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Recovery Strategy for the Peary Caribou (*Rangifer tarandus pearyi*) in Canada

Peary Caribou

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For copies of the recovery strategy, or for additional information on species at risk, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk (SAR) Public Registry[1].

Cover photo: Morgan Anderson, Government of Nunavut, Department of Environment

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This recovery strategy recognizes and respects the intellectual property rights of the *Inuit Qaujimajatuqangit* holders, traditional knowledge holders, elders, hunters and others who shared their knowledge to develop this document. The information shared by individuals at joint planning workshops and at hunters and trappers committee/organization meetings cannot be referenced in other documents without the expressed permission of the individual, hunters and trappers committee/organization or other organization that provided the information. This applies to comments cited from: Peary Caribou Recovery Strategy Development Group meetings (Canadian Wildlife

[1] www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

Service 2012, 2013, 2015); Ekaluktutiak Hunters and Trappers Organization 2013, 2016; Gjoa Haven Hunters and Trappers Organization 2013, 2016; Iviq Hunters and Trappers Organization 2013, 2016; Kurairojuark Hunters and Trappers Organization 2016; Olohaktomiut Hunters and Trappers Committee 2013, 2016; Paulatuk Hunters and Trappers Committee 2013, 2016; Resolute Bay Hunters and Trappers Organization 2013, 2016; Sachs Harbour Hunters and Trappers Committee 2013, 2016; Spence Bay Hunters and Trappers Organization 2013, 2016.

RECOVERY STRATEGY FOR THE PEARY CARIBOU (*RANGIFER TARANDUS PEARYI*) IN CANADA 2021

Environment and Climate Change Canada's Canadian Wildlife Service led the development of this recovery strategy and engaged the co-management partners. Throughout the process, Inuit Qaujimajatuqangit/Traditional Ecological Knowledge, local knowledge and scientific knowledge have been relied upon equally to inform the development of the recovery strategy and the identification of critical habitat. The co-management partners provided input through three co-management partner meetings held in Yellowknife, community technical meetings held in eight of the nine directly affected communities, teleconferences to share knowledge and provide perspective, and participation in the threat calculator exercise. Knowledge and information gained through the recovery strategy development process were also shared with the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) for consideration in the 2015 reassessment for Peary Caribou. When action plans are developed for Peary Caribou, local community and Indigenous involvement and engagement in the development of these action plans will be critical for the successful recovery of Peary Caribou.

Territorial governments and co-management boards have the primary responsibility for management of lands and wildlife within Peary Caribou distribution, but this responsibility does vary in some instances. For example, the Parks Canada Agency is responsible where Peary Caribou exist within national parks, national marine conservation areas and national historic sites under Parks Canada administration.

Environment and Climate Change Canada's Science and Technology branch developed a knowledge assessment (Johnson et al. 2016) about Peary Caribou that draws on Inuit and Inuvialuit knowledge and expertise at the same time as western science. This knowledge assessment is one of the foundations for this recovery strategy.

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996)[2] agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress within five years after the publication of the final document on the SAR Public Registry.

The Minister of Environment and Climate Change and Minister Responsible for the Parks Canada Agency is the competent minister under SARA for the Peary Caribou and has prepared this recovery strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the following co-management partners: governments of the Northwest Territories and Nunavut, Wildlife Management Advisory Council (NWT), Nunavut Wildlife Management Board, Nunavut regional wildlife boards, hunters and trappers organizations/committees, and Inuit and Inuvialuit from nine communities within the range of Peary Caribou as per section 39(1) of SARA.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Environment and Climate Change Canada and the Parks Canada Agency, or any other jurisdiction alone. Co-management partners in the Northwest Territories, Nunavut and others play an important role in managing Peary Caribou. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Peary Caribou and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by Environment and Climate Change Canada and the Parks Canada Agency, the governments of the Northwest Territories and Nunavut, wildlife management boards, Inuit and Inuvialuit, and organizations involved in the recovery of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions, wildlife management boards and organizations.

The recovery strategy sets the strategic direction to arrest or reverse the decline of the species, including identification of critical habitat to the extent possible. It provides all Canadians with information to help take action on species conservation. When critical habitat is identified, either in a recovery strategy or an action plan, SARA requires that critical habitat then be protected.

[2] www.canada.ca/en/environment-climate-change/services/species-risk-act-accord-funding.html#2

In the case of critical habitat identified for terrestrial species, including migratory birds, SARA requires that critical habitat identified in a federally protected area[3] be described in the *Canada Gazette* within 90 days after the recovery strategy or action plan that identified the critical habitat is included in the public registry. A prohibition against destruction of critical habitat under ss. 58(1) will apply 90 days after the description of the critical habitat is published in the *Canada Gazette*.

For critical habitat located on other federal lands, the competent minister must either make a statement on existing legal protection or make an order so that the prohibition against destruction of critical habitat applies.

If the critical habitat for a migratory bird is not within a federal protected area and is not on federal land, within the exclusive economic zone or on the continental shelf of Canada, the prohibition against destruction can only apply to those portions of the critical habitat that are habitat to which the *Migratory Birds Convention Act, 1994* applies as per SARA ss. 58(5.1) and ss. 58(5.2).

For any part of critical habitat located on non-federal lands, if the competent minister forms the opinion that any portion of critical habitat is not protected by provisions in or measures under SARA or other Acts of Parliament, or the laws of the province or territory, SARA requires that the Minister recommend that the Governor in Council make an order to prohibit destruction of critical habitat. The discretion to protect critical habitat on non-federal lands that is not otherwise protected rests with the Governor in Council.

[3] These federally protected areas are: a national park of Canada named and described in Schedule 1 to the *Canada National Parks Act*, The Rouge National Park established by the *Rouge National Urban Park Act*, a marine protected area under the *Oceans Act*, a migratory bird sanctuary under the *Migratory Birds Convention Act, 1994* or a national wildlife area under the *Canada Wildlife Act* see ss. 58(2) of SARA.

Acknowledgments

Environment and Climate Change Canada and the Parks Canada Agency would like to express their gratitude to the Inuit and Inuvialuit co-management partners who shared their knowledge about Peary Caribou in support of the recovery of this species. Inuit and Inuvialuit consistently indicated that conservation of Peary Caribou is essential, as this species is integral to the culture, identity and survival of their communities. Environment and Climate Change Canada appreciates the input of the hunters and trappers organizations in the Northwest Territories and Nunavut, and Inuit and Inuvialuit groups and individuals who shared their knowledge and experiences to help inform this recovery strategy. Knowledge was shared by Inuit Qaujimajatuqangit (IQ) and Traditional Ecological Knowledge (TEK) holders and Inuit and Inuvialuit communities on Peary Caribou life history, habitat use, population status, threats and conservation measures, and this information has been integrated, to the extent possible, alongside scientific knowledge to develop this recovery strategy.

Donna Bigelow, Siu-Ling Han, Dawn Andrews, Amy Ganton, Isabelle Duclos and Lisa Pirie of Environment and Climate Change Canada led the preparation of the recovery strategy with contracted assistance from Rachel Mayberry.

Cheryl Ann Johnson, Agnes Richards, Erin Neave, Sarah N. Banks and Pauline E. Quesnelle led the development of the knowledge assessment.

Environment and Climate Change Canada would like to express its gratitude to the Peary Caribou recovery strategy co-management group, which has worked collaboratively on this recovery strategy from the beginning:

Nunavut

- Resolute Bay Hunters and Trappers Organization – *Philip Manik, Sr., Community of Resolute Bay*
- Ekaluktutiak Hunters & Trappers Organization – *Howard Greenley, James Panioyak,George Angohiatok, Jimmy Haniliak, Community of Cambridge Bay*
- Iviq Hunters and Trappers Organization – *Amon Akeeagok, Jaypetee Akeeagok, Charlie Noah, Community of Grise Fiord*
- Gjoa Haven Hunters & Trappers Association – *James Qitsualik Taqaugak, Community of Gjoa Haven*
- Kurairojuark Hunters & Trappers Association – *John Kayasark, Zachary Oogark, Columban Pujuardjok, Community of Kugaaruk*
- Spence Bay Hunters & Trappers Association – *Abel Aqqaq, Peter Qayutinuak Sr., Community of Taloyoak*
- Government of Nunavut – *Morgan Anderson, Debbie Jenkins, Conor Mallory*
- Kitikmeot Regional Wildlife Board – *Ema Qaggutaq, Simon Qingnaqtuq*
- Qikiqtaaluk Wildlife Board – *Jackie Price, Michael Ferguson*
- Nunavut Tuungavik Incorporated – *David Lee, Paul Irngaut, Bert Dean*
- Nunavut Wildlife Management Board – *Peter Kydd, Karla Letto*

Northwest Territories

- Sachs Harbour Hunters and Trappers Committee – *Issiac Elanik, Vernon Amos, John Lucus Jr., Joey Carpenter, Community of Sachs Harbour*
- Olokhaktomiut Hunters & Trappers Committee – *Bradley Carpenter, Joshua Oliktoak Community of Ulukhaktok*
- Paulatuk Hunters and Trappers Committee – *Raymond Ruben Sr., Community of Paulatuk*
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- Government of the Northwest Territories – *Tracy Davison, Joanna Wilson*
- Wildlife Management Advisory Council (WMAC-NWT) – *John Lucas Jr., Charles Pokiak, Vernon Amos, Rosemin Nathoo*

Others:

- Parks Canada Agency – *Joanne Tuckwell, Andrew Maher, Micheline Manseau, and Peter Sinkins*
- Environment and Climate Change Canada - Science & Technology – *Cathy Nielsen, Cheryl Johnson, and Agnes Richards*

Reviewers:
We are also grateful to everyone who provided advice and input to help inform the development of this recovery strategy: Matthew Huntley, Paul Johanson, Marie-Andrée Carrière, Rachel Vallender, Cory Toth and Victoria Snable (Environment and Climate Change Canada, Canadian Wildlife Service – National Capital Region), and Carine Côté-Germain, Pascale Sauvage, Megan Ross, Lisa Worthington, and Hayley Roberts (Environment and Climate Change Canada, Canadian Wildlife Service – Northern Region).

Executive Summary

Peary Caribou (*Rangifer tarandus pearyi*) are the smallest caribou in North America and one of the four subspecies of caribou recognized in Canada. The most recent range wide population estimate of Peary Caribou is at about 13,200 mature individuals, down from around 22,000 in 1987.

Peary Caribou are currently listed as Endangered in Schedule 1 of the federal *Species at Risk Act* (SARA) based on the Committee on the Status of Endangered Wildlife in Canada's (COSEWIC) 2004 species assessment. More recently, the species was re-assessed as Threatened by COSEWIC in November 2015. Peary Caribou occur in Nunavut and the Northwest Territories, distributed across much of the Canadian Arctic Archipelago and some small areas on the mainland.

Peary Caribou are currently distributed across four local populations: 1) Banks – Northwest Victoria Islands, 2) Western Queen Elizabeth Islands, 3) Eastern Queen Elizabeth Islands, and 4) Prince of Wales – Somerset Island – Boothia Peninsula. These local populations are considered spatially separate from each other and have been grouped based on evidence of inter-island mouvements, genetic analyses and expert opinion, including Inuit Qaujimajatuqangit, Traditional Ecological Knowledge, local knowledge and scientific information.

Peary Caribou require large areas of land containing a diversity of habitats. Peary Caribou migrate across the landscape and sea ice to access different parts of their range to complete their life cycle. Due to their low reproductive output that can be further exacerbated by severe weather events or restricted access to forage, Peary Caribou are limited in their potential to recover from population declines. Climate change is the most serious threat to Peary Caribou and their habitat, primarily due to sea ice loss and increasing frequency, and severity, of icing events. Climate change may also negatively impact Peary Caribou populations through sea level rise and habitat alteration (e.g. increased shrubbery), as well as indirectly compounding the effects of ice breaking from marine traffic, the prevalence of parasites and diseases and possible interactions with predators and competitors. All of these climate-change impacts are expected to inhibit movement between islands or reduce the amount of available habitat for Peary Caribou.

The recovery of Peary Caribou in Canada is considered feasible, however there are unknown factors associated with climate change that may pose challenges for their potential recovery. Despite these unknowns and in keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA.

The population and distribution objectives are the following:

- Maintain Peary Caribou in all areas of Canada where they currently exist.
- All Peary Caribou local populations are healthy (self-sustaining) and available for future generations.

- Peary Caribou populations fluctuate within the normal bounds of population cycles.
- Peary Caribou are able to move freely on the land and sea ice (within and between islands) to ensure natural (limit unnatural movements / not forced to move) habitat use and movements during extreme weather events.
- Peary Caribou local populations are able to support a sustainable Inuit/Inuvialuit harvest that is responsive to fluctuations in populations.

This recovery strategy provides broad strategies and general approaches to achieve the population and distribution objectives and to address the threats to the survival and recovery of Peary Caribou, and will assist in the development of subsequent action plans.

Only sea ice crossings are identified as critical habitat. It has been determined that the critical habitat identified is insufficient to meet the population and distribution objectives. A schedule of studies is included to obtain the information needed to complete the identification of land critical habitat.

As required by SARA, the Minister of the Environment and the Minister Responsible for the Parks Canada Agency will complete one or more action plans under this recovery strategy. These plans will provide detailed information on recovery measures and will be posted on the Species at Risk Public Registry within five years following the publication of this recovery strategy.

Recovery Feasibility Summary

Based on the following four criteria that Environment and Climate Change Canada uses to establish recovery feasibility, there are unknowns regarding the feasibility of recovery of the Peary Caribou. In keeping with the precautionary principle, this recovery strategy has been prepared as per section 41(1) of SARA, as would be done when recovery is determined to be technically and biologically feasible. This recovery strategy addresses the unknowns surrounding the feasibility of recovery.

1. Individuals of the wildlife species that are capable of reproduction are available now or in the foreseeable future to sustain the population or improve their abundance.

Yes. According to current best estimates, there are approximately 13,200 mature Peary Caribou across the Northwest Territories and Nunavut. These animals are capable of successful reproduction and are available to improve local population growth rates and abundance, thereby achieving self-sustainability. Current evidence supports the conclusion that the recovery of all populations is biologically and technically feasible.

2. Sufficient suitable habitat is available to support the species or could be made available through habitat management or restoration.

Yes. Currently, all local populations of Peary Caribou have sufficient suitable habitat within their ranges. In the future, habitat loss due to sea ice loss and sea level rise caused by climate change could reduce the amount of available habitat required for movements between islands.

3. The primary threats to the species or their habitat (including threats outside Canada) can be avoided or mitigated.

Unknown. The primary threat to local populations of Peary Caribou at present is climate change. Changes to weather patterns, specifically icing events, and habitat are already occurring in the Arctic; however, the consequences of these changes on Peary Caribou are not well understood or easily predicted, and it is therefore unknown whether these impacts can be avoided or mitigated.

4. Recovery techniques exist to achieve the population and distribution objectives or can be expected to be developed within a reasonable timeframe.

Yes. The population and distribution objectives for Peary Caribou can be achieved through existing recovery techniques, which primarily consist of mitigating the cumulative effects of threats (e.g. landscape level planning, protection and management of habitat and movement corridors, stewardship initiatives). However, over time and through unforeseen circumstances, there may be situations where recovery of a particular local population is not biologically or technically possible (e.g. compounding effects of climate change are unmanageable), making the overall population and distribution objectives unlikely to be achieved.

Definitions and Acronyms

Note: Definitions are highlighted below and are defined in accordance with their use in this document.

Biophysical attributes	Biological and physical habitat characteristics (e.g. vegetation type, elevation, topography) that define a species necessary habitat to carry out all life-cycle stages (critical habitat).
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
Critical Habitat	The habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species.
CMP	Conservation Measures Partnership
CWS	Canadian Wildlife Service
ECCC	Environment and Climate Change Canada
GN	Government of Nunavut
GNWT	Government of the Northwest Territories
HTC	Hunters and Trappers Committee
HTO	Hunters and Trappers Organization
IQ	Inuit Qaujimajatuqangit. Inuit beliefs, laws, principles and values along with traditional knowledge, skills and attitudes.
IUCN	International Union for the Conservation of Nature
KRWB	Kitikmeot Regional Wildlife Board. One of three regional wildlife organizations in Nunavut.
Local population	A group of Peary Caribou occupying a defined area, distinguished spatially from areas occupied by other groups of Peary Caribou. Local population dynamics are driven primarily by local factors affecting birth and death rates, rather than immigration or emigration among groups. Local populations are independent of, and somewhat different demographically from, each other.
NT	Northwest Territories
NU	Nunavut
NWMB	Nunavut Wildlife Management Board

PCA	Parks Canada Agency
QWB	Qikiqtaaluk Wildlife Board. One of three regional wildlife organizations in Nunavut.
RWO	Regional Wildlife Organization. Three RWOs manage harvesting among HTOs on a regional level in Nunavut.
SARA	*Species At Risk Act*
SEA	Strategic Environmental Assessment
Self-sustaining local population	A local population of Peary Caribou that on average demonstrates stable or positive population growth, and is large enough to withstand stochastic events and persist over the long term (long enough time frames to accommodate the cyclical nature of population fluctuations), without the need for ongoing active management intervention (e.g. predator management or transplants from other populations).
S&T	Science and Technology Branch of ECCC
TEK	Traditional Ecological Knowledge. Includes Indigenous (Aboriginal) Traditional Knowledge and Inuit Qaujimajatuqangit.
WMAC (NWT)	Wildlife Management Advisory Council (NWT)

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Date of Assessment: November 2015

Common Name (population): Peary Caribou

Scientific Name: *Rangifer tarandus pearyi*

COSEWIC Status: Threatened

Reason for Designation: This subspecies of caribou is endemic to the Canadian Arctic Archipelago, living on the edge of plant growth in polar desert and arctic tundra environments. The current population is estimated at 13,200 mature individuals. From a population high of 22,000 in 1987, the species experienced a catastrophic die-off in the mid-1990s related to severe icing events in some parts of its range. The population was ca. 5,400 mature individuals in 1996, the lowest since surveys first commenced in 1961. Of four subpopulations, two are currently showing an increasing trend, one is stable, and the fourth had fewer than 10 individuals at the last count in 2005, with no evidence of any recovery. The overall population has experienced an estimated three-generation decline of 35%, but has been increasing over the past two decades. The highest-impact threats derive from a changing climate, including increased intensity and frequency of rain-on-snow events negatively affecting forage accessibility in winter, and decreased extent and thickness of sea ice causing shifts in migration and movement patterns.

Canadian Occurrence: Northwest Territories, Nunavut

COSEWIC Status History: The original designation considered a single unit that included Peary Caribou, *Rangifer tarandus pearyi*, and what is now known as the Dolphin and Union Caribou, *Rangifer tarandus groenlandicus*. It was assigned a status of Threatened in April 1979. Split to allow designation of three separate populations in 1991: Banks Island (Endangered), High Arctic (Endangered) and Low Arctic (Threatened) populations. In May 2004 all three population designations were de-activated, and the Peary Caribou was assessed separately from the Dolphin and Union Caribou, *Rangifer tarandus groenlandicus*. The subspecies *pearyi* is composed of a portion of the former "Low Arctic population", and all of the former "High Arctic" and "Banks Island" populations, and it was designated Endangered in May 2004. Status re-examined and designated Threatened in November 2015.

