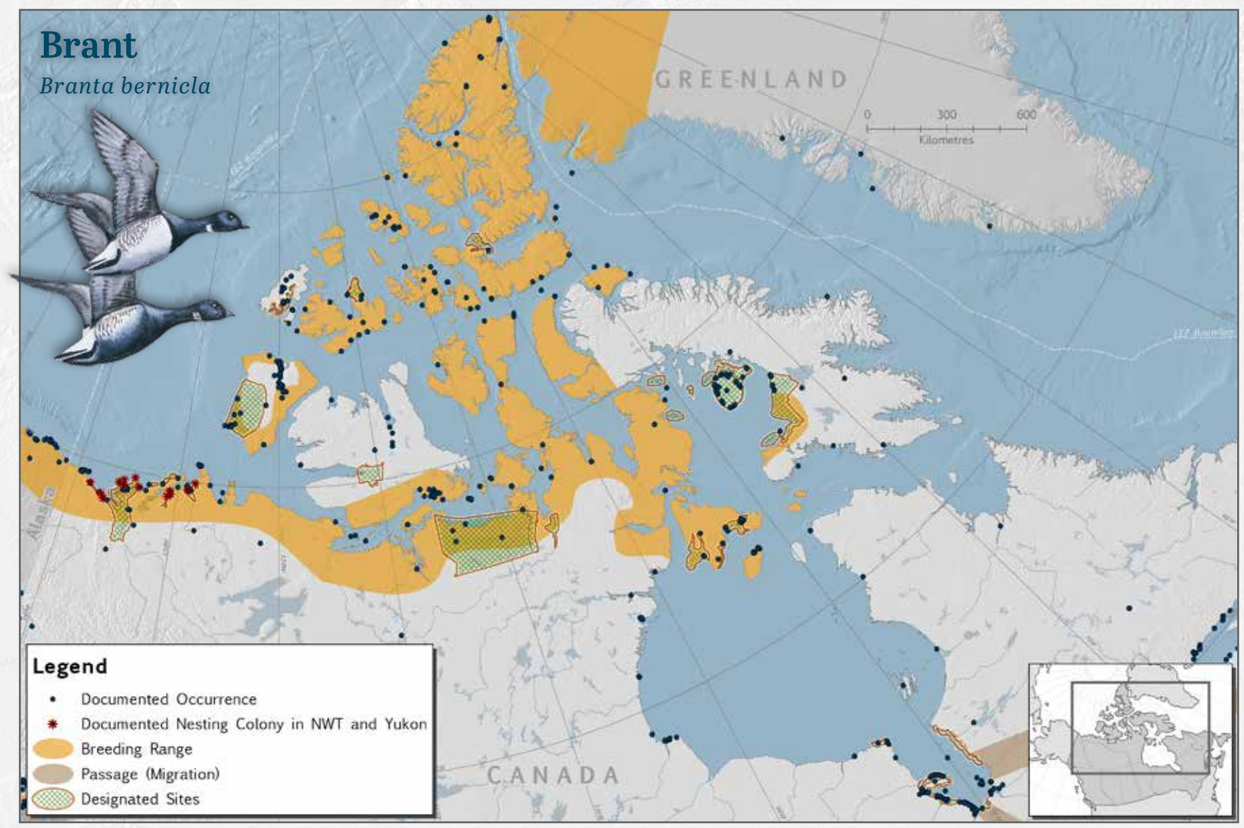


ROSS'S GOOSE DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Accessed: 17/02/2016. http://www.iobis.org; GBIF (Global Biodiversity Information Facility) (2016). Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

Brant

Branta bernicla



BRANT DATA SOURCES

- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al (2008). Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

The occurrence points on these maps show the location of captured specimens from historical museum records, literature records, and in-field surveys. Areas of sparse points may reflect either a lack of data or an absence of birds. Designated Sites are important bird areas and key habitat sites; these are recognized areas that support larger numbers of individuals of one or more species during one or more periods of the year and can include aggregation areas, colonies, nesting, feeding, brood rearing, molting, staging, migration or wintering.

ARCTIC-BREEDING SEA DUCKS—1

Common Eider, King Eider, and Long-tailed Duck

Natural history

There are 15 species of sea ducks in North America. This includes three Arctic-breeding subspecies of Common Eider *(Somateria mollissima)*—the Northern race *(Somateria borealis)*, the Hudson Bay race *(Somateria sedentaria)*, and the Pacific race *(Somateria v-nigra)*. The Common Eider is the largest duck in North America, more than twice the size of the Long-tailed Duck *(Clangula hyemalis)*. The King Eider *(S. spectabilis)* is approximately halfway between the other two species in body size. This range of body sizes corresponds to their range of life-history strategies. On average, Common Eiders live approximate twice as long as Long-tailed Ducks (7.4 years vs. 3.1 years), take longer to achieve sexual maturity (three vs. two years of age), and lay fewer eggs per clutch (three to five vs. seven to eight). Information on juvenile survival is limited, but is generally assumed to be low for all three species.

These three species have relatively similar behavioural and ecological traits. All have circumpolar breeding distributions and are widespread across Arctic and sub-Arctic coastal and marine habitats in Canada during the breeding period. Each is highly gregarious in winter, often forming mixed flocks, but they vary in their degree of sociality during the breeding season. Common Eiders nest in dense colonies, mostly on small marine islands, and form large aggregations in inshore bays or polynyas (open water enclosed by sea ice) outside of the breeding season. This colonial habit means Common Eiders are relatively easy to monitor during the breeding season. King Eiders are loosely colonial and may nest among Common Eiders, in small groups of themselves on islands, or widely dispersed across coastal tundra. Long-tailed Ducks occasionally nest in small loose clusters, but more often they are widely dispersed or solitary nesters among small ponds in coastal wetland areas. Because King Eiders and Long-tailed Ducks are more dispersed and, subsequently, more difficult to locate and to monitor during the breeding season, population sizes are estimated from wintering surveys.

Distribution

All three species divide between Pacific and Atlantic coastal waters during winter months. On the west coast, Common Eiders winter in southern Alaska and around the Aleutian Islands. On the east coast, they winter in coastal areas of Atlantic Canada and the north-eastern United States as far south as Chesapeake Bay, and along the southern coast of Greenland. The Hudson Bay population *(sedentaria)* winters in marine waters around the Belcher Islands in southeastern Hudson Bay. King Eiders and Long-tailed Ducks have a winter range similar to Common Eiders. King Eiders are more likely to use areas further offshore, and Long-tailed Ducks extend considerably further south on the Pacific coast, as far as northern Oregon. Long-tailed Ducks also regularly winter in all five Great Lakes, and are often found in large concentrations (tens to hundreds of thousands) in coastal waters of the mid-Atlantic region of the US.

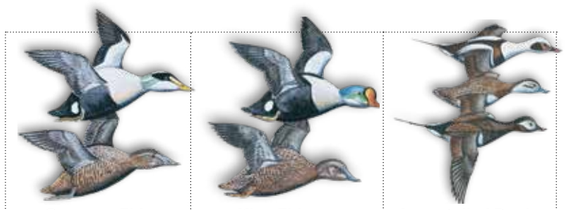


Table 1: The global and national conservation status and continental conservation priority of selected sea ducks.

	Common Eider *(S. mollissima)*	King Eider *(S. spectabilis)*	Long-tailed Duck *(C. hyemalis)*
Global Conservation Status[1]	NEAR THREATENED	LEAST THREATENED	VULNERABLE
Continental Conservation Needs[2]	HIGH	MODERATELY HIGH	MODERATELY HIGH
Canada Conservation Status (wildspecies)[3]	SECURE	SENSITIVE	SECURE

[1]IUCN 2015, [2]North American Waterfowl Management Plan 2004, [3]CESCC 2011.

A female Common Eider feeding on urchins and bivalves beneath sea ice. (photo: Joel Heath)

Common and King Eiders feed largely on benthic (bottom-dwelling) invertebrates year-round, such as mussels and urchins, but may also take other aquatic invertebrates. King Eiders will also forage on plant material in breeding areas. Long-tailed Ducks have a more varied diet, including larval and adult insects and crustaceans. In all three, incubating females rely on internal resources during incubation, only leaving their nest occasionally to drink.

Importance to Inuit

Sea ducks, particularly eiders, are heavily harvested for subsistence purposes across the Canadian Arctic; their eggs are collected for food in early summer, and their nest down is collected commercially in some areas. Common Eiders are the most commonly hunted marine bird in Nunavut, with some Inuit communities relying heavily on this species for much of the year (e.g., Sanikiluaq, in the Belcher Islands). Eider harvests are assessed annually in harvest survey questionnaires. These either are mailed to recreational hunters with their permits (although this method captures only a portion of the harvest because Indigenous residents are not required to purchase a permit) or are voluntary community-based efforts. Eiders are also hunted for sport in Atlantic Canada and New England, and Canadian Arctic breeders are also heavily hunted for subsistence in Greenland.

Conservation concerns

Of these three species, the Common Eider is listed as the highest conservation concern globally ("near threatened"; see Table) and is the highest conservation priority continentally ("high"). In Canada, King Eiders are considered "*sensitive*" whereas Common Eiders and Long-tailed Ducks are considered Secure.

Threats to sea ducks on their Arctic breeding grounds are many, including high levels of predation on eggs and young, subsistence harvest, and degradation of breeding habitat from mining and oil and gas exploration and development. Contaminants are a major issue for sea ducks globally, with these species generally having elevated levels of heavy metals that are likely picked up on their wintering grounds. Outbreaks of infectious diseases have been observed in the southern ranges of these sea ducks, which lead to major, episodic winter die-offs. Avian cholera has also recently affected Common Eiders breeding in the Arctic, where it has had a devastating effect in some colonies. In their wintering areas, the major issues likely vary for each species, but include exposure to contaminants, marine pollution (oil spills), and offshore development. Traditional knowledge has also identified declines in the resident Common Eider population in Hudson Bay, which was later verified by surveys during the breeding period. Causes for the decline are unknown but are suspected to be driven by changes in wintering sea ice conditions, linked, in part, to hydroelectric development on the coast.

Common Eider eggs in a down nest. (photo: Sheila Enfield)

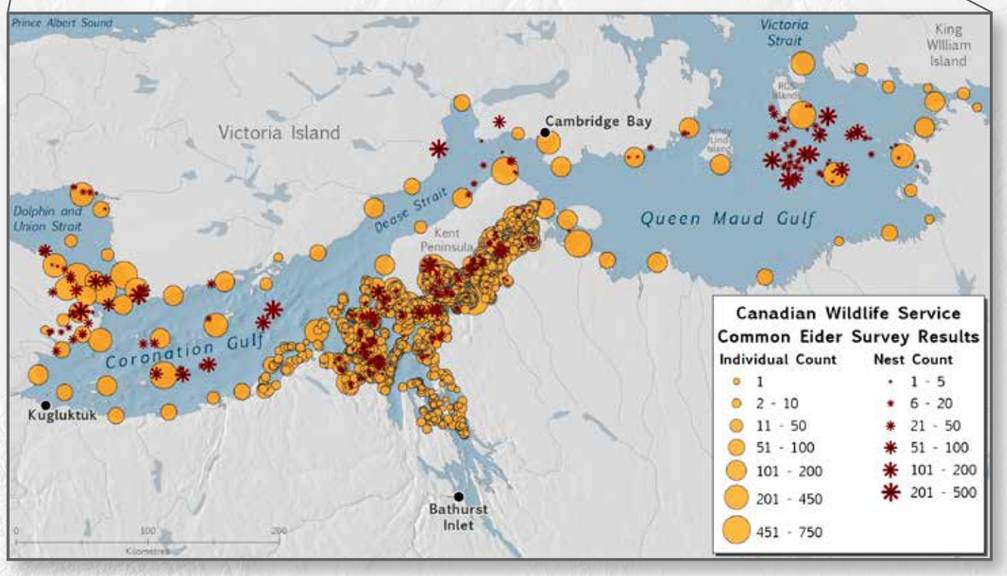
Gaps in current knowledge

In general, the largest unknowns for these three sea ducks are the potential impacts of climate change, which may exacerbate existing threats. There are still considerable gaps in knowledge of demographics and aspects of habitat use, such as brood-rearing areas.

Common Eider

Somateria mollissima

The occurrence points on these maps show the location of captured specimens from historical museum records, literature records, and in-field surveys. Areas of sparse points may reflect either a lack of data or an absence of birds. Designated Sites are important bird areas and key habitat sites; these are recognized areas that support larger numbers of individuals of one or more species during one or more periods of the year and can include aggregation areas, colonies, nesting, feeding, brood rearing, molting, staging, migration or wintering.



COMMON EIDER DATA SOURCES - KITIKMEOT

- *Environment and Climate Change Canada – Canadian Wildlife Service. 2008. Common Eider Survey Data: 1995, 2006, 2007, 2008.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

COMMON EIDER DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Accessed: 17/02/2016. http://www.iobis.org; GBIF (Global Biodiversity Information Facility). 2016. Retrieved from: http://www.gbif.org/*
- *Colony Data: Alexander et al. 1988; Alexander and Hawkings, 1988; Cornish and Dickson, 1997; Environment and Climate Change Canada. 2016. Common Eider Surveys, 1965-2016; Falardeau, FG., Rail, J.-F., Savard, J.-P.L. 2003. Breeding survey of Common Eiders along the west coast of Ungava Bay, in summer 2000, and a supplement on other nesting aquatic birds. Canadian Wildlife Service, Quebec Region; Johnson and Ward, 1985; Kay et al., 2006; Ward, 1979.*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

KING EIDER DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Accessed: 17/02/2016. http://www.iobis.org; GBIF (Global Biodiversity Information Facility). 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

LONG-TAILED DUCK DATA SOURCES

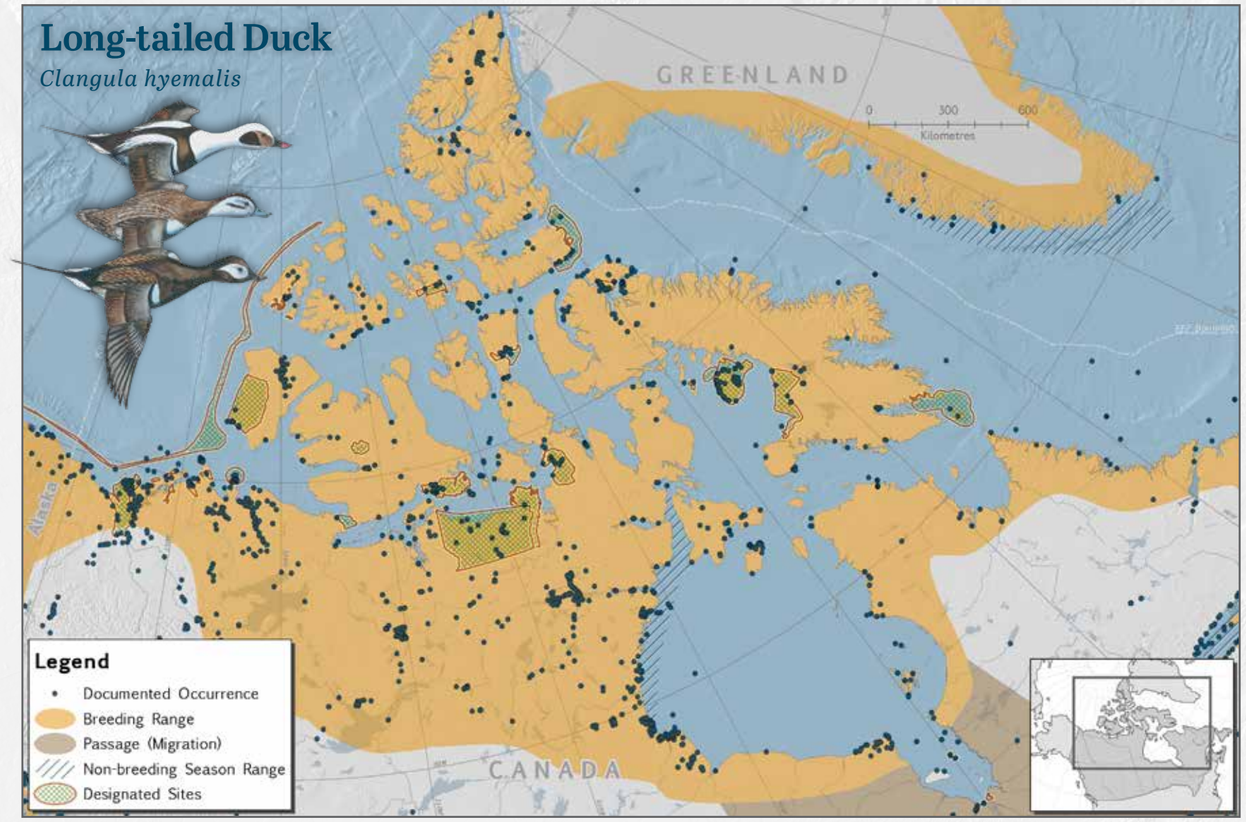
- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Accessed: 17/02/2016. http://www.iobis.org; GBIF (Global Biodiversity Information Facility) 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al (2008). Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

King Eider

Somateria spectabilis

Long-tailed Duck

Clangula hyemalis



ARCTIC-BREEDING SEA DUCKS—2

White-winged Scoter, Surf Scoter, and Black Scoter

Natural history

There are four species of scoter in the world, three of which breed in Canada's sub-Arctic and Arctic regions. Scoters are distinctive, heavy-bodied sea ducks. White-winged Scoters *(Melanitta fusca)* are the largest, with males weighing up to 2 kg. Black Scoters *(M. americana)* are approximately half the size of White-winged Scoters, and Surf Scoters *(M. perspicillata)* are intermediate in size. Scoters begin breeding at two years of age, and lay eight to nine eggs per clutch. Information on adult survival is limited, but is generally assumed to be relatively high (10 or more years) for all three species.

Scoters have similar behavioural and ecological traits, and all are relatively widespread across sub-Arctic and lower Arctic Canada during the breeding period. White-winged Scoters have a circumpolar breeding distribution and, in North America, breed in prairie regions of central Canada and interior British Columbia. Surf Scoters are confined to North America during breeding, although stray birds are fairly common in northwest Europe. The Black Scoter has recently been split form the Common Scoter (*M. nigra*) in Europe; its breeding range is also largely confined to North America with a small population in eastern Russia. Black Scoters are commonly thought to breed in two distinct populations. The eastern population extends from western Hudson Bay to Labrador with the majority of the population concentrated in northern Quebec. The western population extends west from the Mackenzie Delta in the Northwest Territories, through coastal and parts of central Alaska. More recent telemetry and survey data indicate the breeding range of Black Scoters also includes tundra habitats west of Hudson Bay, suggesting eastern and western breeding populations may not be disjunct. Scoters are highly gregarious in winter, often forming large mixed flocks, but they vary in their degree of sociality during the breeding season. White-winged Scoters can nest in relatively high densities, mostly on small islands, and sometimes among nesting gulls and terns. Surf and Black Scoters are more dispersed during breeding and nest solitarily close to ponds and wetlands.

Distribution

All three scoter species divide between east and west coastal waters of North America during winter months, with eastern breeders migrating to the Atlantic coast and western breeders migrating to the Pacific coast. On the Pacific coast, all three species range from the Aleutian Islands to as far south as the Baja California peninsula. On the Atlantic coast, all three species of scoters range from Atlantic Canada south to the Gulf of Mexico, with small numbers remaining on the Great Lakes each year. Scoters often winter in large concentrations, sometimes in mixed-species flocks. In coastal waters of the mid-Atlantic region of the US, for example, they often form flocks of tens of thousands of birds, particularly in and around Chesapeake Bay. The largest aggregations tend to be found in areas with the highest density and biomass of benthic prey (macroinvertebrates).

Table 1: The global and national conservation status and continental conservation priority of scoters.

	White-winged Scoter *(M. fusca)*	Surf Scoter *(M. perspicillata)*	Black Scoter *(M. americana)*
Global Conservation Status[1]	LEAST CONCERN	LEAST CONCERN	NEAR THREATENED
Continental Conservation Needs[2]	MODERATELY HIGH	MODERATELY HIGH	MODERATELY HIGH
Canada Conservation Status (wildspecies)[3]	SECURE	SECURE	SECURE

[1]IUCN 2015, [2]North American Waterfowl Management Plan 2004, [3]CESCC 2011.

A large raft of Surf Scoters. (photo: Paul Colangelo)

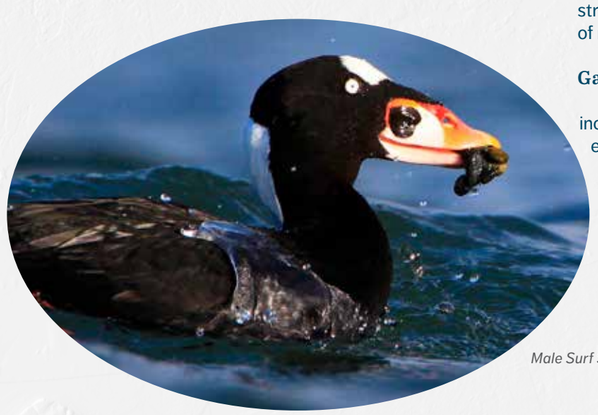
Importance to Inuit

Like other sea ducks, scoters are harvested for subsistence purposes across the Canadian Arctic, and their eggs are occasionally collected for food in early summer. The non-breeding sport harvest is much larger and, in recent years, 40,000–50,000 scoters have been harvested annually in the eastern US alone.

Conservation concerns

Globally, the Black Scoter is listed as the highest conservation concern ("near threatened"), while the White-winged and Surf Scoter are listed as "least concern." All three, however, have the same conservation priority continentally ("moderately high"), and are considered "secure" in Canada (see Table).