* COSEWIC (Committee on the Status of Endangered Wildlife in Canada)

2. Species Status Information

Peary Caribou (*Rangifer tarandus pearyi*) were assessed by COSEWIC as Endangered in 2004 and listed as Endangered in Schedule 1 of the *Species at Risk Act* (SARA) in 2011 (Government of Canada 2014). Peary Caribou were reassessed by COSEWIC as Threatened in 2015, recognizing an increasing trend over the past two decades.

Peary Caribou are thought to be found only in Canada, where they occur in the Northwest Territories (NT) and Nunavut (NU). NatureServe ranks Peary Caribou as critically imperiled at the global and national level (Table 1, summarized from NatureServe (2017)). At the territorial level, Peary Caribou are ranked as critically imperiled in the NT by NatureServe and were designated as Threatened in 2014 under the territorial *Species at Risk (NWT) Act*. In Nunavut, Peary Caribou are unranked by NatureServe and there is no Nunavut SAR legislation. The Nunavut *Wildlife Act* does have provisions related to the harvesting of species at risk, but no regulations are in place for Peary Caribou at this time.

Table 1: List and description of conservation status ranks for Peary Caribou.

NatureServe Ranks			Canadian Status	Territorial status
Rounded Global (G)	**National (N)**	**Sub-national (S)**		
T1[a]	N1[b]	NT – S1S3[c] NU – SNR[d]	SARA – Schedule 1 (Endangered)	NT – Threatened NU – Not listed

[a] T1 = Critically imperiled. T-ranks (Intraspecific taxon status ranks) are assigned for designations below the level of the species
[b] N1 = Critically imperiled
[c] S1 = Critically imperiled
[d] SNR = Unranked

3. Species Information

In Canada, four subspecies of caribou are currently recognized, following Banfield's (1961) classification: Peary Caribou (*R. t. pearyi*); Barren-ground Caribou (*R. t. groenlandicus*); Woodland Caribou (*R.t. caribou*); and Grant's Caribou (*R. t. granti*). A fifth subspecies, Dawson's Caribou (*R. t. dawsoni*), became extinct in the early 1900s. One population of Barren-ground Caribou, known as Dolphin and Union Caribou[4], shares habitat with Peary Caribou in the southern portion of the range, particularly on Victoria Island. This recovery strategy addresses the recovery of the Peary Caribou subspecies.

[4] In 2011, COSEWIC created 'Designatable Units' (DU) for caribou (*Rangifer tarandus*) in Canada using a number of variables to classify the different herds or groups of herds. These DU descriptions provided a clear and consistent scheme for identifying DUs due to the complexity of *Rangifer tarandus* in Canada. The Dolphin and Union population of Barren-ground Caribou was determined to belong to *Rangifer tarandus groenlandicus* (DU2), and was simply referred to as Dolphin and Union Caribou.

3.1 Species Description

Peary Caribou are the smallest caribou in North America. They have short muzzles (Banfield 1961; Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Spence Bay HTA 2013) and short, wide hooves (Banfield 1961). Their winter coat is long and mainly white, while their summer coat is white below and slate-coloured above, without the distinctive flank stripe that Barren-ground Caribou possess (Species at Risk Committee 2012). Their legs are white with the exception of a thin stripe in the front (Banfield 1961). Both Peary Caribou and Dolphin and Union Caribou have grey antler velvet (Species at Risk Committee 2012), which is notably different from the brown antler velvet of other Barren-ground and Woodland Caribou subspecies. Peary Caribou antlers, however, are smaller and thinner than the antlers of the Dolphin and Union Caribou (Ekaluktutiak HTO 2013).

3.2 Species Population and Distribution

3.2.1. Distribution

Thought to be found only in the NT and NU, a few Peary Caribou may rarely cross from Ellesmere Island to Greenland, but the Greenland population is thought to be extirpated (COSEWIC 2015). Peary Caribou are distributed across the Canadian Arctic Archipelago, excluding Baffin Island (COSEWIC 2015). Peary Caribou also occur in a few areas on the mainland, including the Boothia Peninsula, Pearce Point and the Parry Peninsula (Ekaluktutiak HTO 2013; Paulatuk HTC 2013).

Some Peary Caribou move between islands at various times of the year and, therefore, not all islands may be occupied at a given time. In addition, Peary Caribou are known to re-colonize areas after long periods without occupancy (Canadian Wildlife Service 2013; COSEWIC 2015). Peary Caribou tend to leave areas when forage has been depleted and may return when vegetation has grown back (Iviq HTO 2013; Olohaktomiut HTC 2013; Resolute Bay HTO 2013).

The species' distribution (Figure 1) is the area where Peary Caribou are known to occur. The species' distribution was updated through regional surveys and community knowledge and observations, and defined using a standard convex polygon that includes all areas identified as being used by Peary Caribou (Johnson et al. 2016). While there have been recent reports of a few Peary Caribou on Baffin Island (NWMB meeting December 2016), the polygon was modified to exclude Baffin Island since Peary Caribou are not normally found on Baffin Island, and this is thought to be a rare occurence. Within the species' distribution, Peary Caribou occupy a core range or an area outside of the core range (Figure 1). The core range represents what is believed to be the highest use area for Peary Caribou within the species' distribution. This core range was agreed to by the recovery strategy co-management group (Canadian Wildlife Service 2013). The core range differs from that used in COSEWIC (2015) by the

inclusion of King William Island, which was added based on the recommendation of the co-management group (Canadian Wildlife Service 2013). There is limited information available on the frequency or abundance of Peary Caribou outside of the core range. Interbreeding with other subspecies (i.e. Dolphin and Union Caribou or Barren-ground Caribou) and difficulties in distinguishing between the subspecies during aerial surveys make it difficult to assess the use of areas outside the core range by Peary Caribou. Communities have observed Peary Caribou outside the core range (Figure 1) but have also indicated that these are mostly low use areas for Peary Caribou. Recent discussions with the Olokhaktomiut HTC have indicated that the core range should be expanded on Victoria Island to include the Wollaston Peninsula. This area has not been the focus of surveys or research on Peary Caribou, and has been added to the schedule of studies (Table 8).

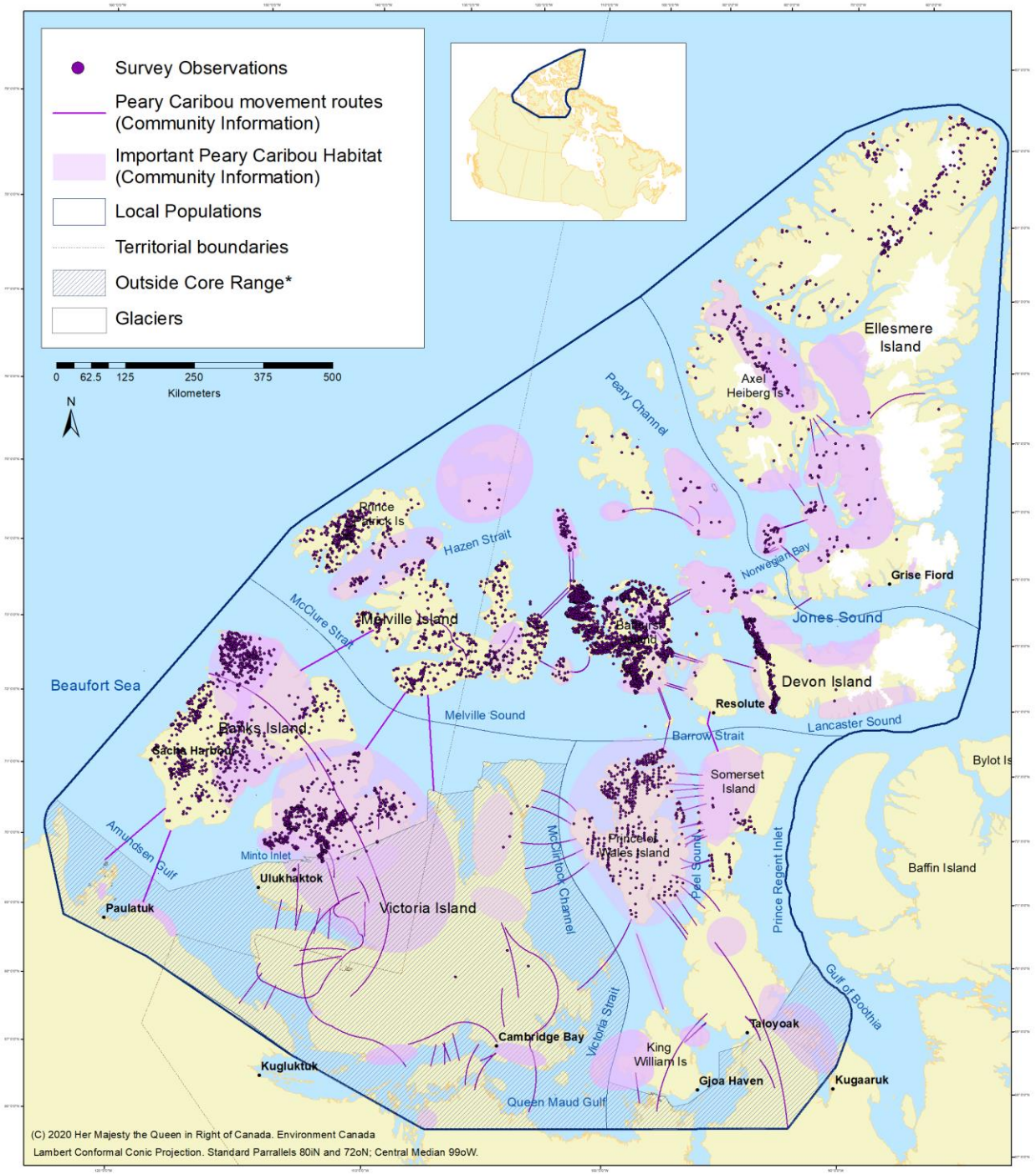

Figure 1. Peary Caribou distribution defined using a standard convex polygon methodology enclosing both survey data and community information (1970-2020) modified from Johnson et al. 2016 to differentiate between core range and areas outside of core range.

* Communities in the Kitikmeot region believe movement routes and Hadley Bay located outside the core range should be protected against shipping and icebreaking during sensitive periods for both Peary Caribou and Dolphin and Union Caribou, and to ensure sea ice formation in the fall.

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3.2.2. Local Populations

In this recovery strategy, the term “local population” refers to a group of Peary Caribou living and occupying a defined area that is spatially separate from other groups, such that the group’s population is driven primarily by local factors affecting birth and death rates, rather than immigration and emigration. The area occupied by a local population has to be large enough to account for life-history requirements, such as calving grounds, wintering grounds and movement routes; as well as being large enough to accommodate natural shifts in habitat use due to changing environmental conditions (Environment Canada 2011; Johnson et al. 2016).

Local Peary Caribou populations have been defined based on evidence of inter-island mouvements, genetic analyses and expert opinion, including Inuit Qaujimajatuqangit (IQ), Traditional Ecological Knowledge (TEK), local knowledge and scientific information (Johnson et al. 2016). Sufficient information is available to develop working hypotheses about local populations. However, there remains uncertainty in the proposed delineated local populations due to data limitations.

The four local populations are as follows (Johnson et al. 2016):

1. Banks – Northwest Victoria Islands
2. Western Queen Elizabeth Islands
3. Eastern Queen Elizabeth Islands
4. Prince of Wales – Somerset Islands – Boothia Peninsula

The local populations are shown in Figure 2.

Local population delineations will be updated as necessary, when new information becomes available. It should be noted that the delineation of local populations accounts for normal movements by Peary Caribou and does not include extreme movement events that may occur once every 20 to 30 years in response to harsh environmental conditions or low food availability (Canadian Wildlife Service 2015).

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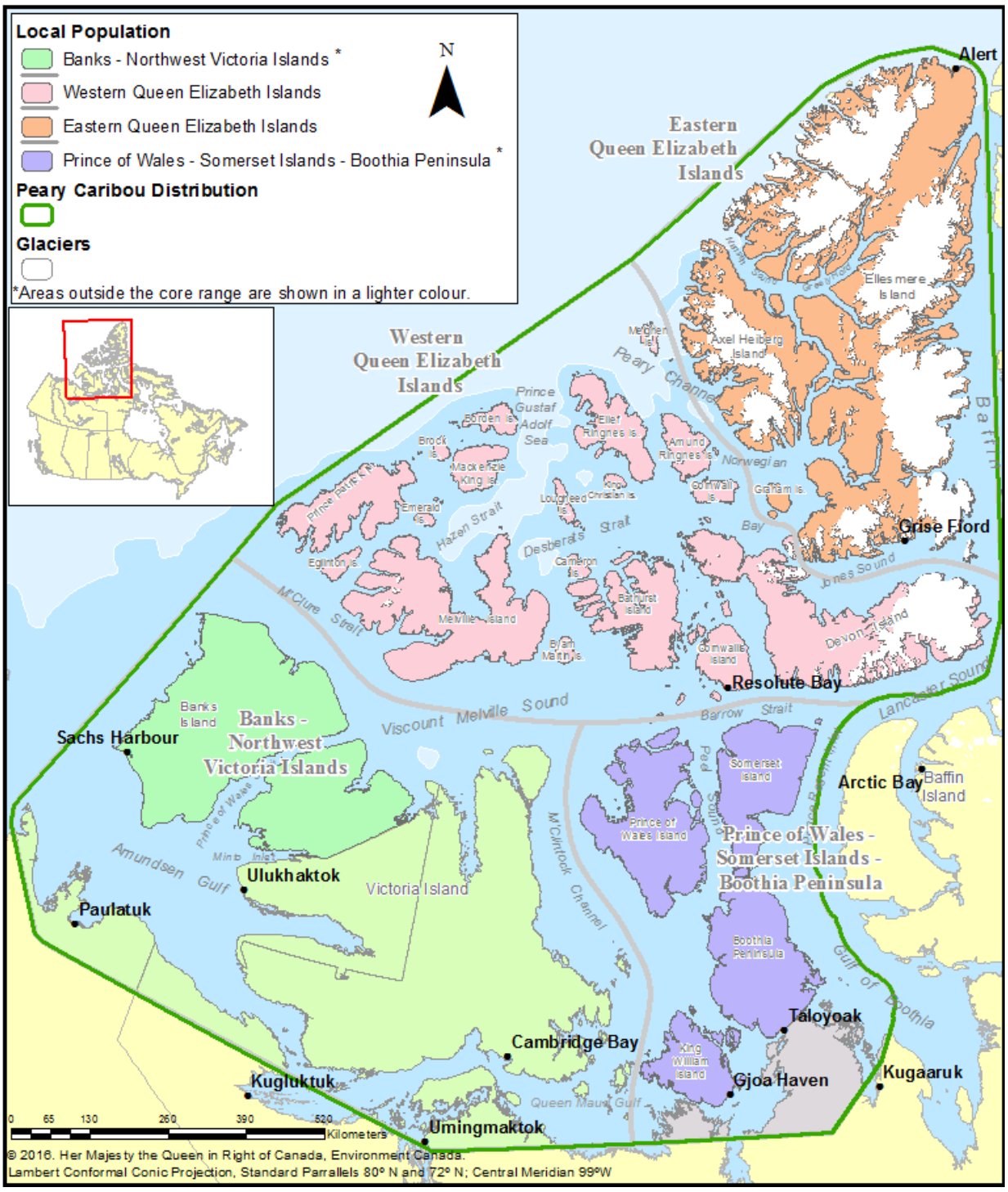

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540 Figure 2. Local Populations of Peary Caribou modified from Johnson et al. 2016.
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3.2.3. Population Sizes and Trends

Obtaining an accurate estimate of the size of a Peary Caribou local population is challenging and costly due to the remoteness of the Arctic Archipelago, the sparse distribution of Peary Caribou over large areas, and the species' capacity to move freely between islands (Gjoa Haven HTA 2013; Olohaktomiut HTC 2013; Paulatuk HTC 2013; Resolute Bay HTO 2013; Canadian Wildlife Service 2015; COSEWIC 2015). Communities recognize the importance of surveying caribou on a regular basis, but acknowledge the challenges identified above, as well as the difficulty to see Peary Caribou on a snowy background, or identify them when they mix with other subspecies of caribou in the southern part of their range (Gjoa Haven HTO 2016; Kurairojuark HTO 2016; Olohaktomiut HTC 2016; Sachs Harbour HTC 2016). Additionally, adverse weather conditions can hinder or prevent surveys and travel to Peary Caribou areas (COSEWIC 2015). As a result of costly operations and adverse weather conditions, population sampling across the Peary Caribou distribution is not comprehensive within a single season, and time between surveys is often lengthy (Olohaktomiut HTC 2013; COSEWIC 2015). IQ/TEK and local knowledge about the abundance of Peary Caribou is generally limited to areas relatively close to the communities.

Based on the best-available information, the current overall number of Peary Caribou in Canada is estimated to be approximately 13,200 mature individuals (COSEWIC 2015). The estimate of 13,200 is down from the approximately 22,000 Peary Caribou reported in 1987 and the estimated 50,000 Peary Caribou in the early 1960s, but up from a low of approximately 5,400 mature individuals in 1996 (COSEWIC 2015).

Peary Caribou population sizes naturally fluctuate and die-offs occur periodically (Tews et al. 2007b; Paulatuk HTC 2013; Sachs Harbour HTC 2013; Canadian Wildlife Service 2015; COSEWIC 2015). Peary Caribou populations are known to decline in size and then subsequently increase, although if the decline occurs rapidly, a rebound may be difficult (Paulatuk HTC 2013; Sachs Harbour HTC 2013).

The Banks – Northwest Victoria Islands local population has decreased overall since the early 1970s, but has been showing an increasing trend over the past 10 years (Johnson et al. 2016). Information from community members in Sachs Harbour agree with an increasing short-term trend (Sachs Harbour HTC 2016; Sachs Harbour HTC 2021). The latest estimates including calves (Table 2) are 2,742 Peary Caribou on Banks Island and 299 on Northwest Victoria Island (Davison and Williams 2013; Davison et al. 2014). In 2019, GNWT-ENR conducted a survey on Banks Island which resulted in a population estimate of 1,913 ± 406 (95%CI) adult. GNWT-ENR also conducted a survey of northwest Victoria Island in 2019, which produced estimates of 78 ± 136 (95% CI) adult Peary caribou for stratum A and 98 ± 91 (95% CI) adult for stratum C. These estimates have not been adjusted to include calves and are not statistically different from the population estimates in 2014 (Banks Island) and 2010 (Northwest Victoria Island). On Victoria Island, it is difficult to distinguish between Peary Caribou and Dolphin and Union Caribou from the air due to overlapping ranges at certain times of the year (Canadian Wildlife Service 2015).