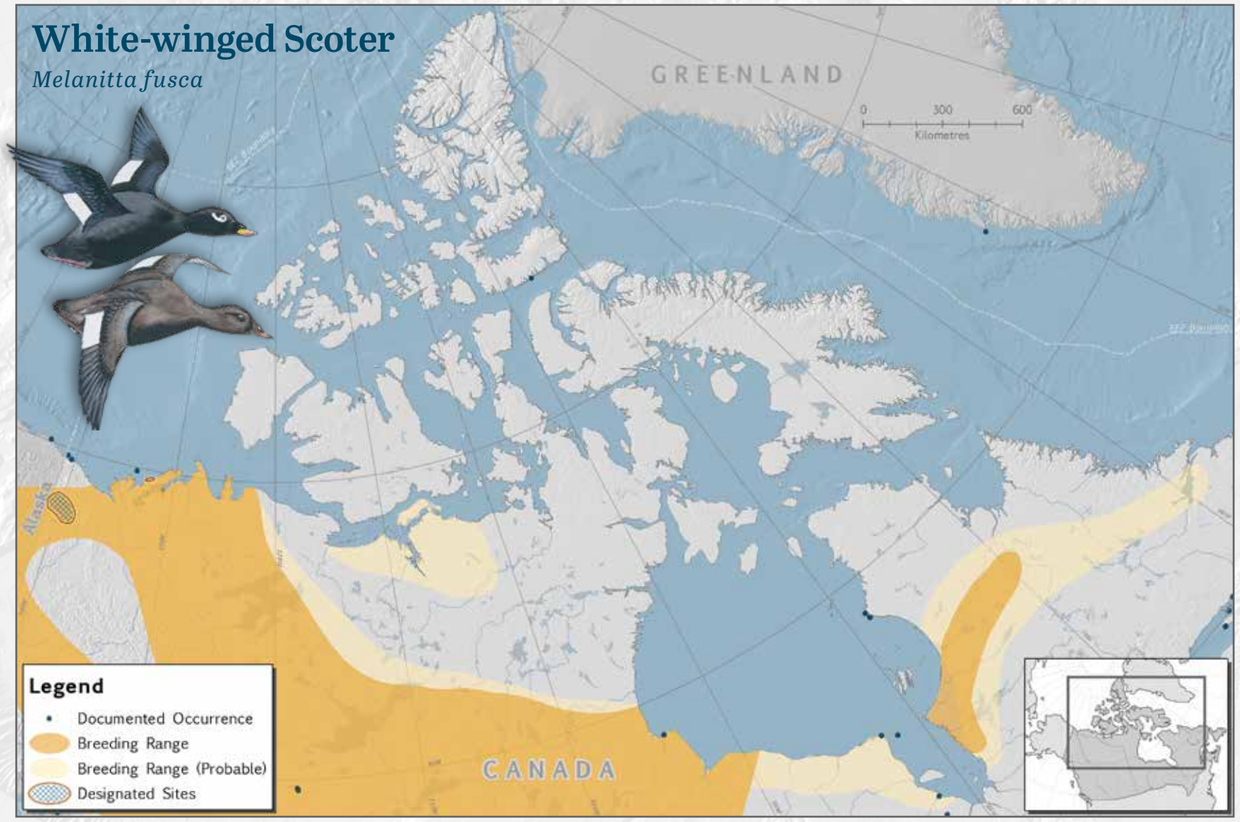
Potential threats to scoters on their Arctic breeding grounds are many, including predation on eggs and young, subsistence harvest, and degradation of breeding habitat from mining and oil and gas exploration and development. Scoters generally exhibit elevated levels of contaminants that are likely accumulated from invertebrate prey on their wintering grounds. White-winged and Surf Scoters are attracted to aquaculture sites, where they may affect the commercial harvest of cultured mussels, opening the potential for conflicts in some areas. Since they have similar wintering distributions, threats during non-breeding are also likely similar for each species, including exposure to contaminants, marine pollution (oil spills), disturbance by vessels, and offshore development. In Europe, scoters were found to be displaced by offshore wind farms for a number of years after construction, but eventually returning to the area. The cumulative impact of multiple offshore wind developments is unknown, however.

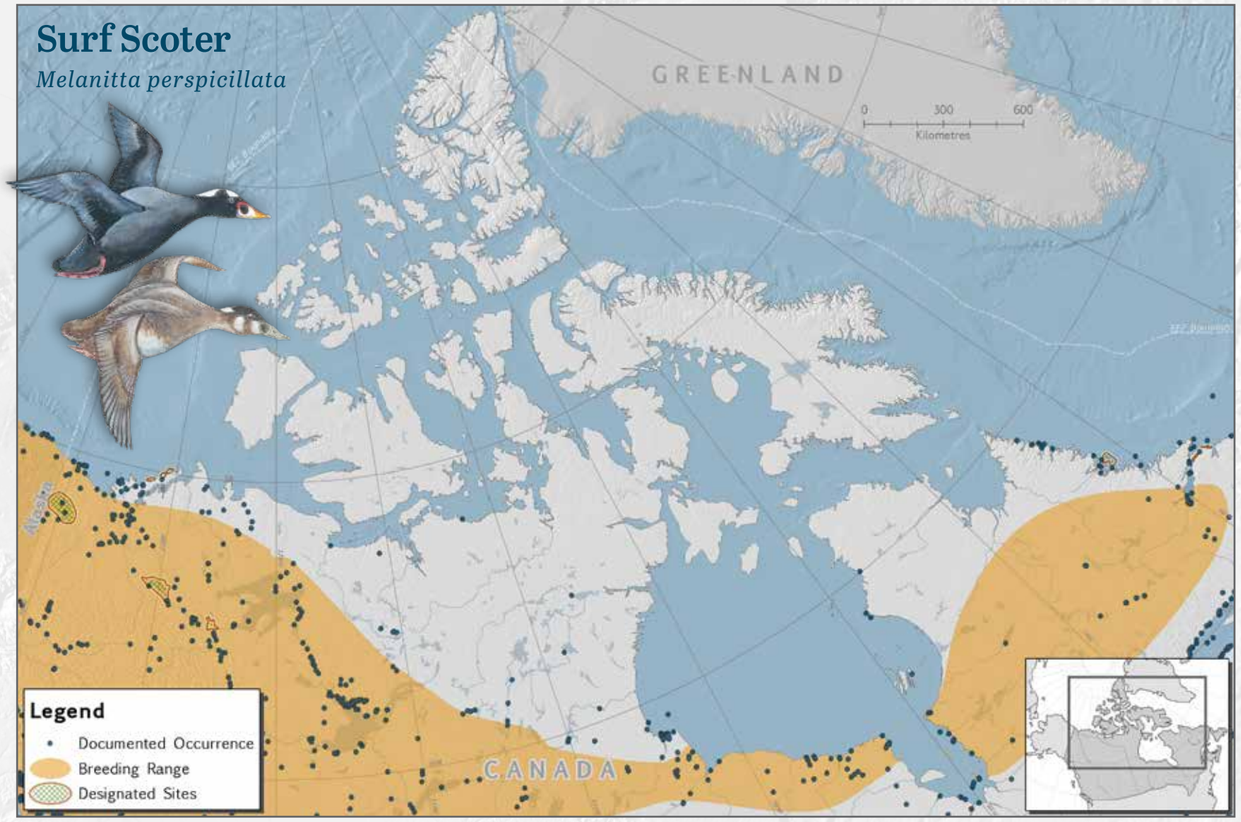


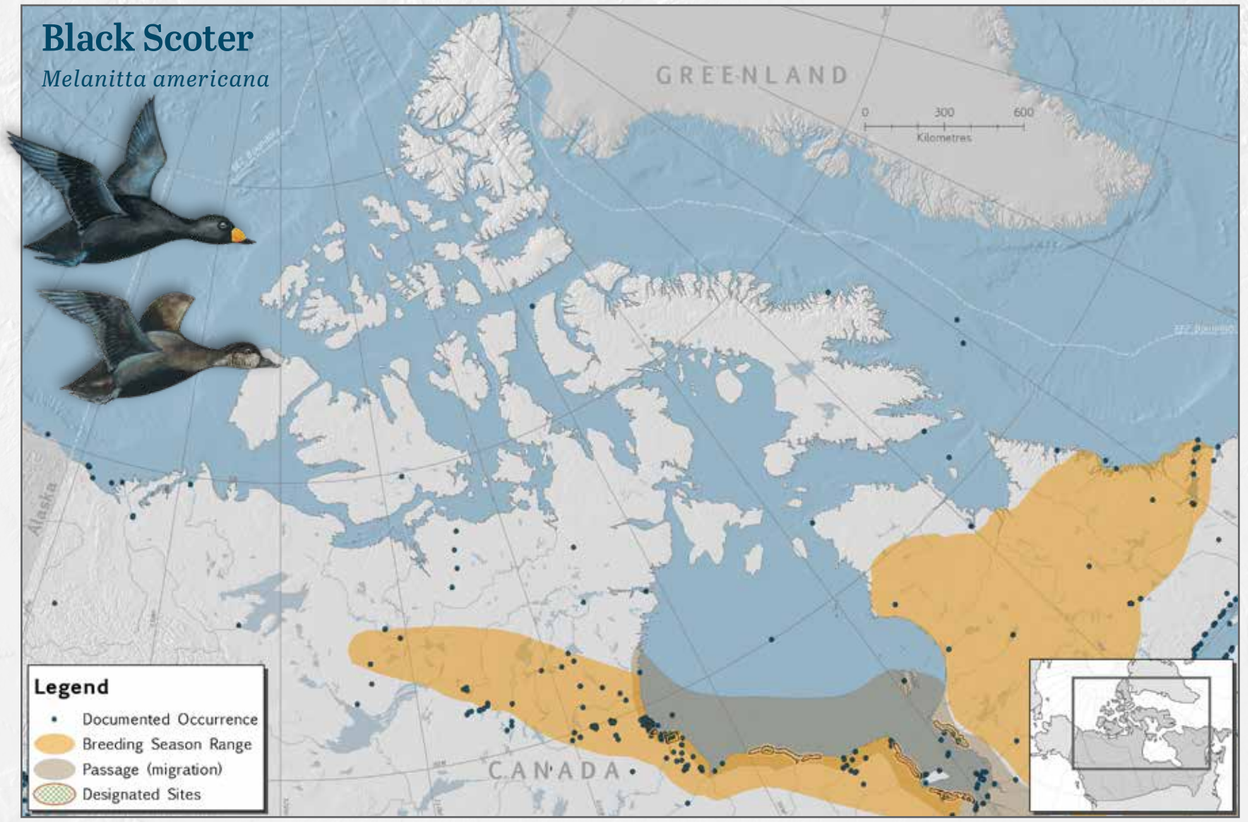
Male Surf Scoter eating bivalves. (photo: Nigel Tate)

Gaps in current knowledge

There are many unknowns for scoters in the Canadian Arctic, including population size and trend, population dynamics, population ecology, and the effects of human harvests. In addition, little is known about the potential effects of climate change, such as drying of wetland tundra breeding habitat, which may exacerbate existing threats. Gaining an improved understanding of population sizes and trends is a primary conservation and management priority for sea duck species, including all three scoters.