In the latest surveys (Table 2), most of the Peary Caribou of the Western Queen Elizabeth Islands local population were found on Melville (3,224), Prince Patrick (3,067) and Bathurst (1,463) Islands (Davison and Williams 2012; Anderson 2014). The long term trend for this local population is increasing. The short-term trend informed by surveys is unknown because of data limitations. Local knowledge, however, indicates that the short-term trend is increasing (Resolute Bay HTO 2016).

The latest surveys (Table 2) of the Eastern Queen Elizabeth Islands show 2,255 Peary Caribou on Axel Heiberg and 918 on Ellesmere Islands (Jenkins et al. 2011; Anderson and Kingsley 2015). Both long and short-term trends for this local population are unknown because of data limitations (Johnson et al. 2016).

The Prince of Wales – Somerset Islands – Boothia Peninsula local population only had a few individuals reported in the most recent surveys (Table 2) conducted in 2004, 2006 and 2016 (Dumond 2006; Jenkins et al. 2011; Anderson 2016a). Like Victoria Island, this local population is particularly difficult to survey because parts of the range (particularly Boothia peninsula) are shared with Barren-ground Caribou. It is not possible to distinguish Peary Caribou from Barren-ground Caribou from the air. It has also been suggested that Peary Caribou may occur farther south than the area traditionally surveyed (Iviq HTO 2013; Spence Bay HTA 2013; Canadian Wildlife Service 2015). Observations from community members of Gjoa Haven, Resolute Bay and Grise Fiord, as well as from western science, indicate that Peary Caribou leave Prince of Wales Island in the fall (Miller and Gunn 1978; Grise Fiord Peary Caribou Workshop 1997; Miller et al. 2005; Taylor 2005; Gjoa Haven HTA 2013; Resolute Bay HTO 2013). Such movements of Peary Caribou could mean that they were missed in the 2004 spring population survey, which may have been conducted before most caribou would have historically migrated back to Prince of Wales Island. The short-term trend is unknown because of data limitations, but based on the best-available survey data, the long-term trend is decreasing (Johnson et al. 2016). Local knowledge indicates that the short-term trend is unknown (Spence Bay HTO 2016) and that in some areas, the local population levels have been low for the past several years (Gjoa Haven HTO 2016; Kurairojuark HTO 2016).

Community members throughout much of the Peary Caribou range indicated that Peary Caribou are currently doing well, and in some cases population sizes are increasing (Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Resolute Bay HTO 2013; Sachs Harbour HTC 2013; Spence Bay HTA 2013; Resolute Bay HTO 2016; Sachs Harbour HTC 2016; Sachs Harbour HTC 2021). A number of communities and representatives have suggested that Peary Caribou are not necessarily declining, but are simply moving to different areas (Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Olohaktomiut HTC 2013; Paulatuk HTC 2013; Spence Bay HTA 2013; Canadian Wildlife Service 2015), and that populations can manage themselves (Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Spence Bay HTA 2013). One community thought that the current population numbers were part of the natural downward cycle for Peary Caribou (Sachs Harbour HTC 2013), and another thought that caribou were having difficulty coming back up in their cycle because it was harder for them to migrate (Olohaktomiut HTC 2013).

While most communities indicated that Peary Caribou were doing well, a few communities identified both long-term and short-term declines in population counts. One community located in the southwestern part of the species' distribution, which also used to historically hunt Peary Caribou outside of the core range, identified a long-term decrease (Olohaktomiut HTC 2016). Over the short-term, the Paulatuk community which is located outside the core range stated that the local population has not appeared to increase (Paulatuk HTC 2016a), whereas the Cambridge Bay community has observed a severe decline in the last few years (Ekaluktutiak HTO 2016).

Table 2: Population size and trend information for Peary Caribou local populations in Canada (NT, NU). Adapted from Johnson et al. (2016).

#	Territory	Local Population Unit	Island	Most Recent Population Estimate (including calves)		Population Trend		Local Short-Term Assessment[b]
				Year	Area Corrected Estimate[a]	Short-term (10 year)	Long-term (30 year)	
1	NT	Banks - Northwest Victoria Islands	Banks	2014	2742 (Davison et al. 2014)[c]	Increasing	Decreasing	Increasing
			NW Victoria	2010	299 (Davison and Williams 2013)[d,e]			
2	NT-NU	Western Queen Elizabeth Islands	Melville	2012	3224 (Davison and Williams 2012)[f]	Unknown	Increasing	Increasing
			Prince Patrick	2012	3067 (Davison and Williams 2012)[a]			
			Eglinton	2012	214 (Davison and Williams 2012)			
			Emerald	2012	45 (Davison and Williams 2012)			
			Byam Martin	2012	153 (Davison and Williams 2012)			
			Devon	2016	14 (Anderson 2016b)[g,h]			
			Lougheed	2016	140 (Anderson 2016c)[d]			
			Bathurst	2013	1463 (Anderson 2014)			
			Cornwallis	2013	4 (Anderson 2014)[c]			
			Little Cornwallis	2013	1 (Anderson 2014)			
			Helena	1997	0 (Gunn and Dragon 2002)			
3	NU	Eastern Queen Elizabeth Islands	Axel Heiberg	2007	2255 (Jenkins et al. 2011)	Unknown	Unknown	Unknown
			Ellesmere	2015	918 (Anderson and Kingsley 2015)			
4	NU	Prince of Wales – Somerset Islands – Boothia Peninsula	Prince of Wales	2016	0 (Anderson 2016a)[d]	Unknown	Decreasing	Unknown
			Somerset	2016	0 (Anderson 2016a)[d]			
			Russell	2004	0 (Jenkins et al. 2011)			
			Boothia	2006	1 (Dumond 2006)[c]			

[a] The original survey results were area-corrected (to standardize island sizes) so that population estimates were comparable across years. In some cases the estimate for an island or geographic region was extrapolated from a smaller study area. Population estimates were also adjusted to include calves (Johnson et al, 2016). COSEWIC estimates the current population of Peary Caribou at about 13,200 mature individuals. The estimates presented here have been corrected to include calves.

[b] Assessment generated from technical meetings in communities 2013 and 2016.

[c] In 2019, GNWT-ENR conducted a survey on Banks Island which resulted in a population estimate of 1,913 ± 406 (95%CI) adult Peary caribou. This estimate has not been adjusted to include calves and is not statistically different from the population estimate in 2014.

[d] A subsequent 2015 survey revealed low numbers of caribou on Northwest Victoria Islands (minimum count of 4; no estimate was conducted). The 2015 survey was conducted in April instead of July/August. Davison, T., and J. Williams (2015).

[e] In 2019, GNWT-ENR conducted a survey of northwest Victoria Island, which produced estimates of 78 ± 136 (95% CI) adult Peary caribou for stratum A and 98 ± 91 (95% CI) adult Peary caribou for stratum C. These estimates have not been adjusted to include calves and are not statistically different from the population estimate in 2010.

[f] Updated February 2015, personal comm T. Davison in Johnson et al. (2016)

[g] Minimum count

[h] Updated since Johnson et al. (2016). Estimate has not been area corrected.

3.3 Needs of Peary Caribou

3.3.1. Habitat and Biological Needs

Habitat Needs

Peary Caribou require vast amounts of land with access to adequate forage, water and protection from severe weather and predators (Iviq HTO 2013; Resolute Bay HTO 2013) to fulfill their annual life cycle. Across all local populations, Peary Caribou inhabit a variety of tundra and barren habitats with moderately moist to dry soils, and sparse to moderate vegetation cover that occur at mid to high elevations (Johnson et al. 2016). Higher elevations may be selected to reduce predation risk, and for better temperatures and snow conditions (Iviq HTO 2013; Olohaktomiut HTC 2013). Wet habitats with high vegetation cover, such as wet sedge meadow/tundra, have low use by Peary Caribou (Thomas et al. 1999; Larter and Nagy 2001b). Community members of Grise Fiord have noted that Peary Caribou are often not found in areas with high vegetative cover, choosing areas with high quality forage instead (Iviq HTO 2013).

Peary Caribou select habitats to maximize forage accessibility. Peary Caribou habitat is covered in snow for nine to 10 months of the year, making access to forage the key factor in habitat selection (Larter and Nagy 2001b; Species at Risk Committee 2012; COSEWIC 2015; Johnson et al. 2016). During winter, Peary Caribou modify their habitat use in response to various snow and ice conditions, and as such, require a diversity of habitats (Species at Risk Committee 2012; Gjoa Haven HTA 2013; Olohaktomiut HTC 2013; Johnson et al. 2016). Peary Caribou will select sites with no snow or conditions that will allow them to push the snow aside or dig (crater) to the vegetation underneath with the least amount of energy (Larter and Nagy 2001b; Miller and Gunn 2003b; COSEWIC 2015). Typically, these are exposed, windblown sites found on tops or sides of hills, slopes or in upland areas that have shallow or no snow, or near formations that provide shelter for vegetation growth, such as ridges or boulders (Miller et al. 1977; Russell et al. 1979; Miller et al. 1982; Thomas and Edmonds 1983; Olohaktomiut HTC 2013).

During the snow-free period, forage availability is relatively unlimited (Miller and Gunn 2003b). Peary Caribou move across the landscape to follow the phenology of vegetation (i.e. growing of leaves, flowers and seeds over the season); they travel to lower coastal areas in the spring/early summer where forage is available first, then return to inland areas as forage becomes available (Johnson et al. 2016). During the summer, Peary Caribou modify their habitat use to maximize feeding on the most nutritious forage, particularly the newest plant growth, flowers and seed heads (Miller and Barry 2003). This high quality forage is critical for reproduction, growth and winter survival (Miller 2003).

Forage and Diet

Since forage availability varies seasonally and across their range (Resolute Bay HTO 2013), Peary Caribou are opportunistic and feed on a wide variety of plant species (Miller 2003). Primary forage plants includes dwarf shrubs, forbs, grasses, rushes and

sedges (Parker and Ross 1976; Shank et al. 1978; Thomas and Broughton 1978; Miller et al. 1982; Larter and Nagy 1997, 2004), and the Gjoa Haven community noted that seaweed may be consumed when other vegetation is inaccessible (Gjoa Haven HTA 2013). Lichens are estimated to comprise <10% of the annual diet of Peary Caribou (Miller and Gunn 2003b), but these may be more important forage in fall and winter in some areas (Miller et al. 1982; Species at Risk Committee 2012). Mosses are thought to be relatively unimportant food sources, and Peary Caribou only browse on them transiently as they move across the landscape (Staaland et al. 1997). Peary Caribou will often select the most nutritious parts of seasonally available forage due to their high protein and energy content, such as flowers, seed heads and winter-green leaves, (Thomas and Kroeger 1980; Gunn et al. 1981; Thomas and Edmonds 1984).

Migration and Distribution

Connectivity across the landscape and sea ice is critical for Peary Caribou. Peary Caribou move between and within islands to use different areas to complete their life-stages – calving, rutting and seasonal foraging, and/or to escape extreme weather events or bad environmental conditions (Canadian Wildlife Service 2013; Sachs Harbour HTC 2013; COSEWIC 2015; Gjoa Haven HTO 2016; Johnson et al. 2016; Resolute Bay HTO 2016; Spence Bay HTO 2016). Some of those movements could be migratory, but the information available does not allow for generalization to all movements. As such, we have chosen to use the word movement instead of migration in this document.

A summary of timing windows for each life-stage can be found in Table 3. The timing and locations of these life-stages and seasonal movements are variable over time because they depend on forage availability, which is in turn determined by annual snow and ice conditions, which determine forage availability: the greater the forage restrictions due to high snow/ice cover, the earlier the life stage process (e.g. calving) or seasonal movement occurs (Miller 1991). Therefore, Peary Caribou can move widely across the landscape to meet their foraging requirements, especially when forage accessibility is low (Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Iviq HTO 2013; Olohaktomiut HTC 2013; Spence Bay HTA 2013; Gjoa Haven HTO 2016).

Caribou group size is influenced by forage availability (Miller et al. 1977). For example, on Melville Island, summer group size is relatively larger (mean 10.1) than winter group size (mean 4.4), and solitary individuals are observed during times of stress (Miller et al. 1977). However, widespread forage inaccessibility due to high snow/ice cover can cause relatively high densities of Peary Caribou (Miller et al. 1977; Miller 1991).

Peary Caribou can remain on one island throughout their life-cycle or travel to several islands across the sea ice (Johnson et al. 2016). Larger islands, such as Banks Island, have diverse landscapes that allow for intra-island movements, whereas inter-island movements allow Peary Caribou to optimize the use of available habitat on multiple islands that are critical for their survival (Miller et al. 1977; Miller and Gunn 1978; Gunn et al. 1981; Grise Fiord Peary Caribou Workshop 1997; Miller and Barry 2003; Miller et

al. 2005; Canadian Wildlife Service 2012; Species at Risk Committee 2012; Resolute Bay HTO 2013; COSEWIC 2015).

It is also suggested that inter-island movements and large areas are essentials for Peary Caribou to avoid predation (Miller and Gunn 2003b; Species at Risk Committee 2012; Johnson et al. 2016). Peary Caribou also have a tendency to leave areas for multiple years and then return to occupy them again (Canadian Wildlife Service 2013; Iviq HTO 2013). It is thought that these movements in small, widely dispersed groups of a dozen or fewer individuals is likely an adaptation to vegetation availability and to avoid predators and insects (COSEWIC 2015). Peary Caribou remain dispersed across the landscape at low densities throughout their annual life cycle, even during calving and rutting. Post-calving densities are relatively small (tens of individuals) compared to Barren-ground Caribou (hundreds to thousands of individuals) (Festa-Bianchet et al. 2011; COSEWIC 2015).

Based on habitat modelling for Peary Caribou by Johnson et al. (2016) and earlier studies on Dolphin and Union Caribou (Poole et al. 2010), the characteristics of sea ice required for successful caribou crossing are >90% sea ice cover in the area and at least 10 cm ice thickness.

Calving and Rutting

Peary Caribou are versatile in their calving locations. They select a variety of habitat types that have sufficient vegetation for continuous foraging (Iviq HTO 2013; COSEWIC 2015) and generally occur at medium to high relative elevations; lower elevations are used less frequently (Resolute Bay HTO 2013; Sachs Harbour HTC 2013; Johnson et al. 2016). Calving commonly occurs in coastal areas (Miller 1991, 1992), but inland areas are also used in years with low snow/ice cover (Miller 1993a, 1994). Given this variability, the locations of calving areas shift over time (Sachs Harbour HTC 2013), but there is some evidence that Peary Caribou have fidelity to calving areas at a larger scale (Gunn and Fournier 2000). Information on rutting habitat is generally lacking. However, there is evidence that Peary Caribou primarily use coastal areas to maximize encounter rates (Miller and Barry 2003) and have fidelity to rutting areas (Miller et al. 1977).

Table 3. Peary Caribou lifecycle stages and timing windows by local population (Adapted from Johnson et al. 2016).

Local Population	Peary Caribou Life-Cycle Stage			
	Calving	**Summer Foraging**	**Rutting**	**Winter Foraging**
Banks – Northwest Victoria Islands	Banks: late May to the third week of June Northwest Victoria: June 5 to 21	July to August	Peak: late October to early November	September to May
Western Queen Elizabeth Islands	Early June to early July; Peak: second to fourth week of June	July to August	Late September to mid-October	September to May
Eastern Queen Elizabeth Islands	Early to mid-June	July to August	Late September to mid-October	September to May
Prince of Wales – Somerset Islands – Boothia Peninsula	Prince of Wales: third week of June Boothia: early to mid-June	July to August	Late September to mid-October	September to May

3.3.2. Limiting Factors

Peary Caribou have a low reproductive output, which means that they are limited in their potential to recover from any disturbances that severely reduce their population size. Females typically do not produce young until two or three years of age and typically only have one calf per year once they have reached sexual maturity (COSEWIC 2015). Insufficient forage availability during the winter can limit population growth for Peary Caribou (COSEWIC 2015). Body condition, which is impacted by a cow's access to forage, will determine whether a female becomes pregnant in a given year (Species at Risk Committee 2012). This relationship causes highly variable pregnancy and calf production rates over time and among populations (COSEWIC 2015). Severe weather events that significantly restrict access to food results in starvation, erratic movements in search of food, large-scale die-offs and/or major declines in calf production (Miller and Gunn 2003b; Iviq HTO 2013; Paulatuk HTC 2013; Resolute Bay HTO 2013; Sachs Harbour HTC 2013; Spence Bay HTA 2013). The generation time, or the average age of parents, for Peary Caribou is thought to be between seven and nine years, with females potentially reaching 15 years of age (COSEWIC 2004; Community of Ulukhaktok et al. 2008; Species at Risk Committee 2012; COSEWIC 2015).

4. Threats

4.1 Threat Assessment

Due to the Peary Caribou's geographically expansive distribution, habitat conditions can be highly variable across their range. As a result, the threats Peary Caribou and their habitat face can vary greatly from one part of the range to the next; threats that are significant in one area may not be of concern in other areas. The threats presented here represent a range-wide perspective.

Threats to Peary Caribou were documented throughout the recovery strategy development process; including during meetings in eight communities. In this recovery strategy, threats to Peary Caribou were assessed based on the IUCN-CMP (World Conservation Union - Conservation Measures Partnership) unified threats classification system. These international standards for describing threats were utilized in order to provide consistency between different species, and improve data sharing and coordination among species at risk and other related wildlife programs.

Threats are defined as human activities (e.g. resource extraction) or natural processes (e.g. severe weather events) that have caused, are causing, or may cause future destruction, degradation, and/or impairment to a living organism (e.g. species), a group of organisms (e.g. population or community) or a whole ecosystem (Salafsky et al. 2008). Threats may be assessed globally, nationally or regionally. For the purpose of the threat assessment, only current threats, and those expected to occur within the next 10 years were considered. However, historical threats, indirect or cumulative effects of the threats, and any other relevant information are presented in Section 4.2 to better understand current threats.

The threat classification table for Peary Caribou (Table 4) was completed by a panel of scientific and IQ/TEK experts on Peary Caribou in September 2014. An expanded version of this table can be found in COSEWIC (2015). The panel considered the scope, severity and timing of each threat. Scope is the proportion of the population that is reasonably expected to be affected by the threat within the next 10 years. Severity is the expected decline over the next three generations due to the threat. Timing describes how immediate the threat is, whether the threat is a problem now or something that may become a problem in the future. Impact is calculated from a combination of scope and severity.

The overall threat impact for Peary Caribou is Very High – Medium.

848 Table 4. Threat classification table for Peary Caribou

IUCN-CMP Threat #	Threat Description	Impact[a]	Scope[b]	Severity[c]	Timing[d]	Description
1	Residential & commercial development	Negligible	Negligible	Extreme	High	
1.1	Housing & urban areas	Negligible	Negligible	Extreme	High	
3	Energy production & mining	Low	Restricted - Small	Slight	High	
3.1	Oil & gas drilling	Low	Restricted - Small	Slight	Moderate	
3.2	Mining & quarrying	Low	Small	Slight	High	
4	Transportation & service corridors	Medium - Low	Restricted - Small	Serious - Moderate	High	
4.1	Roads & railroads	Low	Small	Slight	Moderate	
4.2	Utility & service lines	Negligible	Negligible	Negligible	Unknown	
4.3	Shipping lanes	Medium - Low	Restricted - Small	Serious - Moderate	High	• Marine traffic
4.4	Flight paths	Negligible	Negligible	Slight	Moderate - Low	• Scheduled flights
5	Biological resource use	Low	Small	Slight	High	
5.1	Hunting & collection	Low	Small	Slight	High	• Harvest
6	Human intrusions & disturbance	Low	Restricted	Slight	High	
6.1	Recreational activities	Negligible	Negligible	Negligible	High	
6.2	War, civil unrest, & military exercises	Low	Restricted	Slight	High	
6.3	Work & other activities	Low	Restricted	Slight	High	
8	Invasive & other problematic species & genes	Medium - Low	Pervasive	Moderate - Slight	High	
8.1	Invasive non-native/alien species	Medium - Low	Large - Restricted	Moderate - Slight	High	• Parasites and diseases (both native and non-native)
8.2	Problematic native species	Low	Pervasive	Slight	High	• Competition (e.g. muskoxen) • Predation (e.g. wolves)
8.3	Introduced genetic material	Unknown	Small	Unknown	High	

9	Pollution	Unknown	Pervasive	Unknown	High	
9.4	Garbage and solid waste	Unknown	Pervasive	Unknown	High	
9.5	Air-borne pollutants	Unknown	Pervasive	Unknown	High	
11	Climate change & severe weather	High - Medium	Pervasive	Serious - Moderate	High	
11.1	Habitat shifting & alteration	High - Medium	Pervasive	Serious - Moderate	High	• Sea ice loss • Sea level rise and erosion • Vegetation changes
11.4	Storms & flooding	Medium - Low	Restricted - Small	Serious - Moderate	Moderate	• Icing Events • Wind
Overall Threat Impact: Very High - Medium						

[a] **Impact** – The degree to which a species is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of each threat is based on Severity and Scope rating and considers only present and future threats. Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. The median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: Very High (75% declines), High (40%), Medium (15%), and Low (3%). Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown); Not Calculated: impact not calculated as threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low as threat is only considered to be in the past); Negligible: when scope or severity is negligible; Not a Threat: when severity is scored as neutral or potential benefit.

[b] **Scope** – Proportion of the species that can reasonably be expected to be affected by the threat within 10 years. Usually measured as a proportion of the species' population in the area of interest. (Pervasive = 71–100%; Large = 31–70%; Restricted = 11–30%; Small = 1–10%; Negligible < 1%).

[c] **Severity** – Within the scope, the level of damage to the species from the threat that can reasonably be expected to be affected by the threat within a 10-year or three-generation timeframe. Usually measured as the degree of reduction of the species' population. (Extreme = 71–100%; Serious = 31–70%; Moderate = 11–30%; Slight = 1–10%; Negligible < 1%; Neutral or Potential Benefit ≥ 0%).

[d] **Timing** – High = continuing; Moderate = only in the future (could happen in the short term [< 10 years or 3 generations]) or now suspended (could come back in the short term); Low = only in the future (could happen in the long term) or now suspended (could come back in the long term); Insignificant/Negligible = only in the past and unlikely to return, or no direct effect but limiting.

4.2 Description of Threats

The most significant threats to Peary Caribou are from the impacts of climate change, including sea ice loss, icing events restricting forage availability and sea-level rise. Other important threats to Peary Caribou are the loss of sea ice from marine traffic, as well as threats of parasites and diseases. Mining and exploration, competition, predation, human disturbance and harvesting are also threats to this species. Each threat is described below from high to low impact and each threat category has a standard number that correlates to the IUCN-CMP classification system. The threats described here are only those expected to affect Peary Caribou within the next ten years.

4.2.1. Climate Change & Severe Weather (IUCN-CMP Threat #11)

The most significant threat to Peary Caribou is climate change. The Arctic has experienced some of the most substantial warming on the planet since the mid-20th century (Post et al. 2009; Zhang et al. 2011; IPCC 2013; Ekaluktutiak HTO 2016). Communities are already observing the effects of climate change within the range of Peary Caribou, although not all communities are experiencing every impact. Observed changes include falling sea levels in some areas, and rising sea levels in others, lower water levels in lakes and ponds, increased vegetation, more frequent icing events, increased wind, increased insects abundance, changes in the timing of ice freeze-up and break-up, and species being observed in areas where they have never been seen before (Canadian Wildlife Service 2012; Ekaluktutiak HTO 2013; Olohaktomiut HTC 2013; Paulatuk HTC 2013; Sachs Harbour HTC 2013; Spence Bay HTA 2013; Canadian Wildlife Service 2015; Ekaluktutiak HTO 2016). The long-term effects of climate change and the implications on Peary Caribou and their habitat are unknown.

Direct threats from climate change are discussed in this section, including sea ice loss affecting the caribou's ability to migrate between islands, habitat loss from rising sea levels, decreased accessibility to winter forage due to icing events, changes to vegetation resulting in higher abundances of low nutrient shrubbery, and stronger wind events impacting snow hardness in the winter. Effects of climate change may also compound the impact of other threats to Peary Caribou (Canadian Wildlife Service 2012, 2013). Pathogens may become more prevalent, the range of overlap with predators and competitors could grow, contaminant pathways and cycles may change (e.g. mercury), and caribou unable to migrate between islands due to the loss of sea ice may be unable to withstand further habitat loss caused by human disturbances (e.g. oil and gas exploration).

Habitat Shifting & Alteration (IUCN-CMP Threat #11.1)

Sea ice loss (see also: Marine traffic)

Increasing temperatures have caused a reduction in the extent, thickness, and duration of sea ice as well as a delay in freeze-up in the Arctic (IPCC 2013; Panikkar et al. 2018). Further sea ice loss is predicted to continue into the future (Sou and Flato 2009;

Wang and Overland 2009; Collins et al. 2013; IPCC 2013). The amount of old, thick multi-year sea ice has decreased by 50% between 2005 and 2012, and it is estimated that 75% of summer Arctic sea ice volume has been lost since the 1980s (IPCC 2013). Projections indicate that annual sea ice will likely decrease by 3.5% to 4.1% per decade in the Arctic (IPCC 2013).

Some models predict that the summertime ice cover will decrease by 45% in the Canadian Arctic Archipelago by 2041-2060 (Sou and Flato 2009). These projections of sea ice loss may be conservative as climate models underestimated the rapid decline in summer Arctic sea ice observed over the past decades (IPCC 2013). In some places, freeze-up is already occurring much later than it used to (Ekaluktutiak HTO 2013; IPCC 2013). Recent studies on sea ice break-up around Banks Island suggest break-up will occur 2-3 days earlier for each 1 °C increase in temperature (Cooley et al. 2020). In other areas, waters that would previously freeze annually (such as north of King William Island, and around Prince of Wales and Boothia Peninsula) are now remaining ice-free all winter (Canadian Wildlife Service 2013).

Sea ice is important seasonal habitat for Peary Caribou as it allows them to travel between islands (Canadian Wildlife Service 2013; Post et al. 2013; Gjoa Haven HTO 2016; Resolute Bay HTO 2016; Spence Bay HTO 2016). Such movements facilitate both annual movement between seasonal ranges, and occasional movements to escape severe conditions (Miller et al. 2005) or to allow ranges time to regenerate (Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Iviq HTO 2013; Resolute Bay HTO 2013; Spence Bay HTA 2013). Many Peary Caribou would be unable to access the resources they need to survive at specific times of the year without adequate sea ice providing the ability to move between islands, which could lead to the extirpation of caribou from some or possibly many islands (Miller et al. 2005). Miller et al. (2005) concluded that in the absence of multi-island ranges, large populations of Peary Caribou might only be able to survive on Victoria and Ellesmere Islands because these are the only islands large enough to allow range rotation within the island. Loss of inter-island movements may also increase genetic isolation, leaving caribou less able to adapt to changing conditions. Additionally, loss of inter-island movements may also reduce the chance of areas being repopulated from neighbouring islands (Gunn et al. 1981; Post et al. 2013).

Caribou will experience increasing challenges with crossing sea ice because of accelerated warming (Cooley et al., 2020) and a sustained decline of sea ice extent (i.e., -54,000 km²/year; Yadav et al., 2020) associated with climate change. Reductions of sea ice are already affecting the timing of caribou crossings and increasing accidental drowning deaths that occur when caribou attempt to cross ice that is too thin (Canadian Wildlife Service 2012, 2013; Ekaluktutiak HTO 2013; Olohaktomiut HTC 2013; Sachs Harbour HTC 2013; Ekaluktutiak HTO 2016; Olohaktomiut HTC 2016). One community observed that delays in fall crossings could lead to caribou starving to death while waiting for the ice to be thick enough to cross (Gjoa Haven HTO 2016). Also, individuals are at risk of increased predation, parasites, and infection (Poole et al. 2010), as well as

overgrazing (Species at Risk Committee 2013), when congregated in staging areas waiting for ice to form.

In addition to sea ice loss, marine traffic and ice-breaking activities can keep ice crossings open artificially. This is discussed in section 4.2.2 Marine Traffic.

For more details on the effect of sea ice loss on movements, see Appendix II of Johnson et al. (2016).

Sea level rise and erosion

Global sea level rise is influenced by various factors including thermal expansion of the ocean, as well as melt-water from glaciers, ice caps and ice sheets. Rising sea levels can influence the frequency and extent of coastal flooding and erosion, but the impact of sea level rise on Arctic coastlines is highly variable. The coastlines of the central Arctic Archipelago are rising, causing sea levels to fall, while eastern and western coastlines of the Archipelago are subsiding causing sea levels to rise (Pelletier and Medioli 2014). Rising and subsidence of land is a result of delayed effects from the last glaciation; where ice sheets once depressed land, earth is uplifting, while land along the periphery of the ice sheet is sinking (Pelletier and Medioli 2014). Projections over the 21st century predict that the sea level will experience enhanced rise where the land is currently subsiding, and areas where the land is rising may see a transition from sea level fall to sea level rise (Warren and Lemmen 2014).

Climate scientists predict a global sea level rise between 0.26 to 0.82 m by 2100 (IPCC 2013). Such an increase could inundate coastlines throughout the Canadian Arctic as well as submerge several islands (Pelletier and Medioli 2014). Moreover, where sea ice is projected to decrease, such as in the Arctic (see sea ice loss threat description above), increased extreme high water levels due to wave run-up are predicted. This could lead, combined with thawing permafrost, to increased amounts of coastal erosion (Forbes 2011; Warren and Lemmen 2014) or cause widespread vegetation death due to salinization (Kokelj et al. 2012). Many Arctic coastal communities have noticed erosion near their community or in other areas while travelling (Forbes 2011; Sachs Harbour HTC 2016). All these projections could significantly reduce habitat availability and quality for Peary Caribou in the Arctic Archipelago.

Vegetation changes

Warmer temperatures in the Arctic are changing the timing of emergence and the amount and nutritional quality of plants available to Peary Caribou (Post et al. 2009). Changes in temperatures, precipitations and sunlight could affect plant phenology and likely the quality of plants for caribou (Inuvialuit Game Council, personal communication 2021). It is not clear what impacts these changes will have on Peary Caribou and their habitat.

Increased plant growth and changes in vegetation patterns are being observed in some areas of the Arctic (Ahern et al. 2011; Canadian Wildlife Service 2012; Paulatuk HTC 2013; Sachs Harbour HTC 2013; COSEWIC 2015). It is possible that increased plant

growth and a shorter snow-covered period could benefit Peary Caribou by making more summer forage available (COSEWIC 2004; Tews et al. 2007a), particularly in the southern parts of the range (Jia et al. 2009). Vegetation productivity has risen by 18.5-34.2% from 1982 to 2011 across the Arctic (Xu et al. 2013). More abundant summer forage could increase summer fat accumulation for Peary Caribou, which in turn could positively impact reproductive rates and winter survival, by offsetting the decrease in winter forage availability from icing events (see icing events threat below). The changes in vegetation are expected to be more pronounced and rapid in the Low Arctic than in the High Arctic, as plant growth in the High Arctic is limited by soil nutrients (Walker et al. 2006; Elmendorf et al. 2012a) and water availability during the growing season (Boulanger-Lapointe et al. 2014).

However, an increase in vegetation may not benefit Peary Caribou if the vegetation is poor quality forage, or if the timing of the vegetation availability doesn't match the critical life stages for Peary Caribou, such as calving. Although shrub cover is predicted to represent the primary increase in vegetative biomass in the Arctic, non-forage plants as evergreen shrubs have shown to increase in biomass in some regions (Hudson and Henry 2009; Elmendorf et al. 2012a; Elmendorf et al. 2012b; Pearson et al. 2013). Evergreen shrubs are of low nutritional value to Peary Caribou whichselectively eat high quality and highly digestible forage in order to meet their nutritional requirements, particularly in summer (Thomas and Kroeger 1980; Klein 1992; Larter et al. 2002). Peary Caribou prefer to eat deciduous shrubs, forb flowers and seed heads (Larter and Nagy 1997, 2001a, 2004). An increase in evergreen shrubs may decrease the availability of these preferred high quality foods.

Caribou movements and certain life-stages (e.g. calving and rutting) are timed to coincide with the emergence of high quality food sources (Post and Forchhammer 2008). Climate change is making green-up occur earlier in the year (Jia et al. 2009; Xu et al. 2013). Although Peary Caribou can adjust their life-stages and seasonal movements to prevailing snow conditions to a degree, i.e., a few weeks (Miller 1991, 1993a), it is likely that the timing of caribou life-stages are primarily cued by day length (Post and Forchhammer 2008). Therefore it is unlikely that Peary Caribou will be able to match any larger changes in the growing season. This trophic mismatch could result in a poorer diet for Peary Caribou with potential impacts to health and survival.

For more details on the potentially positive and negative effect of vegetation change on Peary Caribou, see Appendix II of Johnson et al. (2016).

Storms & Flooding (IUCN-CMP Threat #11.4)

Icing events

Freezing rain, or the re-freezing of melted snow, can cause a layer of ice to form that prevents Peary Caribou from accessing the snow-covered forage. Such icing events can lead to malnutrition or starvation resulting in death (Miller and Gunn 2003b; COSEWIC 2015). Severe icing events have been associated with large-scale and sudden population declines of Peary Caribou (Miller and Gunn 2003a; Paulatuk HTC

2013; Resolute Bay HTO 2013; Sachs Harbour HTC 2013; Spence Bay HTA 2013; COSEWIC 2015). Periods with increased frequency of icing events have been observed in many Arctic areas (Gunn and Skogland 1997; Miller and Gunn 2003a; Harding 2004; Tews et al. 2007a; Sharma et al. 2009; Tews et al. 2012; Spence Bay HTA 2013), and climate change is expected to further increase the frequency and severity of icing events (Hansen et al. 2011; Liston and Hiemstra 2011; IPCC 2013; Semmens et al. 2013). The impact of icing events on Peary Caribou is uncertain and will depend on the extent, location and timing of the events. Widespread icing events where caribou cannot find alternate forage nearby will have the highest negative impact, however most icing events are thought to be localized (Canadian Wildlife Service 2015).

For more details on the effects of severe weather events on winter forage accessibility, see Appendix II of Johnson et al. (2016).

Wind

There seems to have been reports of an increase in wind in some communities, both in terms of the number of windy days and the strength of the wind (Wang et al. 2006; Wan et al. 2010; Spreen et al. 2011; Canadian Wildlife Service 2015; Wang et al. 2015). Changes in wind direction have also been observed (Canadian Wildlife Service 2015). Strong winds can increase the energetic costs of movement and thermoregulation for caribou, especially when accompanied by cold temperatures. Wind strength can also affect the hardness and density of the snow pack, which affects the ease of foraging (Miller and Gunn 2003b). In some regions of the Arctic, strong winds could increase sea ice drift speed (Spreen et al. 2011), or accelerate ice retreat (Wang et al. 2015), which could affect ice crossing for caribou. However, stronger wind could be beneficial for caribou during the calving period and in early summer as it provides a relief from insect harassment (Hagemoen and Reimers 2002; Weladji et al. 2003 ; Moen 2008).

4.2.2. Transportation and Service Corridor (IUCN-CMP Threat #4)

Shipping Lanes (IUCN-CMP Threat #4.3)

Marine traffic

While shipping and other marine traffic are comparably low in the fall, winter and spring compared to in the summer, a single open channel created by a vessel in the sea ice could have a large impact on Peary Caribou. Frequent boat traffic in the fall could prevent sea ice from forming, thereby keeping channels open longer. This loss of sea ice can disrupt the inter-island movements by Peary Caribou (see above section on *Sea ice loss*) (Miller et al. 2005; Canadian Wildlife Service 2013; Paulatuk HTC 2013; Resolute Bay HTO 2013; Ekaluktutiak HTO 2016; Kurairojuark HTO 2016; Olohaktomiut HTC 2016). Caribou may not be able to swim across even the narrowest of open water ship tracks because the ice shelf and ice-block rubble along the edges of the shipping channel can prevent caribou from exiting the water, resulting in caribou drowning (Miller et al. 2005). One community observed such a drowning occurrence caused by a ship passing while caribou were on ice (Olohaktomiut HTC 2016). Studies of Dolphin and Union Caribou suggest that caribou generally require >90% ice cover and 10-30 cm ice thickness before attempting to cross seasonal sea ice (Poole et al. 2010).

Changes in sea ice conditions resulting from climate change, are expected to increase both the marine access to the Arctic and the length of the shipping season (Arctic Council 2009). An extended shipping season, along with higher boat traffic, increases the possibility of interaction between migrating and calving species and ships (Arctic Council 2009; Environment and Natural Resources 2016), as well as caribou mortalities due to drowning (Miller et al. 2005). Traffic from industrial vessels, icebreakers, cruise ships and recreational boat traffic is already growing in Arctic waters, and the length of the boating season is increasing (Gunn et al. 2011; Canadian Wildlife Service 2012; Paulatuk HTC 2013; Ekaluktutiak HTO 2016; Kurairojuark HTO 2016; Olohaktomiut HTC 2016; Dawson et al. 2018). This observation of increased shipping activity outside of the traditional shipping season (i.e. in May and November) is related to the warming climate and has significantly increased since 1990 (Pizzolato et al. 2014). Similarly, the number of vessels going through the Northwest Passage has rapidly increased, going from four per year in the 1980s to 20-30 per year in 2009-2013 (>75% increase; Environment and Natural Resources 2011, 2016). Numbers seem to be similar for the period between 2016 and 2019 with 5-31 full transits per year and 12-24 partial transits per year (Canadian Coast Guard, personal communication 2021).

An added concern is that increased shipping traffic may bring additional water pollutants through the illegal dumping of contaminated grey water, changing of ballast water, and potential oil or waste spills (Canadian Wildlife Service 2015; Olohaktomiut HTC 2016). Peary Caribou frequent coastal areas and could be impacted by such pollution. Changes in ice conditions caused by ship wakes are another potential environmental effect of increased shipping (Environment and Natural Resources 2016).

The severity of this threat will depend on which island crossings are affected and the size of the affected populations.