WHITE-WINGED SCOTER DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Web. http://www.iobis.org (consulted on 2016/02/17); GBIF (Global Biodiversity Information Facility) 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: Consortium Gauthier & Guillemette – G.R.E.B.E. 1990. Complexe Grande-Baleine. Avant-projet Phase II. Étude de l'avifaune et du castor : écologie des Macreuses à bec jaune (Melanitta nigra) et à front blanc (M. perspicillata) en période de reproduction sur le territoire du complexe Grande-Baleine. Rapport final présenté à Hydro-Québec, vice-présidence Environnement, Saint-Romuald, Québec, 58 p.; Consortium Gauthier & Guillemette – G.R.E.B.E. 1992. Complexe Grande-Baleine. Avant-projet Phase II. Étude de l'avifaune et du castor : aire de reproduction des macreuses dans la péninsule Québec-Labrador. Rapport présenté à Hydro-Québec, vice-présidence Environnement, Montréal, Québec, 35 p.; Consortium Gauthier & Guillemette – G.R.E.B.E. 1993. Complexe Grande-Baleine. Avant-projet Phase II. Étude de l'avifaune et du castor : description et utilisation de l'habitat d'élevage des macreuses à l'été 1990. Rapport présenté à Hydro-Québec, vice-présidence Environnement, Saint-Romuald, Québec, 54 p.; Benoit, R., A. Reed, R. Lalumière et G. Morissette. 1991. Utilisation par la sauvagine des habitats côtiers de la baie of Many Islands, baie James. Rapport présenté au Service écologique, Direction Ingénierie et Environnement, Société d'énergie de la Baie James, 62 p.; Benoit, R., A. Reed et R. Lalumière. 1992. Utilisation par la sauvagine des habitats côtiers de la côte nord-est de la baie James, été 1991. Rapport présenté au Service écologie, Direction Ingénierie et Environnement, Société d'énergie de la Baie James, 62 p.; Benoit, R., R. Lalumière et A. Reed. 1993. Étude de la sauvagine sur la côte-est de la baie James – 1992. Société d'énergie de la Baie James, 91 p. ;Benoit, R., A. Reed et R. Lalumière. 1994. Étude de la sauvagine sur la côte nord-est de la baie James – 1993. Rapport présenté au Service écologie, Direction Ingénierie et Environnement, Société d'énergie de la Baie James, 113 p.; Benoit, R., R. Lalumière et A. Reed. 1996. Étude sur la Bernache cravant et la Macreuse à ailes blanches (côte nord-est de la baie James – 1995). Rapport présenté au Service écologie, Société d'énergie de la Baie James, 55 p.; Savard, J.-P.L. 1977. Étude de la faune avienne dans les bassins de la Grande rivière de la Baleine et de la Petite rivière de la Baleine (été 1976). Rapport pour Hydro-Québec, Direction de l'Environnement. GB-BIOP-ECO-77-3. Éco-Recherches Ltée, Pointe-Claire, Québec, 132 p. Environment and Climate Change Canada - Quebec Region. 2014. Breeding Scoter Survey. Unpublished data; Environment and Climate Change Canada - Quebec Region. 2010. Satellite telemetry work. Unpublished data. Environment and Climate Change Canada - Quebec Region. 2012. Satellite telemetry work. Unpublished data.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

SURF SCOTER DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Web. http://www.iobis.org (consulted on 2016/02/17); GBIF (Global Biodiversity Information Facility). 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

The occurrence points on these maps show the location of captured specimens from historical museum records, literature records, and in-field surveys. Areas of sparse points may reflect either a lack of data or an absence of birds. Designated Sites are important bird areas and key habitat sites; these are recognized areas that support larger numbers of individuals of one or more species during one or more periods of the year and can include aggregation areas, colonies, nesting, feeding, brood rearing, molting, staging, migration or wintering.

BLACK SCOTER DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Web. http://www.iobis.org (consulted on 2016/02/17); GBIF (Global Biodiversity Information Facility). 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.; Sea Duck Joint Venture. 2017. Black Scoter Range Map. https://seaduckjv.org/meet-the-sea-ducks/black-scoter/*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

ARCTIC-BREEDING LOONS

Red-throated Loon, Yellow-billed Loon, and Pacific Loon

Natural history

Loons are slow-maturing, relatively large-bodied birds with high adult survival and low reproductive rates. All five loon species (family Gaviidae) are present in North America, and all breed within the Arctic region. Three of these species, however, are primarily dependent on the Canadian Arctic to provide the majority of their continental breeding grounds—the Red-throated Loon *(Gavia stellata)*, Yellow-billed Loon *(Gavia adamsii)*, and Pacific Loon *(Gavia pacifica)*. All three species nest on freshwater or brackish ponds in low-lying coastal and inland tundra areas. Red-throated Loons forage almost exclusively in marine waters, while the other loon species forage in their breeding territory, if large enough to sustain suitably sized fish for both adults and young, or on surrounding lakes.

Distribution

During the breeding period, Red-throated and Yellow-billed Loons are broadly distributed across much of the circumpolar North, whereas Pacific Loons are found primarily in the Canadian Arctic, Alaska, and northern Siberia. Because loon breeding territories are widely distributed across this vast landscape, they are relatively difficult to count and to monitor, compared to highly colonial species. During the non-breeding period, all three species of loons that rely on the Canadian Arctic are found in coastal marine waters. Red-throated Loons divide between the Pacific and Atlantic Oceans in winter. On migration, birds wintering on the Atlantic coast stage in Hudson Bay before passing through James Bay and the Great Lakes on their way south. Yellow-billed Loons breeding in the central and western Canadian Arctic and Alaska winter along both northern Pacific coasts as far south as northern California in the eastern Pacific and the Yellow Sea in the western Pacific. Pacific Loons winter along the eastern Pacific coast from Alaska to Mexico.

Importance to Inuit

Across the Canadian Arctic, all loon species are occasionally harvested for subsistence purposes, and their eggs may be collected for food in early summer, although they are not a major focus of hunting. Historically, at least in some Arctic regions, loon feathers, bones, and skins were used for ceremonial purposes (e.g. Yellow-billed Loons in Alaska), and loons also commonly appear in carvings, other crafts, and traditional stories, suggesting a strong spiritual connection with Indigenous peoples.

Conservation concerns

The Yellow-billed Loon is listed as high conservation concern globally ("near threatened"), whereas the Red-throated and the Pacific Loon are considered secure ("least concern"; see Table 1). In Canada, the Yellow-billed Loon is considered "secure" or data deficient. The Red-throated and the Yellow-billed Loon are listed as "birds of conservation concern" by the US Fish and Wildlife Service.

Loons are vulnerable to coastal oil spills in both their breeding and wintering areas, and this could worsen with a potential increase in shipping traffic in the Arctic. Other threats to these species on their Arctic breeding grounds include subsistence harvest, bycatch in subsistence fisheries, breeding habitat degradation and disturbance from mining and oil and gas exploration and development, contaminants, and other effects of climate change. In their wintering areas, the major issues likely vary for each species, but include bycatch in commercial fisheries, contaminants, and offshore wind energy development. Some or all of these threats to loons could be exacerbated by the impacts of climate change, such as changes in prey availability.

Table 1:
The global and continental conservation status of loons.

	Red-throated Loon *(G. stellata)*	Yellow-billed Loon *(G. adamsii)*	Pacific Loon *(G. pacifica)*
Global Conservation Status[1]	LEAST CONCERN	NEAR THREATENED	LEAST CONCERN
Continental Conservation Needs[2]	HIGH CONCERN	HIGH CONCERN	MODERATE CONCERN
Canada (Wings Over Water)[4]	LOW CONCERN	INFO. LACKING	INFO. LACKING
Canada Conservation Status (wildspecies)[3]	SECURE	SECURE	SECURE

[1]IUCN 2015, [2] N. Am. Waterbird Conservation Plan, Kushlan et al. 2002, [3]Milko et al. 2003, [4]CESCC 2011.

Gaps in current knowledge

There is little to no information on the current survival or harvest rates for these species across their ranges in the Canadian Arctic. Distributional information is limited spatially and temporally, and based largely on local Indigenous knowledge, historical sightings, and expert opinion. There have been no broad-scale systematic surveys targeted at these species; thus reliable information on distributions and population sizes and trends is lacking. The long-term continental data that exists suggests little change in Pacific Loon and Red-throated Loon populations and a moderate decrease in Yellow-billed Loons. Some satellite tracking of Yellow-billed and Red-throated Loons has taken place in recent years in western Canada and the United States.

Above: Pacific Loon and chick. (photo: Michael S. Quinton)

Top left: Loons commonly appear in carvings, other crafts, and traditional stories, suggesting a strong spiritual connection with Indigenous peoples. (print: Mayoreak Ashoona, Tuulirjuaq [Great Big Loon], 2009 Stonecut & Stencil, 102.3 x 74 cm, reproduced with the permission of Dorset Fine Arts)

Top right: Incubating adult Red-throated Loon. (photo: Wayne Lynch)

Red-throated Loon

Gavia stellata

RED-THROATED LOON DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Accessed: 17/02/2016. http://www.iobis.org; GBIF (Global Biodiversity Information Facility) 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.D*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

Yellow-billed Loon

Gavia adamsii

YELLOW-BILLED LOON DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Web. http://www.iobis.org (consulted on 2016/02/17); GBIF (Global Biodiversity Information Facility) 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

Pacific Loon

Gavia pacifica

PACIFIC LOON DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System, Intergovernmental Oceanographic Commission of UNESCO. Accessed: 17/02/2016. http://www.iobis.org; GBIF (Global Biodiversity Information Facility) 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

The occurrence points on these maps show the location of captured specimens from historical museum records, literature records, and in-field surveys. Areas of sparse points may reflect either a lack of data or an absence of birds. Designated Sites are important bird areas and key habitat sites; these are recognized areas that support larger numbers of individuals of one or more species during one or more periods of the year and can include aggregation areas, colonies, nesting, feeding, brood rearing, molting, staging, migration or wintering.

ARCTIC-BREEDING SEABIRDS

Northern Fulmar, Ivory Gull, and Thick-billed Murre

COASTAL & MARINE BIRDS
- Geese
- Sea Ducks
- Loons
- ➡**Seabirds**
- Shorebirds

Natural history

Most seabird species are slow-maturing, relatively large-bodied birds, with high adult survival and low reproductive rates. The three species included here are all very different in behavioural and ecological traits, but all are highly reliant on the Arctic. All three species are colonial, and nest in remote areas, mostly on sheer cliffs close to productive Arctic waters, especially polynyas, which are important foraging areas. Fulmars and murres have a few very large Arctic nesting colonies (more than 10,000 birds) that are well known in Canada, and it is relatively straightforward to monitor these sites. Conversely, Ivory Gulls *(Pagophila eburnea)* nest in small colonies (fewer than 60 birds) in extremely remote habitats as disparate as flat gravel barrens, well inland, or the rugged faces of nunataks (bare rock on cliffs or mountains), which makes them difficult to locate and monitor.

Distribution

All three exhibit a circumpolar distribution, and in Canada are most commonly found in the eastern Arctic. Northern Fulmar *(Fulmarus glacialis)* colonies are generally distributed up the eastern side of Baffin Island to the Lancaster Sound and Jones Sound area. A few small colonies (fewer than 80 birds) also exist in Newfoundland and Labrador. Thick-Billed Murre *(Uria lomvia)* colonies are largely found in northern Hudson Bay and the Hudson Strait, and northern Baffin Bay and Lancaster and Jones Sounds. Both of these species are also found in large colonies in Alaska. In North America, however, Ivory Gulls nest exclusively in northern Nunavut, particularly around the Lancaster Sound region.