4.2.3. Invasive & Other Problematic Species & Genes (IUCN-CMP Threat #8)

Invasive non-native/alien species (IUCN-CMP Threat #8.1)

Parasites and diseases

Peary Caribou are thought to be very healthy across their entire distribution with few parasites or diseases (Species at Risk Committee 2012; Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Iviq HTO 2013; Olohaktomiut HTC 2013; Paulatuk HTC 2013; Resolute Bay HTO 2013; Sachs Harbour HTC 2013). However, there is concern that diseases affecting other northern species or other caribou subspecies could be transmitted to Peary Caribou (Ekaluktutiak HTO 2013; Paulatuk HTC 2013; Sachs Harbour HTC 2013; COSEWIC 2015; Olohaktomiut HTC 2016; Paulatuk HTC 2016a; Sachs Harbour HTC 2016). Barren-ground Caribou, for example, have high rates of brucellosis infections (Leighton 2011), which could be transmitted to Peary Caribou if they come into contact with each other. The most common impact of brucellosis is a decreased reproductive success (Leighton 2011). If climate change leads to greater

overlapping ranges with Barren-ground Caribou herds, other than Dolphin and Union Caribou, this disease could become established in Peary Caribou populations (Canadian Wildlife Service 2015; COSEWIC 2015).

A warming climate is also permitting the establishment of parasites that are not currently prevalent in the Arctic Archipelago to become established (Kutz et al. 2014). For example, a type of lungworm (*Varestrongylus spp.*), which affects both caribou and muskoxen *(Ovibos moschatus)*, was detected for the first time on Victoria Island in 2010 (Kutz et al. 2014). Similarly, the stomach parasite *Teladorsagia boreoarcticus*, which can affect Peary Caribou, was recently found on Banks and Victoria Islands (Hoberg et al. 2012). Some of these new parasites could become a concern for Peary Caribou health. Some communities have also expressed concerns that interactions with migratory birds could increase parasites and disease transmission to Peary Caribou in a warming climate context (Olohaktomiut HTC 2016; Sachs Harbour HTC 2016).

Although parasites and diseases were ranked as having a Medium-Low impact across the entire Peary Caribou range, some communities believe that this threat should be ranked higher because of their prevalence among other species, such as muskoxen, migratory birds, and other caribou subspecies like Barren-ground Caribou; and the potential increase of parasites and diseases due to climate change (Olohaktomiut HTC 2016; Sachs Harbour HTC 2016).

Climate change may lead to an increase in activity and/or abundance of warble flies, mosquitoes and other biting insects in the Peary Caribou range (Moen 2008; Culler et al. 2015). Insect harassment can be a major problem for caribou as time spent foraging and resting can dramatically decrease with increasing abundances and/or activities of flies (Hagemoen and Reimers 2002; Witter et al. 2012), and can also be exacerbated by high temperatures (Mörschel and Klein 1997). Insect avoidance behaviours could have a negative effect on caribou reproduction as less energy is spent on feeding, and more energy is expended for insect avoidance (Colman et al. 2003; Weladji et al. 2003). An increase in insect harassment could then be extremely detrimental for Peary Caribou, which must forage continuously to ensure that they have sufficient fat to survive the winter and reproduce successfully. Some communities have already observed an increase in biting insects (Olohaktomiut HTC 2013; Sachs Harbour HTC 2013; Ekaluktutiak HTO 2016) and new types of insects (Ekaluktutiak HTO 2016). Inuit suspect that an increase in deaths of Peary Caribou is due to heat and insect-induced exhaustion (Ekaluktutiak HTO 2016).

Problematic native species (IUCN-CMP Threat #8.2)

Competition – Muskoxen

Community members from Sachs Harbour, Ulukhaktok, Paulatuk, Gjoa Haven and Taloyoak consider interaction with muskoxen to be a major threat to Peary Caribou (Olohaktomiut HTC 2013; Paulatuk HTC 2013; Spence Bay HTA 2013; Gjoa Haven HTO 2016; Olohaktomiut HTC 2016; Sachs Harbour HTC 2016; Spence Bay HTO 2016). Reductions in the abundance of Peary Caribou have coincided with increases in

muskoxen numbers, granted this trend is variable throughout the distribution of Peary Caribou. For example, a negative relationship has been found on Banks Island, Prince of Wales Island and Somerset Island, but not on the Western Queen Elizabeth Islands (Gunn and Dragon 1998; Gunn et al. 2000; Canadian Wildlife Service 2012; Olohaktomiut HTC 2013; Canadian Wildlife Service 2015; COSEWIC 2015; Spence Bay HTO 2016).

Peary Caribou are often found in different areas than muskoxen (Kevan 1974; Thomas et al. 1999; Jenkins 2006; Paulatuk HTC 2013; Spence Bay HTA 2013; COSEWIC 2015). This could be the result of caribou avoiding muskoxen to reduce predation risk (Jenkins 2006; Canadian Wildlife Service 2013), caribou disliking the smell of muskoxen (Ekaluktutiak HTO 2013; Iviq HTO 2013; Paulatuk HTC 2013), or muskoxen trampling the snow and forage (Species at Risk Committee 2012). It has also been suggested that high populations of muskoxen maintain high populations of wolves, which also increases wolf predation on Peary Caribou (Miller 1993b; Nagy et al. 1996; Miller 2003; Gunn 2005; Gunn et al. 2011; Canadian Wildlife Service 2013; Larter 2013). Avoidance of muskoxen may lead to displacement of Peary Caribou, particularly when muskoxen populations are high.

While most studies have largely suggested that competition between Peary Caribou and muskoxen is limited based on low overlap in habitat use and diet (Kevan 1974; Wilkinson et al. 1976; Miller et al. 1977; Parker 1978; Shank et al. 1978; Russell et al. 1979; Thomas and Edmonds 1983; Schaefer et al. 1996; Thomas et al. 1999), muskoxen and caribou may be competing for forage, under specific environmental conditions, which could have negative consequences for Peary Caribou (Larter and Nagy 1997; Gunn et al. 2000; Canadian Wildlife Service 2013; Olohaktomiut HTC 2013). Some studies have indicated that competition may occur when forage accessibility is limited (Miller et al. 1977; Parker 1978; Staaland et al. 1997; Larter and Nagy 2001b) or when muskoxen densities are high (Vincent and Gunn 1981). As expressed by communities, the impacts of severe weather on muskox and their behaviour may have an effect on Peary caribou (Canadian Wildlife Service 2015).

Predation - Arctic Wolves

Arctic wolves (*Canis lupus arctos*) co-occur with Peary Caribou throughout their range (Miller 1992; Miller and Reintjes 1995; van Zyll de Jong and Carbyn 1999) and prey upon caribou as well as muskoxen, either in relation to their availability (Gunn et al. 1998; Gunn et al. 2000; Larter 2013) or preferentially (Miller 1993b; Gunn et al. 2000; Taylor 2005; Species at Risk Committee 2012; Canadian Wildlife Service 2013). Wolves are a major predator of calves and older caribou (Miller et al. 1985). Although wolves and caribou have co-existed for thousands of years, wolf predation could accelerate caribou declines or prevent population recovery, particularly when caribou populations are small and exposed to cumulative threats (Nagy et al. 1996; Gunn et al. 1998; Gunn et al. 2000; Miller and Gunn 2001). Caribou may be particularly sensitive to predation at certain periods of their life-cycle, such as during calving or seasonal movement (Resolute Bay HTO 2013). Predation can also cause changes to movement patterns (Canadian Wildlife Service 2013).

The severity of the threat posed by wolves varies across the range of Peary Caribou, but was considered high in much of the range (Canadian Wildlife Service 2015), notably in the western portion (Canadian Wildlife Service 2013; Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Olohaktomiut HTC 2013; Sachs Harbour HTC 2013). The number of wolves being observed is increasing in many parts of the range (Gunn 2005; Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Olohaktomiut HTC 2013; Spence Bay HTA 2013; Ekaluktutiak HTO 2016; Olohaktomiut HTC 2016; Paulatuk HTC 2016a; Sachs Harbour HTC 2016), but increases in wolf sightings may not necessarily indicate an increase in wolf abundance (Canadian Wildlife Service 2015). One community has expressed concern that industrial development is pushing the range of wolves farther north (Olohaktomiut HTC 2016). During community consultations in 2016, all communities except one identified high or increasing numbers of wolves and their impacts on caribou as a major concern. Most of these communities would rank predation (mainly by wolves) as a high threat in their area, and Cambridge Bay, Gjoa Haven, Taloyoak and Resolute Bay identified wolves as the main threat in their region (Ekaluktutiak HTO 2016; Gjoa Haven HTO 2016; Olohaktomiut HTC 2016; Paulatuk HTC 2016a; Resolute Bay HTO 2016; Sachs Harbour HTC 2016; Spence Bay HTO 2016). Wolves chasing caribou out into the open ocean or on to partly frozen sea ice have been observed by one community (Ekaluktutiak HTO 2016).

The lack of information on wolf populations and their impact on Peary Caribou populations is a major information gap that requires further study.

Other species

Peary Caribou do use wet habitats as they move across the landscape, although only sparsely (Wilkinson et al. 1976; Miller et al. 1982; Thomas et al. 1999; Larter and Nagy 2001b). Communities have identified Ross's geese (*Chen rossii)* and lesser snow geese (*C. caerulescens)* as potential competitors to Peary Caribou because they can significantly damage vegetation in wet areas by eating whole plants, including the roots (Canadian Wildlife Service 2013) which may limit potential caribou forage. Also, as goose populations grow, a concomitant increase in their use of upland habitats is to be expected (Reed et al. 2002). This could lead to greater competition for available habitat between Peary Caribou and Ross's and snow geese. Other herbivores such as Arctic hare (*Lepus arcticus*) and ptarmigan (*Lagopus mutus, L. lagopus)* may also compete with Peary Caribou for forage (Larter and Nagy 2004).

Communities have also identified polar bears (*Ursus maritimus*), grizzly bears (*Ursus arctos* ssp.), wolverines (*Gulo gulo*) and Arctic fox (*Vulpes lagopus*) as other potential predators of Peary Caribou (Canadian Wildlife Service 2012, 2013; Olohaktomiut HTC 2013). Climate change may cause an influx of predators into the Peary Caribou range. Many species' ranges are expanding northward as a consequence of climate change, which is already affecting Arctic ecosystems (Post et al. 2009). For example, some hunters have reported increased predation rates of Peary Caribou from grizzly bears and wolverines (Canadian Wildlife Service 2012, 2013; Olohaktomiut HTC 2013;

Ekaluktutiak HTO 2016; Olohaktomiut HTC 2016) or reduced hibernation time for grizzly bears (Ekaluktutiak HTO 2016).

Further studies are needed to address the questions of competition between Peary Caribou and muskoxen, and the complex predator-prey interaction between Peary Caribou, muskoxen and wolves. For a more detailed description of competition and predation threats, refer to appendix II of Johnson et al. (2016).

4.2.4. Energy Production & Mining (Resource Extraction) (IUCN-CMP Threat #3)

There is considerable concern from Inuit and Inuvialuit about the effects of mining, oil and gas extraction and seismic activities on the health of Peary Caribou local populations (Canadian Wildlife Service 2012, 2015). Past exploration and mining activities coincided with declining caribou populations, starting in the 1970s (Miller et al. 1977; Grise Fiord Peary Caribou Workshop 1997; Canadian Wildlife Service 2013; Iviq HTO 2013; Spence Bay HTA 2013). Energy production and mining activities are currently limited within the Peary Caribou range. However, demand for minerals could increase in the future, and combined with the Arctic's increasing accessibility, resource extraction may become a threat to Peary Caribou if not planned properly as to location and timing of activities. High Arctic communities expressed concerns regarding the growing interest in mining (Iviq HTO 2016; Resolute Bay HTO 2016), which could subsequently raise the level of threat to Peary Caribou.

Resource extraction activities can cause habitat loss for Peary Caribou. It is possible that the functional loss of habitat may be much greater than the actual industry footprint because Peary Caribou may abandon ranges or movement routes in order to avoid resource extraction activities (Iviq HTO 2013). Peary Caribou have been observed to avoid industrial activities and associated disturbances, such as seismic lines, motorized vehicles and helicopters (Riewe 1973; Taylor 2005; Canadian Wildlife Service 2013; Sachs Harbour HTC 2013). For example, in Grise Fiord, community members observed Peary Caribou dispersing to less vegetated areas when hydrocarbon exploration started (Iviq HTO 2013). Behavioural responses to human disturbances, however, are variable (Slaney and Co. Ltd. 1974; Slaney and Co. Ltd. 1975; Gunn and Miller 1980; Taylor 2005; Ekaluktutiak HTO 2013; Iviq HTO 2013; Resolute Bay HTO 2013). Avoidance is thought to have negative consequences for Peary Caribou, including restricting access to high quality habitat (Taylor 2005; Iviq HTO 2013) and disrupting movement routes (Olohaktomiut HTC 2013). Noise pollution, which can also cause avoidance behaviour, was a concern for the Grise Fiord community (Iviq HTO 2016). Associated construction of pipelines for oil and gas would lead to further habitat loss within the construction corridor, as well as potentially disrupting migratory movements (Russell et al. 1979).

Resource extraction activities may directly affect the health of Peary Caribou. Smoke and dust from explosions are thought to make the caribou sick and cause mortality (Taylor 2005; Iviq HTO 2013; Resolute Bay HTO 2013; Sachs Harbour HTC 2013). Elders in Sachs Harbour observed that caribou died from getting tangled in seismic

receiving lines (Sachs Harbour HTC 2013), and Inuit have reported that past oil and gas developments left a large amount of contaminants behind, which continue to be a threat to Peary Caribou (Canadian Wildlife Service 2015).

Increased industrial activity will also increase marine shipping, which threatens the ability of Peary Caribou to migrate between islands (see section 4.2.3 Marine Traffic).

The effects of resource extraction disturbances may be particularly harmful if they occur in sensitive areas (e.g. calving grounds on Banks Island, Species at Risk Committee 2012; Sachs Harbour HTC 2013, 2016), in areas with high densities of Peary Caribou (Canadian Wildlife Service 2013), or during critical periods such as calving or when forage availability is low (Spence Bay HTO 2016). While energy production and mining have been ranked as a low threat overall, and are currently limited within the Peary Caribou range, the threat to caribou in a particular area can be devastating.

For a more detailed description of threats from energy production and mining, refer to Appendix II of Johnson et al. (2016).

4.2.5. Human Intrusions & Disturbance (IUCN-CMP Threat #6)

Human intrusions from work and recreational activities are increasing in the Peary Caribou range. These activities are producing an increase in traffic from snow machines, all terrain vehicles, helicopters, airplanes and drones, which may disturb Peary Caribou. Many communities have expressed concerns about the impacts of noise (intensity and frequency), height and timing of flights on the health of caribou (Ekaluktutiak HTO 2016; Kurairojuark HTO 2016; Olohaktomiut HTC 2016; Sachs Harbour HTC 2016; Spence Bay HTO 2016). Indeed, if these activities cause avoidance behaviour or interrupt foraging, this may increase caribou energetic costs (Weladji and Forbes 2002). Cambridge Bay community members were also concerned that best management practices for aircraft (e.g. minimizing the impact of helicopter and airplane noise and presence by limiting low-level flying and avoiding wildlife during flights) were not always followed by industry or by all pilots (Ekaluktutiak HTO 2016).

Inuit in Grise Fiord and Resolute Bay have expressed concerns that research activities like capture and collaring have a negative impact on Peary Caribou. Handling of caribou is strongly discouraged by Inuit (Iviq HTO 2013; Resolute Bay HTO 2013), and is believed to have a negative effect on the well-being of Peary Caribou, which may cause caribou to leave an area, cause changes in behaviour, or negatively impact their health (Canadian Wildlife Service 2013; Iviq HTO 2013; Resolute Bay HTO 2013). The GN and GNWT work with communities to incorporate their concerns into research programs and no Peary Caribou are currently collared. No research involving collars has taken place in Nunavut in the last 18 years (M. Anderson, personal communication 2016).

Year-round military exercises, particularly ship and land exercises, are increasing in the Peary Caribou range, with military personnel travelling long distances between islands. These activities may disturb Peary Caribou (Resolute Bay HTO 2013). Sensory

disturbance associated with military exercises during critical life stages for Peary Caribou was also identified as a concern (Ekaluktutiak HTO 2016).

Visitation to the islands from tourists is becoming more common, which may cause disturbance to caribou and/or their habitat, which is going largely unmonitored (Canadian Wildlife Service 2015). One community expressed concerns regarding the increase in activities expected to occur in the next few years in Qausuittuq National Park on Bathurst Island (Resolute Bay HTO 2016). The community also expressed the importance and need to identify critical areas like calving grounds and movement routes to minimize disturbances by future National Park patrons (Resolute Bay HTO 2016). Concerns about the large number of people, including tourists, scientists and explorers from various organizations, going out on the land when the temperature is warmer was raised as being a major disturbance for Peary Caribou (Gjoa Haven HTO 2016).

More details on the impact of vehicles and people can be found in Appendix II of Johnson et al. (2016).

4.2.6. Biological Resource Use (IUCN-CMP Threat #5)
Hunting & Collection (IUCN-CMP Threat #5.1)

Peary Caribou are an important component of Inuit and Inuvialuit culture and sustenance in the Arctic, and have been for at least 4,000 years (Meldgaard 1960; Fitzhugh 1976; Manseau et al. 2005; Howse 2008; Friesen 2013). The Inuvialuit Final Agreement (1984) and Nunavut Land Claim Agreement (1993) recognize Indigenous rights to harvest wildlife, subject to conservation and public safety. These two Land Claims Agreements provide primary wildlife management authority to the Wildlife Management Advisory Council (NWT) (WMAC (NWT)), and the Nunavut Wildlife Management Board (NWMB) in the Peary Caribou range. The wildlife management authorities can recommend legislated hunting restrictions to their territorial Minister on Peary Caribou to ensure the sustainability of populations, while local management authorities, such as Hunter and Trapper Committees and Organizations (HTCs/HTOs), can restrict harvest by their members.

Overharvesting may have contributed to historic declines of Peary Caribou, including hunting by European explorers such as Commander Robert Peary in the early 1900s (Petersen et al. 2010). Much of the Peary Caribou range is inaccessible to hunters on snow machines (Canadian Wildlife Service 2013; Ekaluktutiak HTO 2013; Olohaktomiut HTC 2013; Sachs Harbour HTC 2013; COSEWIC 2015) and hunting activities largely take place within 80 km of a given community (Sachs Harbour HTC 2013). Additionally, there are only a few communities in the northern-most extent of the Peary Caribou range, with much of the area being un-inhabited. For these reasons, Inuit and Inuvialuit harvesting is not thought to be a threat to Peary Caribou under current management conditions (Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Olohaktomiut HTC 2013; Paulatuk HTC 2013; Resolute Bay HTO 2013; Spence Bay HTA 2013; Canadian Wildlife Service 2015).

Communities have generally found that restricting harvest has not resulted in a noticeable rebound in the number of Peary Caribou, suggesting that harvest is not a driving factor of Peary Caribou population numbers (Canadian Wildlife Service 2013). Despite this belief, harvest levels are currently low in most areas (Iviq HTO 2013; Paulatuk HTC 2013; Sachs Harbour HTC 2013; COSEWIC 2015). Some HTOs have established voluntary hunting restrictions for many years to foster the recovery of caribou, and have adjusted harvesting levels to respond to changes in population sizes (Larter and Nagy 2000a; COSEWIC 2004; Gunn 2005; Taylor 2005; Government of Nunavut 2014; COSEWIC 2015). There is one example in Resolute Bay where shutting down harvest after die-off years likely contributed to the rebound of the population (Miller and Gunn 2003a). Another example is the voluntary restriction of hunting by Sachs Harbour and Ulukhaktok hunters, which likely helped halt the decline of Peary Caribou in the 1990s (Species at Risk Committee 2012). Lastly, the harvest rate is estimated at 1-3% on Banks Island, and has been below the quota for many years (Species at Risk Committee 2012). Successful management of harvest relies on having adequate knowledge of the caribou population levels as overharvesting could promote a decline in the population or delay the recovery.

There is a concern that unreported mortality could potentially lead to declines in Peary Caribou. Disregard for HTC by-laws[5] (e.g. illegal harvesting and unreported captures) was raised as a concern by one community where overharvesting was seen as a threat (Sachs Harbour HTC 2016). Additionally, preferential harvest by sex or age is thought to have negative consequences on caribou populations (Canadian Wildlife Service 2013; Paulatuk HTC 2016b). In areas where Peary Caribou mix with Dolphin and Union Caribou (e.g. Victoria Island) hunting pressure could be higher than expected on Peary Caribou as the two subspecies are difficult to differentiate. Hunting pressure could also increase if current hunting restrictions for other herds in the southern range of Peary Caribou are lifted (Paulatuk HTC 2016a). There is also community concern that hunting pressure could increase on Peary Caribou if selling and shipping caribou to other communities becomes common. Demand for Peary Caribou is increasing with the decline of other caribou subspecies (M. Anderson, personal communication 2016).

Note that the discussion of harvest in this recovery strategy is to evaluate harvest as a potential threat to Peary Caribou. Harvest management and monitoring is the responsibility of the territorial governments and co-management boards as per respective Land Claims Agreements. It is important that harvest is managed in a way that prevents potential overharvesting becoming a threat in the future. Accurate harvest levels throughout the range were not available to indicate the level of threat from harvest. A long-term objective of this recovery strategy is to ensure that Peary Caribou local populations are able to support a sustainable Inuit/Inuvialuit harvest that is responsive to natural fluctuations in populations.

[5] By-laws are rules or laws established by the Hunter and Trapper Associations, Committees and Organizations to regulate the harvest of wildlife in their area of responsibility. HTC by-laws are enforceable under the NWT Wildlife Act.

4.2.7. Threats of Unknown Impact

Pollution (IUCN-CMP Threat #9)

There are few direct sources of air-borne pollutants in Nunavut and the Northwest Territories, but the Arctic can be a sink for atmospheric pollutants transported from other regions (Gamberg et al. 2005; Hung et al. 2005; Law and Stohl 2007). The threat to Peary Caribou from atmospheric pollution is unknown. Levels of mercury and heavy metals vary widely across caribou herds in Canada (Northern Contaminants Program 2003). In one study, Peary Caribou on Banks Island had lower mercury and cadmium levels than Barren-ground Caribou from the Bluenose herd, which authors suggested may be the result of lower amounts of lichen in the Peary Caribou diet (Larter and Nagy 2000b). However, in a comparison of mercury levels using additional studies, Peary Caribou from Banks Island had higher mercury levels than seven of the eight sampled Barren-ground Caribou herds (Northern Contaminants Program 2012). While mercury levels can vary between herds, overall caribou health in the Arctic does not appear to be affected by mercury (AMAP 2018). The levels of persistent organic pollutants (POPs) sampled from 15 caribou herds across northern Canada in the 1990s were very low (Northern Contaminants Program 2003). The effects of new and emerging classes of contaminants, such as persistent fluorinated contaminants, are largely unknown (Gamberg et al. 2005).

Concentrations of POPs and mercury appear to be going down and/or stabilizing across the Arctic (Northern Contaminants Program 2017). Despite this downward trend, many uncertainties about the effects of climate change on POPs and mercury cycling still remain. Climate change has the potential to influence how pollutants are released and deposited, as well as how they are stored or moved in the environment. Western communities expressed concerns about the negative effects smoke and dust from forest fires in the Northwest Territories and surrounding areas were having on wildlife, including Peary Caribou (Ekaluktutiak HTO 2016; Olohaktomiut HTC 2016; Paulatuk HTC 2016a; Sachs Harbour HTC 2016). Climate change and warmer temperatures have been linked to rises in frequency and severity of forest fires in some regions (IPCC 1996; Stocks et al. 1998; Dale et al. 2001), resulting in a possible increase in atmospheric emissions and pollutants (Friedli et al. 2003; Law and Stohl 2007). The High Arctic monitoring station in Alert, NU, found that rising air temperatures are affecting the timing of deposition events (i.e., when pollutants are being released from the atmosphere) (Northern Contaminants Program 2017). Lastly, changing vegetation in the Arctic (see vegetation changes in section 4.2.1) can indirectly influence how contaminants are distributed in the environment by altering snow cover, soil temperature and/or moisture, thereby, altering how contaminants from soils and plants are transferred to animals and surrounding environments (Macdonald et al. 2005; Stern et al. 2012). The impacts of climate change are complex and further investigation is necessary to better understand the cumulative impacts climate change is having on emissions and pollutants in the Arctic.

Communities are concerned that waste and contamination from past industrial, research, community and military activities that have not been cleaned up may pose a continuing threat to Peary Caribou health (Canadian Wildlife Service 2013; Gjoa Haven HTA 2013; Iviq HTO 2013; Resolute Bay HTO 2013; Canadian Wildlife Service 2015; Ekaluktutiak HTO 2016; Kurairojuark HTO 2016; Paulatuk HTC 2016a; Resolute Bay HTO 2016; Sachs Harbour HTC 2016). For example, hunters have found abandoned fuel caches leaching their contents. Identifying and cleaning up contaminated sites has been identified as a high priority by Inuit in many communities (Canadian Wildlife Service 2013; Gjoa Haven HTA 2013; Canadian Wildlife Service 2015; Ekaluktutiak HTO 2016; Paulatuk HTC 2016a; Resolute Bay HTO 2016). Pollution from ships' grey water and ballast water is another source of contaminants that may threaten Peary Caribou (Canadian Wildlife Service 2015).

The effect of contaminants on Peary Caribou local populations is not well known, but there may be a more discernable effect on caribou close to contaminated sites. It is important to note that contaminants don't just affect the health of caribou, they may also affect the health of Inuit and Inuvialuit who depend on caribou for sustenance.

Introduced Genetic Material (IUCN-CMP Threat #8.3)

The impact of introduced genetic material on Peary Caribou is unknown. Currently, the only locations where there is a possibility of significant mixing with other caribou subspecies is on northwest Victoria Island with Dolphin and Union Caribou, and on Boothia Peninsula with Barren-ground Caribou. Results from genetic analyses have shown that Peary Caribou are genetically different from both Barren-ground Caribou and Dolphin and Union Caribou, with Dolphin and Union Caribou being more genetically similar to Barren-ground Caribou than Peary Caribou (Zittlau et al. 2003). Hunters have reported Peary Caribou interbreeding with other caribou subspecies and have observed changes in physical characteristics in some areas (Gjoa Haven HTA 2013; Olohaktomiut HTC 2013; Paulatuk HTC 2013; Ekaluktutiak HTO 2016). If the range of Barren-ground Caribou expands northward as a result of climate change, increased interbreeding may occur.

5. Population and Distribution Objectives

Population objectives

The long term population objectives include the following:

- All Peary Caribou local populations are healthy (self-sustaining) and available for future generations.
- Peary Caribou local populations fluctuate within the normal bounds of population cycles.
- Peary Caribou local populations are able to support a sustainable Inuit/Inuvialuit harvest that is responsive to fluctuations in populations.

The short term population objective for Peary Caribou is to halt further declines before 2031 (i.e., 10 years after this recovery strategy is posted on the Species at Risk Public Registry).

Distribution objectives

- Maintain Peary Caribou in all areas of Canada where they currently exist.
- Peary Caribou are able to move freely on the land and sea ice (within and between islands) to ensure natural habitat use and seasonal movement (limit unnatural movements / not forced to move), as well as movements during catastrophic events such as weather.

Rationale

Based on discussions with co-management partners, species experts and communities, it was clear that providing Peary Caribou with the ability to continue their population cycles and free movement across their range was essential. The population and distribution objectives reflect the species' need for large areas, and maintained access to available habitat, as well as connectivity on both the land and sea ice. These objectives are crucial to achieve a recovery state at an appropriate scale for this species.

To determine if a population is healthy or self-sustaining, a population will be evaluated based on the criteria below:

- The population has as many or more births as deaths over the long term.
- It is large enough to survive and recover from natural events (such as weather events) and human activities.
- It does not need human support (such as feeding or predator management).
- It can persist over the long-term (over a number of decades).

6. Broad Strategies and General Approaches to Meet Objectives

6.1 Actions Already Completed or Currently Underway

Federal and territorial governments, the NWMB, WMAC (NWT), Inuit and Inuvialuit, local communities, HTO/Cs, non-government organizations and affected industries have taken a range of actions to manage and conserve Peary Caribou and their habitat.

Actions completed or currently underway include:

- Shared and coordinated co-management of Peary Caribou in the NT between the Government of the Northwest Territories (GNWT) Department of Environment and Natural Resources (GNWT-ENR), WMAC (NWT), Inuvialuit Game Council, HTCs, and in NU with the GN Department of Environment (GN-DoE), NWMB and HTOs.

- Ongoing collaboration on management, conservation, research and monitoring initiatives between the NT and NU co-management authorities.

See Table 5 for a more comprehensive list.

Table 5. Summary of completed or ongoing recovery-related activities

Theme	Territory/Organization	Recovery or management activities
Research	GNWT-ENR, GN-DoE and PCA	Identify and delineate Peary Caribou ranges, habitats within ranges, refine local population delineation and patterns of inter-island movements using the following techniques: • IQ/TEK, local knowledge and appropriate research methodologies • A large-scale genetic project using fecal pellets along with IQ/TEK • Using location data to identify preferred habitat of Peary caribou in late winter and summer in Aulavik National Park • Scat analysis to identify Peary Caribou diet in Aulavik National Park
	GNWT-ENR and WMAC (NWT)	Documenting TEK and local knowledge about Peary Caribou through interviews with key knowledge holders in Ulukhaktok, NT. Work with other communities pending.
	GN-DoE	Working with the Utah State University on a project about movement and space use and predation patterns of the wolves on the Fosheim Peninsula and Axel Heiberg Island. Information has now been collected for five wolf packs, and three wolves are currently collared.
	NT/NU: World Wildlife Fund	Collection of IQ/TEK and scientific knowledge in the Last Ice Area (the area in the Arctic that will continue to have summer sea ice until 2050[6]).
	GNWT-ENR, PCA, WMAC-NWT, Inuit Tapiriit Kanatami (ITK), ECCC, University of Sherbrooke, McGill University and University of Toronto	Research developed in collaboration with communities in NT and NU to 1- document Inuit/Inuvialuit Knowledge of the impacts of climate change on the interactions between Peary caribou, muskoxen and their predators; and 2- examine how climate change affects snow and vegetation, and how those changes affect intra- and interspecific interactions with Peary Caribou. This holistic approach will examine factors driving Peary caribou populations and identify important habitat.
Monitoring	GNWT-ENR and PCA	Population surveys are conducted approximately every five years in areas closest to communities and less frequently for remote areas. Community monitoring informs decision to conduct surveys.

[6] World Wildlife Fund. 2015. The Last Ice Area. http://wwf.panda.org/what_we_do/where_we_work/arctic/last_ice_area/ Accessed September 1 2015.

	GN-DoE	Conduct regular surveys by island group and uses community-based monitoring to inform when population trends have shifted and call for aerial surveys to update estimates.
	NT Communities and GNWT-ENR	Community-based health, condition and genetics monitoring through samples collected from harvested caribou to help monitor population health including body condition, diet, sex and age of the harvest in the Northwest Territories. Similar monitoring may be implemented in Nunavut in the future.
	NT and NU	Programs are in place in both the Northwest Territories and Nunavut to collect samples from harvested wolves and grizzly bears to monitor the health and demographics of the predator population.

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Regulations / By-laws / Voluntary actions (including harvesting)	GNWT and GN	<u>MANAGEMENT AND CONSERVATION ACTIONS</u> for Peary Caribou: GNWT: enforced through by-laws written into regulations under the NWT Wildlife Act that are signed at the community level by HTCs. GN: (as well as general provisions preventing disturbance to wildlife) are enforced through Regulations under the Nunavut *Wildlife Act* and through by-laws drafted at the community level by HTOs and RWO. <u>HARVESTING – Community Rules and Regulations</u>
	NT: Ulukhaktok and Sachs Harbour communities	Initially suggested the need for restrictions and voluntarily restrict harvest of Peary Caribou, and now it is written into regulations[7].
	GNWT and NT : Communities	In the NT, active management of Peary Caribou was implemented in the 1990's on a voluntary basis. Harvest levels were established and tracked through a quota system implemented by management area.
	NT: Sachs Harbour	In 1990, due to concerns about low numbers, the Sachs Harbour HTC initiated a male-only quota for Peary Caribou on Banks Island which was subsequently written into regulation. Recently the regulations were changed to a quota with mandatory sample submission.
	NT : Ulukhaktok	In 1993, the Olokhaktomiuk HTC initiated a voluntary zero harvest on Peary Caribou from northwest Victoria Island, to help ensure that only Dolphin and Union Caribou were harvested from the island and not Peary Caribou. This was later written into regulation and then a small quota with mandatory sample submission was implemented.
	NU : Communities	Closed, restricted and/or managed hunting by Inuit in NU on a voluntary basis. Some examples[8]: • From 1986 to 1996, the Iviq HTA in Grise Fiord initiated a voluntary zero harvest on Peary Caribou on a large portion of southern Ellesmere Island. • The Resolute Bay HTO in Resolute Bay initiated a prohibition on harvest on Bathurst Island from 1975-1989, and expanded it in 1982 to Cornwallis and other islands. In

[7] Sachs Harbour Community Conservation Plan (1992, 2000, 2008, 2016); Olokhaktomiut Community Conservation Plan (2008, 2016).
[8] Government of Nunavut. 2014.

		addition, Resolute Bay HTO prohibited harvest from the mid-1990s to the winter of 2000 to 2001 on Bathurst Island.
Protected areas	NT/NU: PCA	In 1988, Quttinirpaaq National Park was established. In 1992, Aulavik National Park was established. In 2015, Qausuittuq National Park was established in the Bathurst Island group, NU, a key area for Peary Caribou. . In 2019, an agreement was signed between Canada and Inuit of the Qikiqtani Region to establish Tallurutiup Imanga National Marine Conservation Area. Work to establish this NMCA under the Canada National Marine Conservation Areas Act is ongoing.
Land-use planning	NT: WMAC (NWT)	WMAC (NWT) is responsible for helping communities prepare the Community Conservation Plans, which outline goals and principles for conservation in the Inuvialuit Settlement Region, and are reviewed and updated regularly. The Community Conservation Plans are used in the environmental impact screening and review process for making land-use decisions, including where Peary Caribou conservation is prioritized.
	NT: Sachs Harbour,Ulukhaktok and Paulatuk	Community Conservation Plans identify important areas for Peary Caribou, and designate the highest degree of protection to calving areas[9]. Protection for caribou is also advocated in the Paulatuk Community Conservation Plan, but Barren-ground Caribou are the primary caribou species found in Paulatuk[10].
	GN	Nunavut Land Use Plan[11]: In the current draft, a Limited Use Area is designated east of the Qausuittuq National Park, which is identified as important for the survival of Peary Caribou on Bathurst Island, NU. Some sea ice crossings for Peary Caribou are designated Conditional Use with seasonal restrictions, and the Key Bird Habitats designated on eastern Axel and the Fosheim are also important protection measures for Peary Caribou.

[9] Sachs Harbour Community Conservation Plan (1992, 2000, 2008, 2016); Olokhaktomiut Community Conservation Plan (2008, 2016).
[10] Paulatuk Community Conservation Plan (2008, 2016).
[11] Nunavut Planning Commission. 2021. Nunavut Land Use Plan [draft]. 110 pp.

Environmental review process	NU/NT: Nunavut Impact Review Board and Inuvialuit Environmental Impact Screening Committee & Review Board NT: Inuvialuit Environmental Impact Screening Committee	Consider Peary Caribou life-history requirements when planning and reviewing development activities. Conducts environmental screening of development activities proposed for both the onshore and offshore areas of the Inuvialuit Settlement Region, which considers community conservation plans addressing Peary Caribou important areas.
Environmental clean-up	GN / PCA / Crown-Indigenous Relations and Northern Affairs Canada	Department of Indian and Northern Affairs (now Crown-Indigenous Relations and Northern Affairs Canada - CIRNAC) initiated the clean-up of the industrial exploration site at Johnson Point on Banks Island in the NT, with the clean-up of contaminant and removal of buildings[12]. They also cleaned up some sites on Lougheed Island, Satellite Bay (Prince Patrick Island), Romulus Lake (central Ellesmere Island) and Rae Point (eastern Melville Island). In NU, CIRNAC is working to clean-up sites on Bathurst Island and the surrounding High Arctic islands through the Federal Contaminated Sites Action Plan, while PCA is working to remove fuel drums and other industrial waste from sites within the Qausuittuq National Park. In NWT, clean-up is also planned on Mould bay (Prince Patrick Island).
Climate Change	GNWT	GNWT is currently developing a Climate Change Adaptation Strategy for Wildlife in the NWT.
Stewardship	NU/NT: Resolute Bay HTO, Iviq HTO, Olokhaktomiut HTC and Sachs Harbour HTC	Cooperative stewardship agreements and activities: to support Inuit engagement in the monitoring, management and conservation of Peary Caribou funded through the Aboriginal Funds for Species At Risk program and the Habitat Stewardship Program (Federal Government funding programs).

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[12] Contaminants and Remediation Directorate. 2009. Contaminated site remediation: what's happening in the ISR. March 2009. Indian and Northern Affairs Canada, Ottawa, ON.

Collectively, these actions, and the level of commitment associated with these actions across the Peary Caribou range, are an encouraging foundation upon which to build.

There are a number of recovery documents currently in place or in development that impact Peary Caribou.

Table 6 summarizes the recovery objectives in these documents.

Table 6: Status of Peary Caribou recovery planning in territorial and federal jurisdictions where Peary Caribou occur.