In terms of annual movements, Ivory Gulls are fairly distinct again, remaining further north and closer to pack ice year-round, while Northern Fulmars and Thick-Billed Murres move to more southerly, open waters. Northern Fulmars breeding in the Canadian High Arctic generally migrate out to the Labrador Sea and the northwest Atlantic Ocean via Baffin Bay and the Davis Strait. Thick-Billed Murres also migrate through Baffin Bay and the Hudson Strait to the Davis Strait, on their way to more inshore areas and bays around Newfoundland and Labrador, with smaller numbers along the coast of southwest Greenland, and south along the US coast as far as the mid-Atlantic region.

Importance to Inuit

Seabirds and their eggs are harvested across the circumpolar North. Although Northern Fulmars are harvested in some northern nations (e.g. the Faroe Islands), they are rarely taken in the Canadian Arctic. The Thick-Billed Murre is the most frequently harvested seabird in the Canadian North, and its eggs are collected for food in early summer at easily accessible colonies (e.g. Digges Sound). Thick-Billed and Common Murres *(Uria aalge)* are also heavily harvested off the coast of Newfoundland and Labrador in winter, with up to 200,000 birds taken there each year, mostly (around 95%) Thick-Billed Murres. Despite being legally protected, Ivory Gulls are still harvested in small numbers in northwest Greenland and the Canadian Arctic, although probably only opportunistically.

Table 1: The global and continental conservation status of selected seabirds.

	Northern Fulmar *(F. glacialis)*	Ivory Gull *(P. eburnea)*	Thick-billed Murre *(U. lomvia)*
Global Conservation Status[1]	LEAST CONCERN	NEAR THREATENED	LEAST CONCERN
Continental Conservation Needs[2]	MODERATE CONCERN	MODERATE CONCERN	MODERATE CONCERN
Canada (Wings Over Water)[4]	NOT CURRENTLY AT RISK	HIGH CONCERN	MODERATE CONCERN
Canada Conservation Status (wildspecies)[3]	SENSITIVE	AT RISK	SECURE

[1]IUCN 2015, [2]N. Am. Waterbird Conservation Plan, Kushlan et al. 2002, [3]Milko et al. 2003, [4]CESCC 2011.

Conservation concerns

All three of these seabird species, emblematic of the Canadian Arctic, are considered to be "of conservation concern" continentally (see Table 1). The Ivory Gull is also listed as "high conservation concern" globally ("near threatened"). Surveys in the Canadian Arctic in 2002–11 suggested that the number of Ivory Gulls declined about 80% in just 20 years, and traditional knowledge suggests that declines may extend over a longer time period than this. Long-term monitoring of a limited number of Thick-Billed Murre colonies suggests population trends have remained relatively stable overall. The Northern Fulmar population at Prince Leopold Island, however, appears to have declined over time.

The drastic decline in Ivory Gulls in recent years has yet to be fully explained, although environmental contaminants, particularly mercury, may play an important role. Murres and fulmars are also subject to contaminant loading, especially of pollutants associated with plastics.

Gaps in current knowledge

Population trends and breeding success of fulmars and murres are generally well known, though some colonies in Nunavut have not been surveyed since the 1970s. The breeding distribution and success of Ivory Gulls are less well understood. The foraging distributions of breeding birds, moult times, migration routes, and non-breeding habitat use, as well as their demographic and/or energetic consequences, are considerably less well understood for all three species. The potential impacts of climate change, including the loss of sea ice, changes in prey distributions, and increasing disturbances in the marine environment are the largest unknowns for these Arctic seabirds.

A colony of murres on the sea cliffs of Coats Island, Nunavut. (photo: Jennifer Provencher)

Adult Ivory Gull bathing on the Arctic pack ice. (photo: Philip Mugridge)

Above left: Thick-billed Murres on an ice floe (photo: Design Pics Inc). Above right: Northern Fulmar gliding above sea water. (photo: Arterra Picture Library)

Northern Fulmar

Fulmarus glacialis

NORTHERN FULMAR DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Web. http://www.iobis.org (consulted on 2016/02/17); GBIF (Global Biodiversity Information Facility). 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Colonies: Canadian Wildlife Service. 2016.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

Ivory Gull

Pagophila eburnea

IVORY GULL DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Web. http://www.iobis.org (consulted on 2016/02/17); GBIF (Global Biodiversity Information Facility). 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Nesting Colonies: Canadian Wildlife Service. 2016.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

Thick-billed Murre

Uria lomvia

THICK-BILLED MURRE DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Web. http://www.iobis.org (consulted on 2016/02/17); GBIF (Global Biodiversity Information Facility). 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Colonies: Canadian Wildlife Service, 2016; Canadian Wildlife Service, 2013. Nesting Colonies in NWT and Yukon.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

The occurrence points on these maps show the location of captured specimens from historical museum records, literature records, and in-field surveys. Areas of sparse points may reflect either a lack of data or an absence of birds. Designated Sites are important bird areas and key habitat sites; these are recognized areas that support larger numbers of individuals of one or more species during one or more periods of the year and can include aggregation areas, colonies, nesting, feeding, brood rearing, molting, staging, migration or wintering.

ARCTIC-BREEDING SHOREBIRDS

Red Knot and Red Phalarope

Natural history

Shorebirds are among the world's greatest migrants, with many species breeding in the Arctic and wintering in the fertile lowlands of the southern hemisphere, as far south as Tierra del Fuego on the southernmost tip of South America. Forty-nine species of shorebirds are recorded as regularly occurring or breeding in Canada. For 15 species that are wholly confined to the North American Arctic and sub-Arctic regions during breeding, Canada provides over 75% of their continental range. Therefore, Canada has a significant responsibility for conservation of Arctic-breeding shorebirds.

Arctic-breeding shorebirds encompass a diverse group of species with a broad range of behavioural, ecological, and life-history characteristics. They largely forage on terrestrial and aquatic invertebrates, and seeds/berries or other plant material, and use a variety of habitats—from wetlands and estuaries, brackish and freshwater ponds, marshes and boggy areas, to dry upland tundra. Species range in mass from under 40 g to over 400 g, usually initiate breeding at one to two years old, lay three to four eggs each season, and can easily live up 10 or more years.

Distribution

Where suitable habitat is available, Arctic-breeding shorebirds are broadly distributed across the sub-Arctic, Low Arctic, and High Arctic regions of Canada. During migration, Arctic-breeding shorebirds use multiple flyways to spread widely across the globe, usually stopping at a few critical coastal wetland foraging sites en route. Shorebirds depend on these specific stopover sites to refuel along their migration routes, with large numbers of Canadian Arctic breeders passing through James Bay in spring and fall. The Western Hemisphere Shorebird Reserve Network (WHSRN) exists to identify and conserve a system of key sites for migratory shorebirds across the Americas. To date, they have identified seven important sites in southern Canada, and one has been nominated in James Bay.

Conservation concerns

Globally, 44% of shorebird populations have declined over the last few decades. Although a number of factors are likely responsible for these declines, habitat loss in the non-breeding season and disturbance at breeding areas and critical stopover sites are believed to play important roles in these general trends. Overall, shorebirds are not an important part of the subsistence harvest across the Canadian Arctic, although adults of the largest species, such as godwits and curlews, are probably taken opportunistically.

Few Arctic-breeding shorebirds are considered to be of high conservation concern globally, probably due to their vast breeding ranges and often large populations. At the continental level, however, the situation is quite different, with many species considered to be of moderate to high conservation concern (see Table 1). The Red Knot *(Calidris canutus)*, for example, has the highest conservation profile due to a drastic and well-documented decline in the subspecies *rufa*, related to the availability of prey at a major stopover site in Delaware Bay. A widespread, and potentially just as drastic, decline in the Red Phalarope *(Phalaropus fulicarius)* is less well understood. Red Phalaropes use of offshore marine habitats during the non-breeding season, but their resource requirements and potential threats during this period are not known.

Since the 1990s, the Program for Regional and International Shorebird Monitoring (PRISM) has coordinated breeding surveys for shorebirds across the continent, including in the Arctic, to improve our understanding of population trends and distributions. The current declining trends observed in many shorebirds are of particular concern because their populations are often slow to recover, due to low reproductive rates, and, in the event of nest failure, little opportunity for re-nesting during the short Arctic summer. Being dependent on shallow water habitats during breeding, staging, and wintering, shorebirds are highly vulnerable to warming temperatures, and breed in the Arctic where the onset of climate change is expected to be most rapid. Many northern-breeding species are already showing impacts of climate change, as their arrival dates shift earlier in the season. Shorebirds have the added vulnerability of being heavily dependent on a few critical stopover sites, where they gather in very large numbers. The sudden loss of even one of these sites, due to natural or human-induced disruptions, could have far-reaching effects on their populations.

Predation on tundra-breeding birds, including shorebirds, can be extreme in years following lemming population crashes when predators, particularly Arctic Foxes, switch to alternative prey sources. Loss or degradation of breeding or foraging habitat is a common issue for Arctic-breeding shorebirds—sometimes caused by overabundant foragers, such as Snow Geese. Arctic-breeding shorebirds are also at risk from a range of environmental contaminants, particularly mercury contamination, as recent studies indicate mercury deposition and rates of methylation are increasing in Arctic habitats. Over the past century, elevated mercury deposition has led to large increases in mercury exposure for Arctic wildlife, particularly in aquatic ecosystems, with some shorebirds exceeding thresholds that have been shown to reduce reproductive success in other small avian invertivores.

Table 1: The global and national conservation status and continental conservation needs of selected shorebirds.

	Red Knot *(C. canutus)*	**Red Phalarope** *(P. fulicarius)*
Global Conservation Status[1]	NEAR THREATENED	LEAST CONCERN
Continental Conservation Needs[2,3]	HIGH CONCERN	MODERATE CONCERN
Canada Conservation Status (wildspecies)[4]	AT RISK	SECURE

[1]IUCN 2015, [2] Canadian Shorebird Conservation Plan, Donaldson et al 2000, [3] U.S. Shorebird Conservation Plan, Brown et al. 2001, [4]CESCC 2011.

Two Red Phalaropes float on the surface of the Arctic Ocean. (photo: Ralph Lee Hopkinsk)

Red Knot perched on the tundra. (photo: All Canada Photos)

Red Knot

Calidris canutus

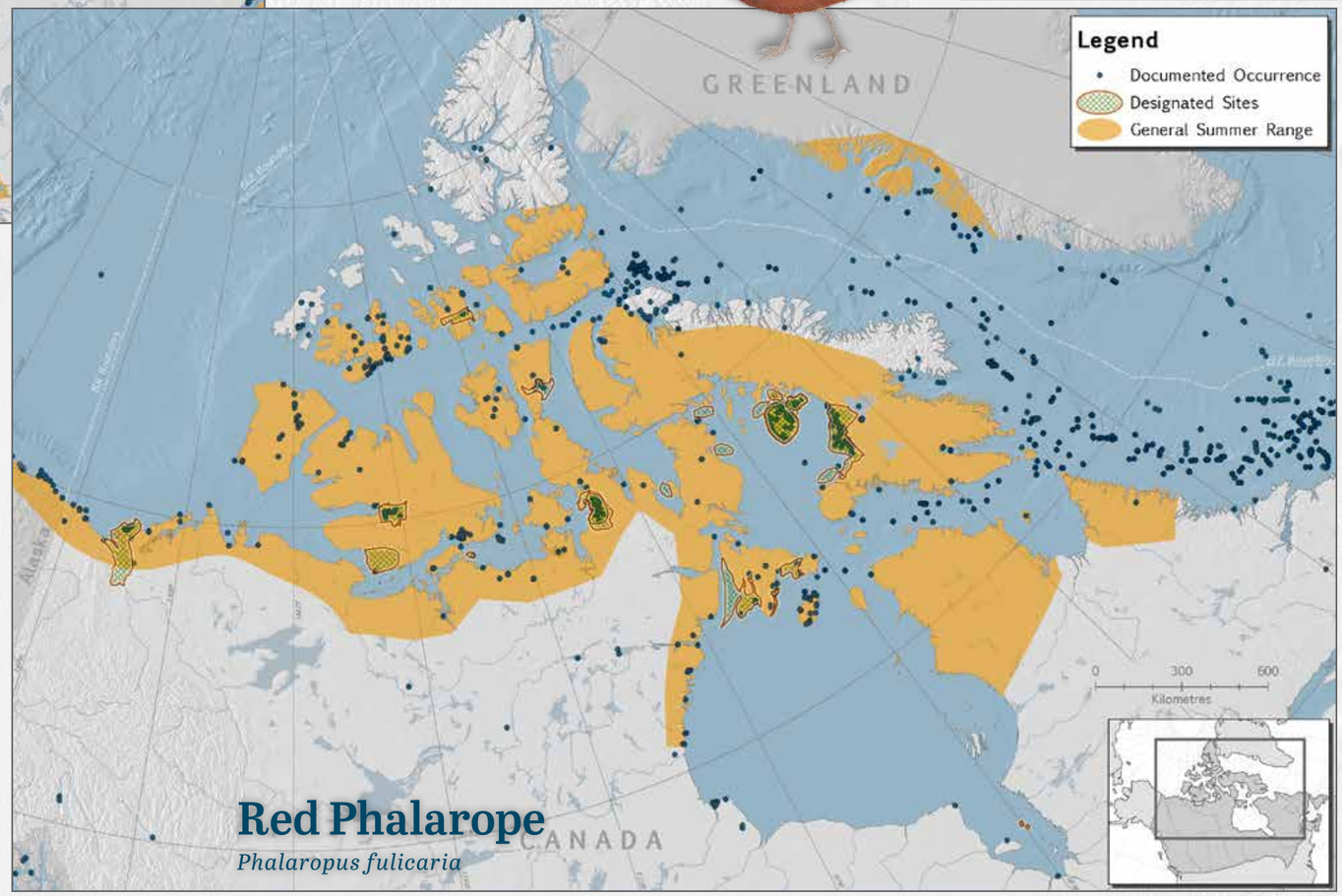
DATA SOURCES

- *Documented Occurrence: GBIF (Global Biodiversity Information Facility). 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.; Canadian Wildlife Service. 2016.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*

The occurrence points on these maps show the location of captured specimens from historical museum records, literature records, and in-field surveys. Areas of sparse points may reflect either a lack of data or an absence of birds. Designated Sites are important bird areas and key habitat sites; these are recognized areas that support larger numbers of individuals of one or more species during one or more periods of the year and can include aggregation areas, colonies, nesting, feeding, brood rearing, molting, staging, migration or wintering.

DATA SOURCES

- *Documented Occurrence: OBIS. 2016. Global biodiversity indices from the Ocean Biogeographic Information System. Intergovernmental Oceanographic Commission of UNESCO. Web. http://www.iobis.org (consulted on 2016/02/17); GBIF (Global Biodiversity Information Facility). 2016. Retrieved from: http://www.gbif.org/*
- *Range Data: BirdLife International and NatureServe. 2015. Bird species distribution maps of the world. BirdLife International, Cambridge, UK and NatureServe, Arlington, USA.; Canadian Wildlife Service, 2016.*
- *Designated Sites: Bird Studies Canada. 2015. Important Bird Areas of Canada Database. Port Rowan, Ontario: Bird Studies Canada. http://www.ibacanada.org; Canadian Wildlife Service. 2016. Key Habitat Sites for Migratory Birds in the Nunavut Settlement Area (Revised May 2016). Environment and Climate Change Canada.; Latour, P.B. et al. 2008. Key migratory bird terrestrial habitat sites in the Northwest Territories and Nunavut (3rd Ed.). Occasional Paper 114. Canadian Wildlife Service; Mallory, M.L. and A.J. Fontaine. 2004. Key marine habitat sites for migratory birds in Nunavut and the Northwest Territories. Occasional Paper 109. Canadian Wildlife Service.*
- *Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.*



Red Phalarope

Phalaropus fulicaria

FURTHER READING

COASTAL AND MARINE BIRDS

Auger, E. E. 2005. *The Way of Inuit Art: Aesthetics and History in and Beyond the Arctic*. Jefferson, NC: McFarland & Company.

Burger, A. E., and S. A. Shaffer. 2008. "Application of Tracking and Data-Logging Technology in Research and Conservation of Seabirds." *Auk* 125: 253–264.

Chardine, J. W., G. J. Robertson, and H. G. Gilchrist. 2008. "Seabird Harvest in Canada." In *Seabird Harvest in the Arctic*, edited by F. Merkel and T. Barry, 20–29. Circumpolar Seabird Group, CAFF Technical Report No. 16. Akureyri, Iceland: CAFF International Secretariat.

CAFF. 2001. *Arctic Flora and Fauna: Status and Conservation*. Helsinki: Conservation of Arctic Flora and Fauna Working Group (CAFF), Arctic Council.

Croxall, J. P., S. H. M. Butchart, B. Lascelles, A. J. Stattersfield, B. Sullivan, A. Symes, and P. Taylor. 2012. "Seabird Conservation Status, Threats and Priority Actions: A Global Assessment." *Bird Conservation International* 22: 1–34.

Egevang, C., I. J. Stenhouse, R. A. Phillips, A. Petersen, J. W. Fox, and J. D. Silk. 2010. "Tracking of Arctic Terns (*Sterna paradisaea*) Reveals Longest Animal Migration." *Proceedings of the National Academy of Sciences* 107: 2078–2081.

Gilg, O., H. Strøm, A. Aebischer, M. V. Gavrilo, A. E. Volkov, C. Miljeteig, and B. Sabard. 2010. "Post-Breeding Movements of Northeast Atlantic Ivory Gull (Pagophila eburnea) Populations." *Journal of Avian Biology* 41: 532–542.

IPCC. 2014. *Climate Change 2014: Synthesis Report*. Edited by R. K. Pachauri and L. A. Meyer. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva: IPCC.

Krech, S. 2005. "Birds and Eskimos." In *Arctic Clothing of North America—Alaska, Canada, Greenland*, edited by J. C. H. King, B. Pauksztat, and R. Storrie, 62–68. London: British Museum Press.

Mallory, M. L., and B. M. Braune. 2012. "Tracking Contaminants in Seabirds of Arctic Canada: Temporal and Spatial Insights." *Marine Pollution Bulletin* 64: 1475–1484.

———, S. A. Robinson, C. E. Hebert, and M. R. Forbes. 2009. "Seabirds as Indicators of Aquatic Ecosystem Conditions: A Case for Gathering Multiple Proxies of Seabird Health." *Marine Pollution Bulletin* 60: 7–12.

Montevecchi, W. A., and R. A. Myers. 1996. "Dietary Changes of Seabirds Indicate Shifts in Pelagic Food Webs." *Sarsia* 80: 313–322.

Mosbech, A., G. Gilchrist, F. Merkel, C. Sonne, A. Flagstad, and H. Nyegaard. 2006. "Year-Round Movements of Northern Common Eiders (*Somateria mollissima borealis*) Breeding in Arctic Canada and West Greenland Followed by Satellite Telemetry." *Ardea* 94: 651–665.

Provencher, J. F., A. J. Gaston, P. D. O'Hara, and H. G. Gilchrist. 2012. "Seabird Diet Indicates Changing Arctic Marine Communities in Eastern Canada." *Marine Ecology Progress Series* 454: 171–181.

Ronconi, R. A., B. G. Lascelles, G. M. Langham, J. B. Reid, and D. Oro. 2012. "The Role of Seabirds in Marine Protected Area Identification, Delineation and Monitoring: Introduction and Synthesis." *Biological Conservation* 156: 1–4.

Arctic-Breeding Geese

Alisauskas, R. T., R. F. Rockwell, E. G. Cooch, G. Zimmerman, K. L. Drake, J. O. Leafloor, T. J. Moser, and E. T. Reed. 2011. "Harvest, Survival, and Abundance of Midcontinent Lesser Snow Geese Relative to Population Reduction Efforts." *Wildlife Monographs* 179: 1–42.

Alexander, S.A. 1986. Beaufort Sea coastal bird surveys, 1985 season. Canadian Wildlife Service. Unpubl. Rep. Edmonton. 80 pp.

Alexander, S.A., Barry, T.W., Dickson, D.L., Prus, H.D. and K.E. Smyth. 1988. *Key Aras for Birds in Coastal Regions of the Canadian Beaufort Sea.* Canadian Wildlife Service: Edmonton, Alberta

Alexander, S.A. and J.S. Hawkings. 1988. "Breeding bird survey of coastal islands and the outer Mackenzie delta and northern Tuktoyaktuk Peninsula". 1987. Canadian Wildlife Service. Technical Report Series No. 39, Western and Northern Region, Alberta.

Bateman, H. A., T. Joannen, and C. D. Stutzen-Baker. 1988. "History and Status of Midcontinent Snow Geese on Their Gulf Coast Winter Range." In *Waterfowl in Winter*, edited by M.W. Weller, 495–515. Minneapolis: University of Minnesota Press.

Bêty, J., G. Gauthier, J.-F. Giroux, and E. Korpimäki. 2001. "Are Goose Nesting Success and Lemming Cycles Linked? Interplay between Nest Density and Predators." *Oikos* 93: 388–400.

Canadian Endangered Species Conservation Council (CESCC). 2011. *Wild Species 2010: The General Status of Species in Canada*. Canadian Endangered Species Conservation Council, National General Status Working Group.

Cooke, F., C. M. Francis, E. G. Cooch, and R. T. Alisauskas. 2000. "Impact of Hunting on Population Growth of Mid-Continent Lesser Snow Geese." In *Population Monitoring and Management of Snow Geese*, edited by H. Boyd, 17–31. Canadian Wildlife Service Occasional Paper no. 102. Ottawa: Canadian Wildlife Service.

Dickey, M.-H., G. Gauthier, and M.-C. Cadieux. 2008. "Climatic Effects on the Breeding Phenology and Reproductive Success of an Arctic-Nesting Goose Species." *Global Change Biology* 14: 1973–1985.