Territorial/Federal Jurisdiction	Recovery Document	Recovery Objective / Principles
Nunavut	Management Plan for Peary Caribou in Nunavut (2015 draft under review/consideration with NWMB)	• To manage Peary Caribou in a co-operative manner that involves the full participation of communities and engagement of co-management partners. • To include IQ and scientific knowledge equally in the management process. • To promote local and regional involvement in decision making. • To protect, conserve and manage Peary Caribou in a sustainable manner. • To ensure the full and effective participation of Inuit and co-management partners in ongoing monitoring and management of Peary Caribou, and decision making.
Northwest Territories	Federal recovery strategy will be adopted with exemptions/additions as required	
Federal	Aulavik National Park of Canada Management Plan	• Build on existing partnerships with other federal, territorial and Inuvialuit agencies that contribute to ecological monitoring, including work to monitor Peary Caribou and muskoxen. • Explore opportunities to link archaeological information to the park to better understand their ecology, such as interpretation of historical caribou and muskoxen harvests and population cycles. • Work with co-management partners to develop a recovery strategy for Peary Caribou.
	Quttinirpaaq National Park of Canada Management Plan	• Relative abundance of Peary Caribou is maintained above current minimum population of 45 animals. • No major change in distribution trends for Peary Caribou or muskoxen.

Territorial/Federal Jurisdiction	Recovery Document	Recovery Objective / Principles
	Qausuittuq National Park	• Interim Management Plan approved by Qausuittuq Park Management Committee in 2020: o Foundations for the Future: Guide for Managing Qausuittuq National Park (Nunavut, Canada) 2020 - 2022 • Management Plan for Qausuittuq National Park expected to be completed by 2023.

6.2 Strategic Direction for Recovery

In order to achieve the population and distribution objectives, the following table (Table 7) and narrative describe the broad strategies and approaches to be taken at a national level, and the research and management activities needed to address the threats to Peary Caribou and their habitat. IQ/TEK and local knowledge should be considered and inform all the strategies. Management approaches are inclusive of both western science and traditional knowledge, and address the following broad strategy categories:

- Monitoring and research: conduct targeted studies to increase the understanding of key habitats, population dynamics and demographics, movements and habitat use, and the potential impacts of threats to Peary Caribou.
- Habitat and species conservation and management: develop management measures to protect habitat and mitigate threats to Peary Caribou while working collaboratively across jurisdictions.
- Education and awareness, stewardships, and partnerships: expand education about Peary Caribou on a territorial, national and international scale, while developing and maintaining relationships with co-management partners.
- Law and policy: develop and implement policy or regulatory structures, support compliance as well as promote consideration of Peary Caribou in land use planning.

The feasibility of the strategies outlined in Table 7 is subject to appropriations, priorities and budgetary contraints of the participating jurisdictions, wildlife management boards and associated organizations. Further details and an implementation schedule will follow in one or more action plans.

Table 7: Recovery planning table for Peary Caribou.

Threat or Limitation	Broad Strategy to Recovery	Priority[a]	General Description of Research and Management Approaches
Broad Strategy Category: Monitoring and Research			
Knowledge gaps to recovery and all threats	General	High	1. Utilize IQ/TEK, local knowledge and scientific knowledge for monitoring, surveying and research, respecting the importance of IQ/TEK and local knowledge to Peary Caribou conservation and recovery.
		Medium	2. Develop and maintain a central repository (database) for Peary Caribou monitoring/research to ensure timely sharing of data. 3. Explore opportunities for community-based monitoring programs.
	Key habitats	High	4. Conduct IQ/TEK studies to capture knowledge on Peary Caribou ecology and their habitat (e.g. important habitat attributes). 5. Identify calving areas and other key habitats critical at different life stages or times of the year.
	Population dynamics and demographics	High	6. Conduct population studies of Peary Caribou to understand/refine local population delineations, population structure, demographic parameters, trends, movement patterns and exchange rates. 7. Investigate factors affecting reproductive output, survival and fidelity to calving areas.
	Movement and habitat use	High	8. Determine/refine knowledge of migratory routes, connectivity and identify sea-ice crossings (e.g. location and frequency of use) within the species' distribution. 9. Investigate patterns of habitat use at a finer scale (e.g. local population scale, improved location data in association with habitat types or attributes).
		Medium	10. Determine current Peary Caribou habitat condition and monitor habitat change/alteration.
		Low	11. Develop and conduct in-depth studies on vegetation used by Peary Caribou (e.g. diet, grazing impact, vegetation recovery after grazing, plant growth). 12. Identify crossing locations on ice fields. 13. Maintain standardized protocols and survey designs (data collection and analysis) for local populations and their habitat.
	Potential Impacts of threats	High	14. Assess the current and future potential impact of climate change on Peary Caribou and their sea ice and land habitats throughout their distribution. 15. Determine the relative importance of known and potential threats to Peary Caribou across their range, and their cumulative impacts to the species. 16. Investigate the relationship between Peary Caribou and muskoxen, wolves, other caribou and predators.

Threat or Limitation	Broad Strategy to Recovery	Priority[a]	General Description of Research and Management Approaches
		Medium	17. Assess the extent, distribution, and possible consequences of sensory disturbance (e.g. aircraft traffic, snowmobiles, all-terrain vehicles, tourism, research, and the equipment associated with industrial exploration and development) on Peary Caribou and investigate mitigation measures to reduce its effects, particularly during sensitive periods (e.g. seasonal movements, calving seasonal conditions). 18. Investigate parasites and diseases from other species (e.g. muskoxen, migratory birds) and their potential impact on Peary Caribou, as parasites and diseases could increase with climate change. 19. Minimize sensory disturbance to Peary Caribou during monitoring and research programs, investigate new techniques that cause less disturbance to animals, and select monitoring and research techniques that have a minimal disturbance (e.g. non-invasive techniques such as genetics, remote sensing, IQ/TEK collection). 20. Monitor marine vessel traffic through the range of Peary Caribou for routes, timing of travel and ship type.
		Low	21. Investigate the extent and impact of harvest or potential harvest, including sport hunting, and determine mitigation activities, if required, in cooperation and accordance with land claim agreements.
Broad Strategy Category: Habitat and Species Conservation Management			
Knowledge gaps to recovery and all threats	Measures to protect habitat	High	22. Conserve habitat for Peary Caribou across their range for all their life stages (e.g. calving, summer, rut, winter, movement corridors (sea-ice and land)). 23. Undertake coordinated land and resource planning to ensure that all development activities are planned and implemented in a manner that protect Peary Caribou important habitat (e.g. consider sensitive periods/areas such as sea-ice movement corridors between seasonal ranges, calving, etc.). 24. Develop cumulative effects assessment approaches that are appropriate for Peary Caribou local populations across their vast range. 25. Develop a long-term protected areas strategy for Peary Caribou, which considers the fact that Peary Caribou may return to an area after abandoning it for many years.
	Measures to mitigate threats	High	26. Effectively manage and implement precautionary measures across Peary Caribou range to meet Peary Caribou needs and reduce impacts. 27. Participate in initiatives aimed at reducing climate change (local, regional, national and international scale), at reducing/eliminating contamination and other toxic substances. 28. Establish a mitigation hierarchy[b] approach to limit the negative impacts from disturbance in key areas such as calving grounds and sea-ice crossings.

Threat or Limitation	Broad Strategy to Recovery	Priority[a]	General Description of Research and Management Approaches
			29. Mitigate sources of mortality that may have detrimental impacts on Peary Caribou populations. 30. Investigate approaches such as a threshold of disturbance, tiered identification or temporal protection to assist management of Peary Caribou and their habitat.
		Medium	31. Determine the location of sites containing waste/contaminants and investigate clean-up options.
	Collaborative management	High	32. For local populations that are jointly managed (i.e. territorial transboundary), undertake collaborative management among responsible federal, territorial, co-management jurisdictions and agencies to ensure equitable efforts are underway.
		Medium	33. Communicate among key rights holders/stakeholders (e.g. governments, wildlife management boards, regional wildlife management boards, land claims organizations, Inuit/Inuvialuit, researchers, mining/oil and gas, shipping and tourism industry, non-government organizations and the public) and other organizations responsible for land and/or resource management and/or conservation within the Peary Caribou range to ensure coordination of planning and management, and where possible, coordinate cross-jurisdictional cooperation and implementation.
Broad Strategy Category: Education and Awareness, Stewardship and Partnerships			
All threats and knowledge gaps to recovery	Expand education territorially, nationally and internationally	Medium	34. Communicate the importance of Peary Caribou to Inuit/Inuvialuit culture, economies, the ecosystem and biodiversity. 35. Develop and/or deliver outreach products to key rights holders/stakeholders and the general public on the importance of Peary Caribou, their habitat and how to mitigate threats. 36. Promote the collection/sharing of incidental observations of Peary Caribou and publicize the need for public reporting of caribou observations (e.g. researchers, government, industry). 37. Communicate the importance of participation in body condition monitoring, harvest reporting and sample submissions.
	Develop/maintain relationships with co-management partners	Medium	38. Encourage stewardship of Peary Caribou habitat among industry, interest groups, Inuit/Inuvialuit communities and organizations. 39. Foster cooperative relationships with key rights holders/stakeholders (e.g. governments, wildlife management boards, regional wildlife management boards, land claims organizations, Inuit/Inuvialuit, researchers, mining/oil and gas, shipping and tourism industry), and others to coordinate activities, mitigate threats, and provide information about sensitive areas and seasons to Peary Caribou and their habitat.

Threat or Limitation	Broad Strategy to Recovery	Priority[a]	General Description of Research and Management Approaches
			40. Promote education of Inuit and Inuvialuit hunters and youth about traditional and best practices to minimize wastage, alternative food sources, identification of various caribou subspecies and awareness of illegal harvest activities. 41. Promote national and international (e.g. Greenland) cooperation and collaboration to fill knowledge gaps and to mitigate range-wide threats in Canada (e.g. climate change, pollution, contaminants). 42. Promote compliance with federal (e.g. SARA), territorial, land claims acts and policies, as well as beneficial management practices that protect Peary Caribou and their habitat. 43. Identify opportunities and approaches that can align and integrate with groups and initiatives working toward Peary Caribou and/or arctic conservation (e.g. The Last Ice Area project (World Wildlife Fund 2015)). 44. Create opportunities for public involvement in habitat and species conservation and other conservation initiatives.
Broad Strategy Category: Law and Policy			
All anthropogenic threats	Develop/implement policy or regulatory structures	High	45. Engage and influence existing regulatory structures to ensure that strong and up-to-date regulations are in place for protecting Peary Caribou and their habitat at local, regional, territorial, national and international scales (e.g. shipping, climate change reduction, resource extraction). 46. Develop, implement and promote beneficial management practices for the species and their habitat (e.g. timing windows, flight height, wildlife plans for the mining/oil and gas exploration/industry, shipping seasons, noise disturbance, etc.). 47. Implement existing policies and programs to reduce and/or mitigate threats and develop new policies and programs where gaps exist.
	Support enforcement	High	48. Support enforcement of existing acts and regulations pertaining to threats facing Peary Caribou and their habitat, and encourage additional protection where necessary (e.g. community conservation plans, land use plans).
	Promote consideration of Peary Caribou in land use planning	High	49. Consider Peary Caribou requirements in management plans and policies for public lands, private Inuit/Inuvialuit lands, environmental assessments and land-use (energy, mining, shipping, tourism, etc.) planning initiatives.

[a] "Priority" reflects the degree to which the broad strategy contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species.

[b] "Mitigation hierarchy" refers to a step-wise approach to identify, manage and restore threats by predicting the impact of a threat, taking measures to avoid the threat, taking action to mitigate threats, restoring the impacts and as a last resort offsetting the impacts of a threat.

6.3 Narrative to Support the Recovery Planning Table

Recovery of Peary Caribou will require the commitment, collaboration and cooperation among federal and territorial jurisdictions, the NWMB, the WMAC (NWT), the Inuit and Inuvialuit, local communities, HTOs, industry and other interested parties. It will be important to monitor the distribution, size and trends of Peary Caribou local populations so that the effectiveness of individual caribou range management regimes can be evaluated and adjusted as necessary.

A large number of research and management approaches have been identified for Peary Caribou (Table 7) to address the significant knowledge gaps and management complexities for this species. These challenges exist due to the widespread nature of the species and their dependence on specific environmental conditions. Coupled with their presence in areas that are not used or used infrequently by the Inuit, Inuvialuit and local communities, as well as in habitats with challenging survey conditions, it is clear that research and data gathering are important for better understanding the current situation for Peary Caribou and how that may change in the future. Manageable human-caused threats should be addressed, and although weather and other natural events cannot be prevented, their cumulative effects can be mitigated through the management of other threats (Canadian Wildlife Service 2013).

The following sections expand on the general research and management approaches, providing additional rationale.

6.3.1. Monitoring and Research

In order to advance conservation and protection efforts, which are supported through management, information gaps must be addressed in a coordinated way that includes IQ/TEK and local knowledge and western science. By concentrating monitoring and research efforts, and including key stakeholders in the process, knowledge of Peary Caribou can be advanced collectively to make informed management decisions.

Investigate the Population Structure of Peary Caribou to Understand/Refine Local Population Delineations and Movement Patterns Across the Range

There is considerable variation in the present level of understanding of Peary Caribou local population condition, structure and trends across their distribution. For local populations where little current information is known, population ecology studies are required to establish a baseline from which to plan and measure recovery progress (Olohaktomiut HTC 2013). For all local populations, demographic data, population size and trends, and caribou distribution and movement should be monitored over time to test the efficacy of management actions and adapt those management actions as appropriate.

In addition, while there is some information on movement routes, there is no information on rates of exchange of individuals between different islands to assess and quantify the

level of demographic independence among the animals occupying different areas. These data should be collected to improve local population delineations and population models.

Assess the Current and Future Potential Impact of Threats to Peary Caribou Throughout Their Range By:

(1) Investigating the Impacts of Climate Change

Climate change is considered the most significant threat to Peary Caribou and may compound the effects of other threats. Sea ice loss, sea level rise, terrestrial habitat changes and increased frequency of rain-on-snow or icing weather events may significantly impact Peary Caribou populations and habitat conditions. The assessment and monitoring of climate regimes and climate-related effects on caribou populations and habitat, coupled with predicted shifts in vulnerability to climate-mediated disturbance and habitat dynamics, will be important for monitoring recovery and managing other threats. When the effects of climate change cause negative impacts to Peary Caribou populations or habitat, adaptive management of other threats may be required (Canadian Wildlife Service 2013).

(2) Investigating current threats to Peary Caribou Health

While Peary Caribou are currently thought to be generally healthy, parasites and diseases could increase with climate change, and pollution from contaminated sites and industrial activities could negatively affect the health of Peary Caribou. Therefore, information on the health and body condition of Peary Caribou, as well as the presence of contaminants in vegetation should be monitored to better understand the relationship between these threats and the viability of local populations, and whether there is a need for additional recovery actions.

(3) Investigating threats from Interspecific Competition with Muskoxen, Wolves, other caribou subspecies and other Predators (Polar Bear, Grizzly Bear, Wolverine)

A negative relationship exists in some areas between Peary Caribou and muskoxen abundance (Iviq HTO 2013; Olohaktomiut HTC 2013; Paulatuk HTC 2013; Spence Bay HTA 2013; Gjoa Haven HTO 2016; Olohaktomiut HTC 2016; Sachs Harbour HTC 2016; Spence Bay HTO 2016). This may be because of competition for habitat or promoting increased predation by wolves. Understanding the mechanism(s) behind this relationship is needed so that strategies can be developed to manage this threat where necessary.

For relationships with other caribou, the extent of interbreeding between Peary Caribou and other caribou subspecies is currently unknown, but may increase with climate change. Monitoring interbreeding and range overlap with other subspecies will be necessary to better understand the extent and impact of this threat on the Peary Caribou population in terms of both genetics and the spread of disease.

Predators, such as wolves and grizzly bears, have been increasing in numbers in some areas (Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Olohaktomiut HTC 2013;

Spence Bay HTA 2013; Ekaluktutiak HTO 2016; Gjoa Haven HTO 2016; Olohaktomiut HTC 2016; Paulatuk HTC 2016a; Sachs Harbour HTC 2016; Spence Bay HTO 2016), possibly in relation to climate change, which may be elevating predation rates on Peary Caribou. As a result, a better understanding of the impact of predators on Peary Caribou is needed. The implications of controlling predator populations as a way to improve Peary Caribou population growth must be better understood before such a management strategy is considered. Controls of predators may have unintended results on caribou health or to other aspects of the ecosystem.

6.3.2. Habitat and Species Conservation and Management

Coordinating mitigation efforts and implementing joint management strategies will promote a collaborative process that shares a common goal, and avoids a duplication of effort or conflicting management objectives.

Mitigate Disturbance in Key Areas of Peary Caribou Habitat, such as Calving Areas and Sea-ice Crossings

Shipping and ice-breaking is increasing in the Arctic (Paulatuk HTC 2013; Resolute Bay HTO 2013; Sachs Harbour HTC 2013; Dawnson et al. 2018) and, consequently, there is a need to manage the effects of these activities on inter-island movements by Peary Caribou. A plan should be developed in conjunction with industry stakeholders to manage the timing of shipping and ice-breaking such that disruption of Peary Caribou inter-island movements is minimized (Paulatuk HTC 2013).

Efforts should also be made to minimize disturbance in other areas of Peary Caribou habitat, such as calving areas (Iviq HTO 2013). Management of the amount, type, distribution and timing of human developments will be necessary, particularly as calving areas and other key habitats are better identified. Both anthropogenic and natural disturbances will need to be monitored and measured. Anthropogenic disturbance (i.e. industrial and other human activities) will need to be managed in a manner consistent with land and/or resource planning that has taken into account the current and future habitat requirements of Peary Caribou. Management of land use activities is also addressed in section 6.3.4.

The extent, distribution and effects of various sources of sensory disturbance, such as low-flying aircraft, snowmobiles, equipment associated with various industries and recreational users, on individual Peary Caribou, and Peary Caribou local populations, should be assessed and managed in conjunction with territorial and federal regulations and guidelines (Olohaktomiut HTC 2013; Resolute Bay HTO 2013). Where required, additional management actions to reduce the effects of sensory disturbance on Peary Caribou should be implemented and the effectiveness of the management actions should be monitored over time and adapted as necessary.

The disturbance of Peary Caribou during monitoring and research programs (e.g. capturing, handling and collaring) should be minimized, and monitoring and research

techniques that are the least intrusive should be selected (Iviq HTO 2013; Resolute Bay HTO 2013).

Mitigate Threats and Sources of Mortality that May Have Detrimental Impacts on Peary Caribou Populations

Mitigating Peary Caribou mortality that is attributed to environmental conditions is challenging because they are beyond the ability to manage. However, anthropogenic activities that cause mortality can be mitigated to reduce negative impacts to Peary Caribou populations. For example, any decisions on harvest restrictions of Peary Caribou will be made and implemented through the co-management process of the NWMB and the WMAC (NWT) (Canadian Wildlife Service 2013), and strategies to minimize unreported harvesting and address other harvesting concerns should be developed. Better information on population size and trend, as well as harvest data, would help develop better tools to support sustainable harvest (Johnson et al. 2016).

Develop Cumulative Effects Assessment Approaches Collaboratively with Partners That Are Appropriate For Peary Caribou Local Populations Across Their Vast Range

It will be important to undertake coordinated planning to ensure that proposed developments take into consideration the cumulative impacts of existing developments, as well as threats within a local caribou population (Resolute Bay HTO 2013). Activities should be planned and implemented such that their timing, location and extent minimizes disturbance to Peary Caribou, particularly during sensitive periods and in important areas (Sachs Harbour HTC 2013).