Dickson, D.L., Dickson, H.L. and G.M. Audi. 1988. "Bird surveys at Stokes Point and Philip Bay, Yukon in 1983". Canadian Wildlife Service. Technical Report Series No. 40, Western and Northern Region, Alberta.

Hawkings, J.S. 1986. "Breeding bird survey of the Whitefish Station area, Mackenzie Delta, 1985". Canadian Wildlife Service Technical Report Series No. 4, Pacific and Yukon Region, British Columbia.

Hines, J.E. and M.O. Wiebe Robertson. 2006. "Surveys of Geese and Swans in the Inuvialuit Settlement Region, Western Canadian Arctic 1989-2001". Occasional Paper 112. Canadian Wildlife Service, Ottawa, Ontario.

IUCN. 2015. *The IUCN Red List of Threatened Species*. Version 2015-4.

Jeffries, R. L., & R. F. Rockwell. 2002. "Foraging Geese, Vegetation Loss and Soil Degradation in an Arctic Salt Marsh." *Applied Vegetation Science* 5: 7–16.

Jónsson, J. E., J. P. Ryder, and R. T. Alisauskas. 2013. "Ross's Goose (*Chen rossii*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Lewis, T. L., D. H. Ward, J. S. Sedinger, A. Reed, and D. V. Derksen. 2013. "Brant (*Branta bernicla*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Mowbray, T. B., F. Cooke, and B. Ganter. 2000. "Snow Goose (*Chen caerulescens*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

North American Waterfowl Management Plan. 2004. *Strengthening the Biological Foundation: 2004 Implementation Framework*. Canadian Wildlife Service, US Fish & Wildlife Service, and Secretaria de Medio Ambiente y Recursos Naturales.

Peterson, S. L., R. F. Rockwell, C. R. Witte, and D. N. Koons. 2013. The Legacy of Destructive Snow Goose Foraging on Supratidal Marsh Habitat in the Hudson Bay Lowlands. *Arctic, Antarctic, and Alpine Research* 45: 575–583.

Scheuhammer, A. M. 2009. "Historical Perspective on the Hazards of Environmental Lead from Ammunition and Fishing Weights in Canada." In *Ingestion of Lead from Spent Ammunition: Implications for Wildlife and Humans*, edited by R. T. Watson, M. Fuller, M. Pokras, and W. G. Hunt, 61–67. Boise, ID: The Peregrine Fund.

Sedinger, J. S., C. A. Nicolai, C. J. Lensink, C. Wentworth, and B. Conant. 2007. "Black Brant Harvest, Density Dependence, and Survival: A Record of Population Dynamics." *Journal of Wildlife Management* 71: 496–506.

Smith, P. A., K. H. Elliott, A. J. Gaston, and H. G. Gilchrist. 2010. "Has Early Ice Clearance Increased Predation on Breeding Birds by Polar Bears?" *Polar Biology* 33: 1149–1153.

The Wildlife Society-American Fisheries Society (TWS-AFS). 2008. *Sources and Implications of Lead Ammunition and Fishing Tackle on Natural Resources*. Technical Review 08-01. Bethesda, MD: The Wildlife Society and American Fisheries Society.

US Fish & Wildlife Service (USFWS). 2015. *Waterfowl Population Status, 2015*. Washington, DC: US Fish & Wildlife Service, Division of Migratory Bird Management.

Arctic-Breeding Sea Ducks–1

Allison, A. B., J. R. Ballard, R. B. Tesh, J. D. Brown, M. G. Ruder, M. K. Keel, B. A. Munk, et al. 2015. "Cyclic avian mass mortality in the northeastern United States is associated with a novel orthomyxovirus." *Journal of Virology* 89: 1389–1403.

Cornish, B.J., and D.L. Dickson. 1997. "Common Eiders nesting in the western Canadian Arctic". In *King and Common Eiders in the Western Canadian Arctic*, edited by D.L. Dickson. Occasional Paper 94. Canadian Wildlife Service, Ottawa, Ontario.

Canadian Endangered Species Conservation Council (CESCC). 2011. *Wild Species 2010: The General Status of Species in Canada*. Canadian Endangered Species Conservation Council, National General Status Working Group.

Descamps, S., S. Jenouvrier, H. G. Gilchrist, and M. R. Forbes. 2012. "Avian Cholera, a Threat to the Viability of an Arctic Seabird Colony?" *PLoS ONE* 7(2): e29659.

Gilliland, S. G., H. G. Gilchrist, R. F. Rockwell, G. J. Robertson, J.-P. L. Savard, F. Merkel, and A. Mosbech. 2009. "Evaluating the Sustainability of Harvest among Common Eiders (*Somateria mollissima borealis*) in Greenland and Canada." *Wildlife Biology* 15: 24–36.

Goudie, R. I., G. J. Robertson, and A. Reed. 2000. "Common Eider (*Somateria mollissima*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

IUCN. 2015. *The IUCN Red List of Threatened Species*. Version 2015-4.

Johnson, S.R.; Ward, J.G. 1985. "Observations of Thick-billed Murres (Uria lomvia) and other seabirds at Cape Parry, Amundsen Gulf, NWT". *Arctic* 38:112–115.

Kay, G., Kuptana, D., Wolki Sr., G., Hines, J.E. 2006. "Inuvialuit ecological knowledge of King Eiders, Pacific Common Eiders, Black Brant, and some other birds near Holman and Sachs Harbour, Northwest Territories". Occasional Paper of the Canadian Wildlife Service

McDonald, M. & B. Fleming 1990. *Development of a Community-Based Eider Down Industry in Sanikiluaq: Resource Management and Business Strategies*. Report to Canada-Northwest Territories Economic Development Agreement, Project No. 561 510. Sanikiluaq, NWT: Northwest Territories Municipality of Sanikiluaq.

North American Waterfowl Management Plan. 2004. *Strengthening the Biological Foundation: 2004 Implementation Framework*. Canadian Wildlife Service, US Fish & Wildlife Service, and Secretaria de Medio Ambiente y Recursos Naturales.

Powell, A. N., and R. S. Suydam, 2012. "King Eider (*Somateria spectabilis*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Robertson, G. J., and H. G. Gilchrist, 1998. "Evidence of Population Declines among Common Eiders Breeding in the Belcher Islands, Northwest Territories." *Arctic* 51: 378–385.

———, and J.-P. L. Savard, 2002. Long-Tailed Duck (*Clangula hyemalis*). In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Sea Duck Joint Venture. 2004. "Common Eider (*Somateria mollissima*)." *Sea Duck Information Series*, no. 4. Anchorage, AK: Sea Duck Joint Venture.

Silverman, E. D., D. T. Saalfeld, J. B. Leirness, and M. D. Koneff. 2013. "Wintering Sea Duck Distribution along the Atlantic Coast of the United States." *Journal of Fish and Wildlife Management* 4: 178–198, e1944-687X.

Ward, J.G. 1979. "Bird and mammal surveys in the Cape Parry area, Northwest Territories, June-August 1979". Unpublished Report by LGL Ltd., Edmonton, for Dome Petroleum Ltd., Calgary. 40 p.

White, T. P., R. R. Veit, and M. C. Perry. 2009. "Feeding Ecology of Long-Tailed Ducks (*Clangula hyemalis*) Wintering on the Nantucket Shoals." *Waterbirds* 32: 293–299.

Arctic-Breeding Sea Ducks–2

Anderson, E. M., R. D. Dickson, E. K. Lok, E. C. Palm, J.-P. L. Savard, D. Bordage, and A. Reed. 2015. "Surf Scoter (*Melanitta perspicillata*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Bordage, D., and J.-P. L. Savard. 2011. Black Scoter (*Melanitta americana*). In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Braune, B. M., and B. J. Malone, 2006. "Mercury and Selenium in Livers of Waterfowl Harvested in Northern Canada." *Archives of Environmental Contamination & Toxicology* 50: 284–289.

Brown, P. W., and L. H. Fredrickson. 1997. "White-Winged Scoter (*Melanitta fusca*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Canadian Endangered Species Conservation Council (CESCC). 2011. *Wild Species 2010: The General Status of Species in Canada*. Canadian Endangered Species Conservation Council, National General Status Working Group.

Connelly, E. E., M. Duron, K. A. Williams, and I. J. Stenhouse. 2015. "Summary of High Resolution Digital Video Aerial Survey Data." In *Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Outer Continental Shelf*, edited by K. A. Williams, E. E. Connelly, S. M. Johnson, and I. J. Stenhouse, Chapter 5. Final Report to the Department of Energy EERE Wind & Water Power Technologies Office. Portland, ME: Biodiversity Research Institute.

IUCN. 2015. *The IUCN Red List of Threatened Species*. Version 2015-4.

Kirk, M., D. Esler, and W. S. Boyd. 2007. "Morphology and Density of Mussels on Natural and Aquaculture Structure Habitats: Implications for Sea Duck Predators." *Marine Ecology Progress Series* 346: 179–187.

Loring, P. H., P. W. C. Paton, S. R. McWilliams, R. A. McKinney, and C. A. Oviatt. 2013. "Densities of Wintering Scoters in Relation to Benthic Prey Assemblages in a North Atlantic Estuary." *Waterbirds* 36: 144–155.

Natcher, D. C., L. Felt, K. Chaulk, A. Proctor, and the Nunatsiavut Government. 2011. "Monitoring the Domestic Harvest of Migratory Birds in Nunatsiavut, Labrador." *Arctic* 64: 362–366.

North American Waterfowl Management Plan. 2004. *Strengthening the Biological Foundation: 2004 Implementation Framework*. Canadian Wildlife Service, US Fish & Wildlife Service, and Secretaria de Medio Ambiente y Recursos Naturales.

Raftovich, R. V., S. C. Chandler, and K. A. Wilkins. 2015. *Migratory Bird Hunting Activity and Harvest during the 2013–14 and 2014–15 Hunting Seasons*. Laurel, MD: Migratory Bird Management, US Fish & Wildlife Service.

Sea Duck Joint Venture (SDJV). 2015. *Atlantic and Great Lakes Sea Duck Migration Study: Progress Report*.

Sea Duck Joint Venture (SDJV) Management Board. 2014. Sea Duck Joint Venture Strategic Plan 2014-2018. Anchorage, AK and Sackville, NB: US Fish and Wildlife Service and Canadian Wildlife Service.

Wilson, L.K., M.L. Harris, S. Trudeau, M.G. Ikonomou, and J.E. Elliot. 2010. "Properties of Blood, Porphyrins, and Exposure to Legacy and Emerging Persistent Organic Pollutants in Surf Scoters (*Melanitta perspicillata*) Overwintering on the South Coast of British Columbia, Canada." *Archives of Environmental Contamination & Toxicology* 59: 322–333.

Žydelis, R., D. Esler, M. Kirk, & W.S. Boyd. 2009. "Effects of Off-Bottom Shellfish Aquaculture on Winter Habitat Use by Molluscivorous Sea Ducks." *Aquatic Conservation: Marine and Freshwater Ecosystems* 19: 34–42.

Arctic-Breeding Loons

Agler, B. A., S. J. Kendall, D. B. Irons, and S. P. Klosiewski. 1999. "Declines in Marine Bird Populations in Prince William Sound, Alaska, Coincident with a Climatic Regime Shift." *Waterbirds* 22: 98–103.

Barr, J. F., C. Eberl, and J. W. Mcintyre. 2000. "Red-Throated Loon (*Gavia stellata*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Canadian Endangered Species Conservation Council (CESCC). 2011. *Wild Species 2010: The General Status of Species in Canada*. Canadian Endangered Species Conservation Council, National General Status Working Group.

Environment Canada. 2011. "Status of Birds in Canada—2011. Population Assessment Summary."

Gray, C., C. Anderson, J. Fiely, M. Chickering, R. Gray, A. Gilbert, and S. Ford. 2015. "Red-Throated Loon (*Gavia stellata*)." In *Determining Offshore Use of Diving Bird Species in Federal Waters of the Mid-Atlantic United States Using Satellite Tracking*, 26–57. 2014 Annual Report to the Bureau of Ocean Energy Management. Hadley, MA: US Fish & Wildlife Service.

IUCN. 2015. *The IUCN Red List of Threatened Species*. Version 2015-4.

Kushlan, J. A., M. J. Steinkamp, K. C. Parsons, J. Capp, M. Acosta Cruz, M. Coulter, I. Davidson, et al. 2002. *Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1*. Washington, DC: Waterbird Conservation for the Americas.

Milko, R. J., L. Dickson, R. Elliot, and G. Donaldson. 2003. *Wings over Water: Canada's Waterbird Conservation Plan*. Ottawa: Environment Canada, Canadian Wildlife Service.

Naves, L. C., and T. K. Zeller, 2013. *Saint Lawrence Island Subsistence Harvest of Birds and Eggs, 2011-2012, Addressing Yellow-billed Loon Conservation Concerns. Alaska Migratory Bird Co-Management Council*. Alaska Department of Fish & Game Division of Subsistence, Technical paper no. 384. Anchorage, AK: ADF&G.

North, M. R. 1994. "Yellow-Billed Loon (*Gavia adamsii*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Paruk, J. D., D. C. Evers, J. A. Schmutz, C. DeSorbo, K. Wright, I. Johnson, J. Fair, D. M. Mulcahy, and S. McCloskey, 2011. Migration and Post-Breeding Movements of Yellow-Billed Loons (Gavia adamsii) Breeding in Alaska and the Western Canadian Arctic. Final Report to the National Fish & Wildlife Foundation. BRI Report # 2011-32. Gorham, ME: Biodiversity Research Institute.

Russell, R. W. 2002. "Pacific Loon (*Gavia pacifica*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

U.S. Fish & Wildlife Service. 2008. *Birds of Conservation Concern 2008*. Arlington, VA: United States Department of Interior, Fish & Wildlife Service, Division of Migratory Bird Management.

Arctic-Breeding Seabirds

BirdLife International. 2012. "*Pagophila eburnea*." In *The IUCN Red List of Threatened Species 2012*.

Braune, B. M., M. L. Mallory, and H. G. Gilchrist. 2006. "Elevated Mercury Levels in a Declining Population of Ivory Gulls in the Canadian Arctic." *Marine Pollution Bulletin* 52: 969–987.

Canadian Endangered Species Conservation Council (CESCC). 2011. *Wild Species 2010: The General Status of Species in Canada*. Canadian Endangered Species Conservation Council, National General Status Working Group.

Chardine, J. W., G. J., Robertson, and H. G. Gilchrist. 2008. "Seabird Harvest in Canada." In *Seabird Harvest in the Arctic*, edited by F. Merkel and T. Barry, 20–29. Circumpolar Seabird Group, CAFF Technical Report no. 16. Akureyri, Iceland: CAFF International Secretariat.

COSEWIC. 2006. COSEWIC *Assessment and Update Status Report on the Ivory Gull* (Pagophila eburnea) *in Canada*. Committee on the Status of Endangered Wildlife in Canada. Ottawa: COSEWIC.

Environment Canada. 2011. "Status of Birds in Canada—2011." *Population Assessment Summary*.

Gaston, A. J., and J. M. Hipfner. 2000. "Thick-Billed Murre (*Uria lomvia*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

———, D. K. Cairns, R. D. Elliot, and D. G. Noble. 1985. *A Natural History of Digges Sound*. Canadian Wildlife Service Report Series, no. 46. Ottawa, ON: Supply and Services Canada.

———, M. L. Mallory, and H. G. Gilchrist. 2012. "Populations and Trends of Canadian Arctic seabirds." *Polar Biology* 35: 1221–1232.

Gilchrist, G., H. Strøm, M. V. Gavrilo, and A. Mosbech. 2008. *International Ivory Gull Conservation Strategy and Action Plan*. Circumpolar Seabird Group, CAFF Technical Report no. 18. Akureyri, Iceland: CAFF International Secretariat.

———, and M. L. Mallory. 2005. "Declines in Abundance and Distribution of the Ivory Gull (*Pagophila eburnea*) in Arctic Canada." *Biological Conservation* 121: 303–309.

Gilg, O., H. Strøm, A. Aebischer, M. V. Gavrilo, A. E. Volkov, C. Miljeteig, and B. Sabard. 2010. "Post-Breeding Movements of Northeast Atlantic Ivory Gull (*Pagophila eburnea*) Populations." *Journal of Avian Biology* 41: 532–542.

IUCN 2015. *The IUCN Red List of Threatened Species*. Version 2015-4.

Kushlan, J. A., M. J. Steinkamp, K. C. Parsons, J. Capp, M. Acosta Cruz, M. Coulter, I. Davidson, et al. 2002. *Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1*. Washington, DC: Waterbird Conservation for the Americas.

Mallory, M. L., and A. J. Fontaine. 2004. *Key Marine Habitat Sites for Migratory Birds in Nunavut and the Northwest Territories*. Canadian Wildlife Service Occasional Paper no. 109. Ottawa: Environment Canada.

FURTHER READING

———, S. A. Hatch, and D. N. Nettleship. 2012. "Northern Fulmar (*Fulmarus glacialis*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology

———, I. J. Stenhouse, H. G. Gilchrist, G. J. Robertson, J. C. Haney, and S. D. Macdonald. 2008. "Ivory Gull (*Pagophila eburnea*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Milko, R. J., L. Dickson, R. Elliot, and G. Donaldson. 2003. *Wings over Water: Canada's Waterbird Conservation Plan*. Ottawa: Environment Canada, Canadian Wildlife Service.

Olsen, B. 2008. "Seabird Harvest in the Faroe Islands." In *Seabird Harvest in the Arctic*, edited by F. Merkel and T. Barry, 30–35. Circumpolar Seabird Group, CAFF Technical Report no. 16. Akureyri, Iceland: CAFF International Secretariat.

Provencher, J. F., A. L. Bond, A. Hedd, W. A. Montevecchi, S. Bin Muzaffar, S. J. Courchesne, H. G. Gilchrist, et al. 2014. "Prevalence of Marine Pollution in Marine Birds from the North Atlantic." *Marine Pollution Bulletin* 84: 411–417.

Stenhouse, I. J., and W. A. Montevecchi. 1999. "Increasing and Expanding Populations of Breeding Northern Fulmars in Atlantic Canada." *Waterbirds* 22: 382–391.

———, G. J. Robertson, and H. G. Gilchrist. 2004. "Recoveries and Survival Rates of Ivory Gulls Banded in Nunavut, Canada, 1971–1999." *Waterbirds* 27: 486–492.

Arctic-Breeding Shorebirds

Alaska Shorebird Group. 2008. *Alaska Shorebird Conservation Plan*. Version II. Anchorage, AK: Alaska Shorebird Group.

Baker, A. J., P. M. González, T. Piersma, L. J. Niles, I. do Nascimento, P. W. Atkinson, N. A. Clark, et al. 2004. "Rapid Population Decline in Red Knots: Fitness Consequences of Decreased Refueling Rates and Late Arrival in Delaware Bay." *Proceedings of the Royal Society B* 271: 875–882.

———, P. González, R. I. G. Morrison, and B. A. Harrington. 2013. "Red Knot (*Calidris canutus*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Blomqvist, S., N. Homlgren, S. Åkesson, A. Hedenström, and J. Petterson. 2002. "Indirect Effects of Lemming Cycles on Sandpiper Dynamics: 50 Years of Counts from Southern Sweden." *Oecologia* 133: 146–158.

Brow, S., C. Hickey, B. Harrington, and R. Gill, eds. 2001. *The US Shorebird Conservation Plan*, 2nd ed. Manomet, MA: Manomet Center for Conservation Sciences.

Canadian Endangered Species Conservation Council (CESCC). 2011. *Wild Species 2010: The General Status of Species in Canada*. Canadian Endangered Species Conservation Council, National General Status Working Group.

Donaldson, G. M., C. Hyslop, R. I. G. Morrison, H. L. Dickson, and I. Davidson, eds. 2000. *Canadian Shorebird Conservation Plan*. Ottawa: Canadian Wildlife Service, Environment Canada.

Gratto-Trevor, C., R. I. G. Morrison, B. Collins, J. Rausch, M. Drever, and V. Johnston. 2011. *Trends in Canadian Shorebirds. Canadian Biodiversity: Ecosystem Status and Trends 2010*. Technical Thematic Report no. 13. Ottawa: Canadian Councils of Resource Ministers.

IUCN. 2015. *The IUCN Red List of Threatened Species*. Version 2015-4.

Morrison, R. I. G., and B. A. Harrington. 1979. "Critical Shorebird Resources in James Bay and Eastern North America." *Transactions of the North American Wildlife and Natural Resource Conference* 44: 498–507.

———, Y. Aubry, R. W. Butler, G. W. Beyersbergen, C. Downes, G. M. Donaldson, C. L. Gratto-Trevor, et al. 2001. "Declines in North American Shorebird Populations." *Wader Study Group Bulletin* 94: 34–38.

Perkins, M., L. Ferguson, R. B. Lanctot, I.J. Stenhouse, S. Kendall, S. Brown, H. R. Gates, et al. 2016. "Mercury Exposure and Risk in Breeding and Staging Alaskan Shorebirds." *The Condor* 118, no. 3: 571–582.

Rehfisch, M. M., and H. Q. P. Crick. 2003. "Predicting the Impact of Climate Change on Arctic-Breeding Waders." *Wader Study Group Bulletin* 100: 86–95.

Skagen, S. K., P. A. Smith, B. A. Andres, G. Donaldson, and S. Brown. 2012. "Contribution of Arctic PRISM to Monitoring Western Hemispheric Shorebirds." In *Arctic Shorebirds in North America: A Decade of Monitoring*, edited by J. Bart, V. Johnston, P. A. Smith, and J. Rausch, ix–xiii. Studies in Avian Biology no. 44, Cooper Ornithological Society. Berkeley: University of California Press.

Tracy, D. M., D. Schamel, and J. Dale. 2002. "Red Phalarope (*Phalaropus fulicarius*)." In *The Birds of North America Online*, edited by A. Poole. Ithaca, NY: Cornell Lab of Ornithology.

Western Hemisphere Shorebird Reserve Network (WHSRN). 2015. *WHSRN: An International Strategy for Saving Shorebirds and Their Habitats – Fact Sheet*.