6.3.3. Education and Awareness, Stewardship and Partnerships

Promoting Peary Caribou conservation and protection is an opportunity to engage and collaborate with a diverse range of jurisdictions, communities and organizations. By creating a strong network of support, a deeper understanding of Peary Caribou can be gained that will support robust and informed management decisions, and recognize the extensive history and relationship of the Inuit and Inuvialuit with caribou. Education within the harvesting community can also assist with intergenerational knowledge transfer to prevent wastage, improper use or unsustainable harvest.

Promote National and International Cooperation and Collaboration to Fill Knowledge Gaps and to Mitigate Range-wide Threats in Canada (e.g. Climate Change, Pollution, Contaminants, Marine traffic)

Management of anthropogenic impacts nationally and internationally is an integral part of Peary Caribou conservation, and includes things such as land and resource planning, marine traffic, reducing climate change, and coordinating management efforts and activities in Peary Caribou habitat. Fostering cooperation between jurisdictions and highlighting the importance of IQ/TEK and local knowledge in the management process can help fill knowledge gaps that would support and/or inform Peary Caribou management, and is key for mitigating and reducing disturbance to caribou in important habitats.

6.3.4. Law and Policy

One way to address all anthropogenic threats is through law and policy, ranging from the local level, up to national and international scales. Cooperation between jurisdictions to develop and implement policies, as well as support those policies once in place, are essential for Peary Caribou protection throughout their range.

Consider Peary Caribou Requirements in Management Plans and Policies for Public Lands, Private Inuit/Inuvialuit Lands, Environmental Assessments, Land-use (Energy, Mining, Shipping, Tourism, etc.) and Planning Initiatives

The federal recovery strategy, in combination with other documents involving Peary Caribou management and conservation measures (e.g. Community of Sachs Harbour et al. 2008; Community of Ulukhaktok et al. 2008), and planning initiatives, can consider and incorporate Peary Caribou habitat and lifecycle requirements, which could alleviate concerns regarding habitat protection (Iviq HTO 2013; Resolute Bay HTO 2013; COSEWIC 2015; Johnson et al. 2016). Standards and protocols could be developed that would assist in these planning initiatives and provide clarity on sensitive areas and times for Peary Caribou, as well as a general code of conduct for non-sensitive areas.

7. Critical Habitat

Critical habitat is the habitat that is necessary for the survival or recovery of a wildlife species listed as endangered, threatened or extirpated and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species.

Section 41(1)(c) of SARA requires that the recovery strategy include an identification of the species' critical habitat, to the extent possible, as well as examples of activities that are likely to result in its destruction (section 7.3). Once identified, critical habitat must be protected from destruction and should inform land use planning, environmental assessment and/or permitting. This federal recovery strategy identifies critical habitat to the extent possible, based on the best available information for Peary Caribou. Identification of additional critical habitat and/or refinement of existing critical habitat for Peary Caribou in Canada will occur as additional information becomes available.

Critical habitat is identified to the extent possible, based on the best available scientific, IQ and TEK information. There is insufficient information to identify critical habitat on the land portion of the species range; only sea ice critical habitat is identified in this recovery strategy (Figure 3). Thus, the critical habitat identified is insufficient to meet the population and distribution objectives. A schedule of studies (section 7.2) has been developed to provide the necessary information to complete the identification of land-based critical habitat.

7.1 Identification of the Species' Critical Habitat

Critical habitat for Peary Caribou is identified to reflect their need for large areas and connectivity (movement corridors) on both the land and sea ice. Firstly, Peary Caribou can use different areas for their winter and summer ranges, as well as their calving and rutting areas during their annual life cycle. Peary Caribou may complete these life stages on one island or across several islands, which could require annual movements over land and/or sea ice. Therefore, Peary Caribou require large areas containing a variety of habitat types as well as landscape connectivity on both land and sea ice to complete their life cycle. Secondly, Peary Caribou select habitat and topographical features that maximize forage accessibility under changing weather conditions (section 3.3.1) and thus require large areas that encompass a variety of habitat and terrain types. Severe icing events that cause widespread forage inaccessibility are predicted to increase with climate change, which is considered a primary threat to the recovery of Peary Caribou (section 4.2.1). Ensuring that Peary Caribou have large, connected areas that offer a variety of topographies and possible escape from severe snow and ice events will help mitigate this threat. Lastly, Peary Caribou also undergo periodic range shifts such that areas abandoned in some years may be used again in other years. These shifts are also observed in movement routes over land and sea ice. Therefore, Peary Caribou require large expanses of land and sea ice to accommodate these natural shifts in range use and movement routes.

Threshold approaches that have been used to set amounts of critical habitat required for other caribou subspecies are not appropriate for Peary Caribou given the current level of knowledge. A threshold would need to consider maintaining the variety of habitats and topographies required by Peary Caribou under different weather conditions, and the necessity to maintain connectivity so that the caribou can complete annual movements to alternate habitat during extreme disturbances (particularly icing events). In the future, when more information is available, a threshold approach may be possible. Other alternate approaches such as a tiered identification or temporal protection may also be possible in the future.

Critical habitat for Peary Caribou is comprised of two components: (1) geographic location and (2) biophysical attributes. Geographic location identifies the areas containing critical habitat for sea ice. Inside the geographic location, critical habitat is identified only where biophysical attributes are present.

(1) Geographic Location

Sea Ice Critical Habitat

Sea ice is required by Peary Caribou to move between islands. Sea ice crossing areas were identified by communities based on their knowledge and observations (Figure 1). Based on this knowledge and community input between 2013 and 2020, sea ice critical habitat was identified for Peary Caribou (Figure 3 - Figure 7; Canadian Wildlife Service 2013; Ekaluktutiak HTO 2013; Gjoa Haven HTA 2013; Iviq HTO 2013; Olohaktomiut HTC 2013; Paulatuk HTC 2013; Resolute Bay HTO 2013; Sachs Harbour HTC 2013;

Spence Bay HTA 2013; Canadian Wildlife Service 2015, Canadian Wildlife Service 2020). Sea ice areas providing connectivity between different local populations or key islands with important habitat were included as critical habitat, which explains some discrepancies between Figure 1 and Figures 3-7.

An additional distance of 2-km was applied to all identified sea ice areas as critical habitat (excluding land features) to ensure formation of sea ice despite disturbance from nearby shipping or ice breaking activities (based on advice provided by the Meteorological Service of Canada - Ice).

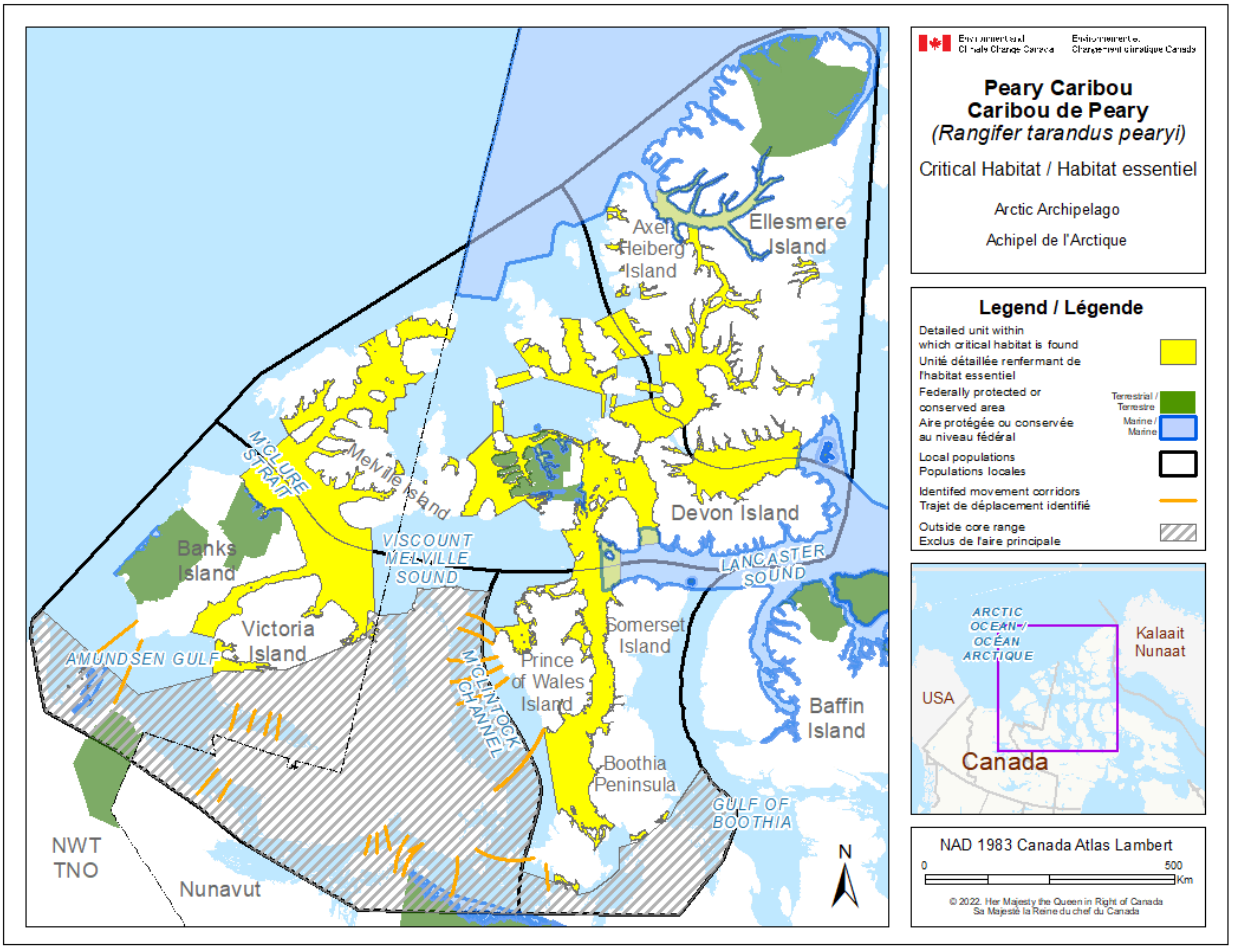


Figure 3. Identified sea ice critical habitat over the Peary Caribou range. Movement corridors identified by communities outside the core range are not considered critical habitat but are shown as they could be identified as critical habitat if new information become available.

(2) Biophysical Attributes

Biophysical attributes are the habitat features and characteristics that help define a species' critical habitat to carry out life-cycle processes. The location of biophysical attributes required by Peary Caribou will vary over space and time given the dynamic nature of ecosystems, weather conditions and climate change.

Sea Ice Critical Habitat

Sea ice is an essential component of Peary Caribou habitat as corridors for annual movements between islands. This habitat is seasonal and exists from when it starts forming in the fall until ice breakup in the following spring or summer. To account for this temporal feature and to protect the formation of ice from shipping and ice-breaking, all the sea ice habitat identified on Figures 3-7 is to be considered as critical habitat.

Pack ice[13] that forms in the summer is not considered critical habitat. Polynyas are geographic areas of unfrozen seawater forming a natural ice hole year-round. Identified sea ice where polynyas exist is not considered critical habitat and will not benefit from critical habitat protection.

[13] Pack Ice refers to areas with aggregated drifting ice.

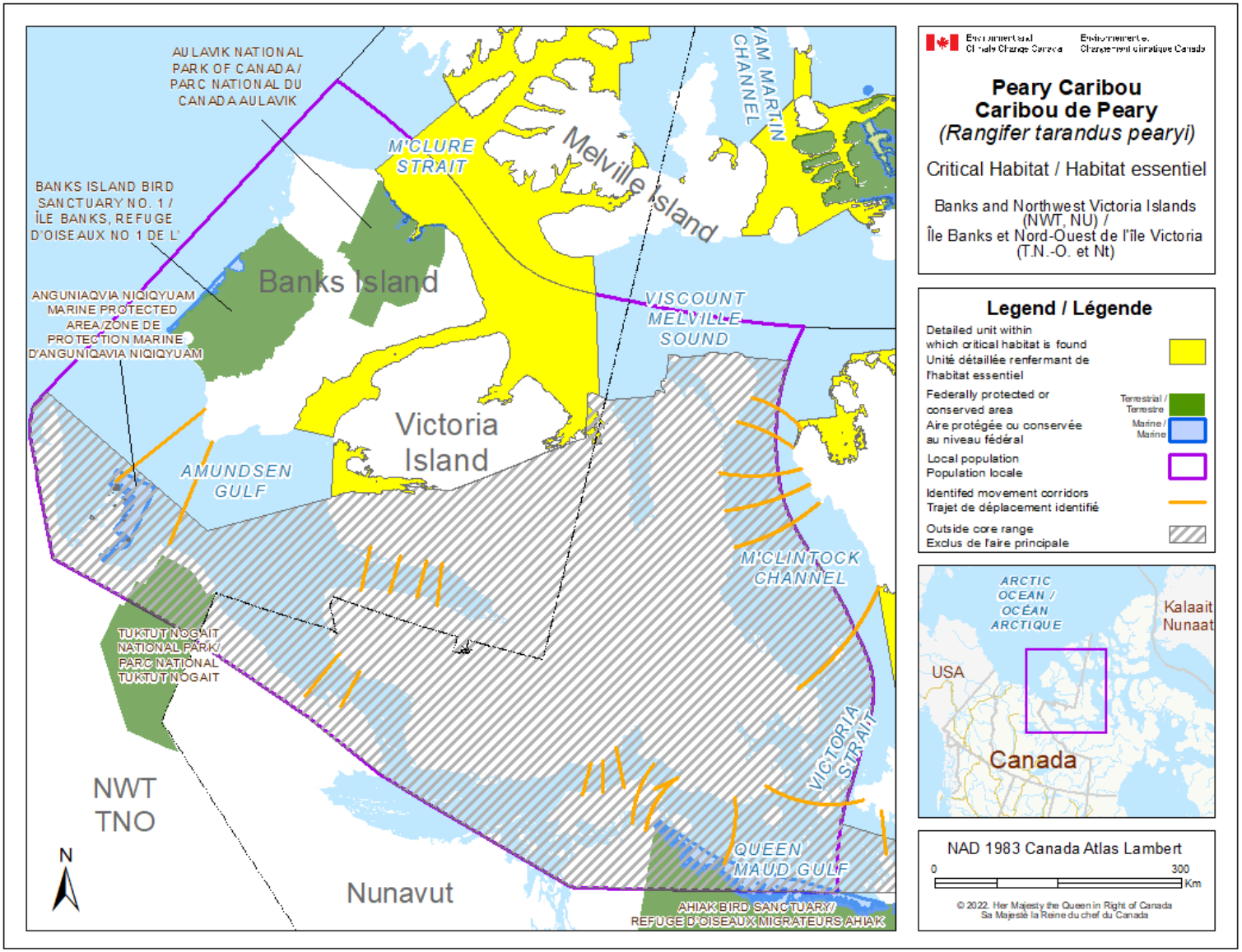
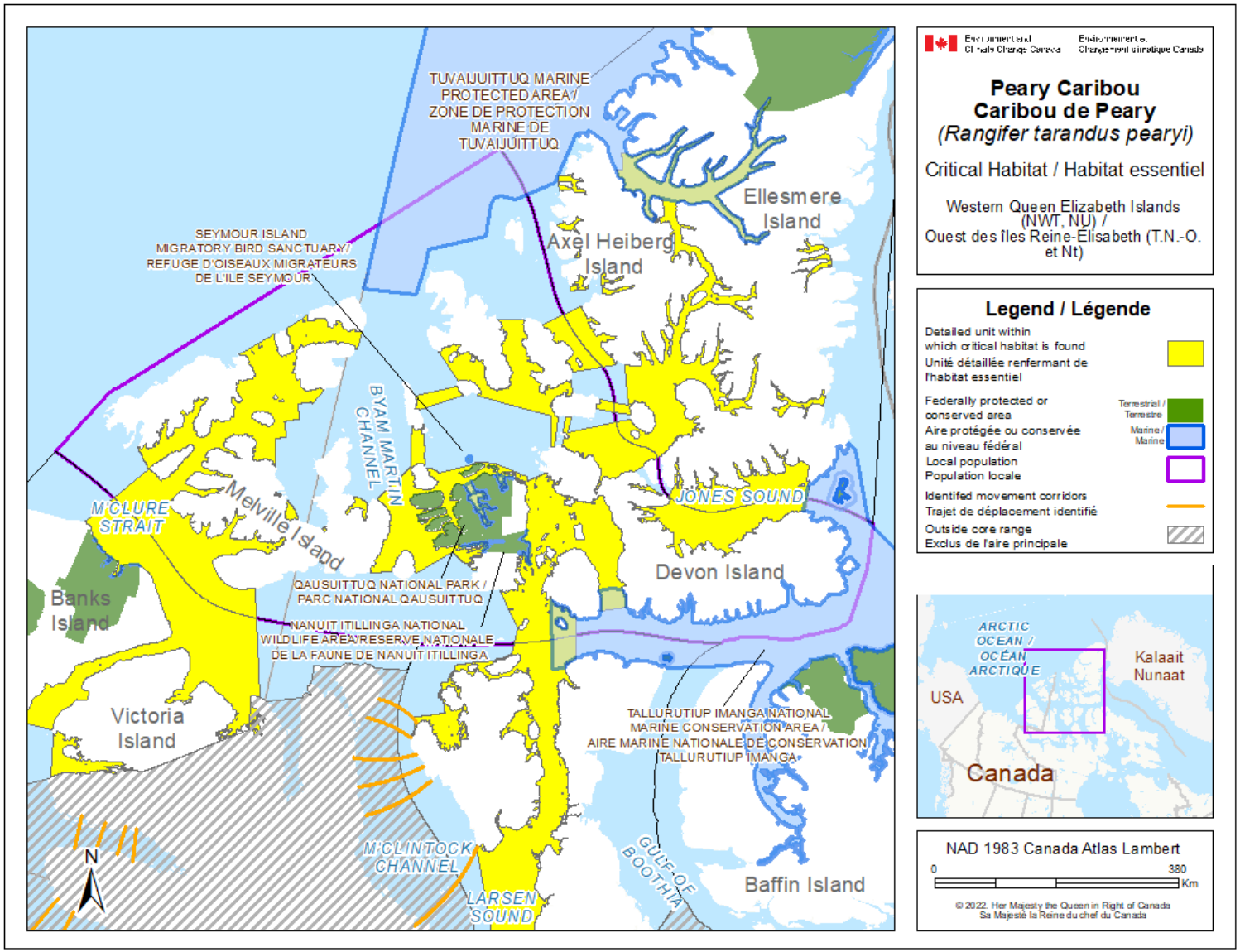


Figure 4. Areas that contain critical habitat for Peary Caribou in the Banks - Northwest Victoria Islands local population (NT & NU).

1951



1952

1953 Figure 5. Areas that contain critical habitat for Peary Caribou in the Western Queen Elizabeth Islands local population (NT & NU).

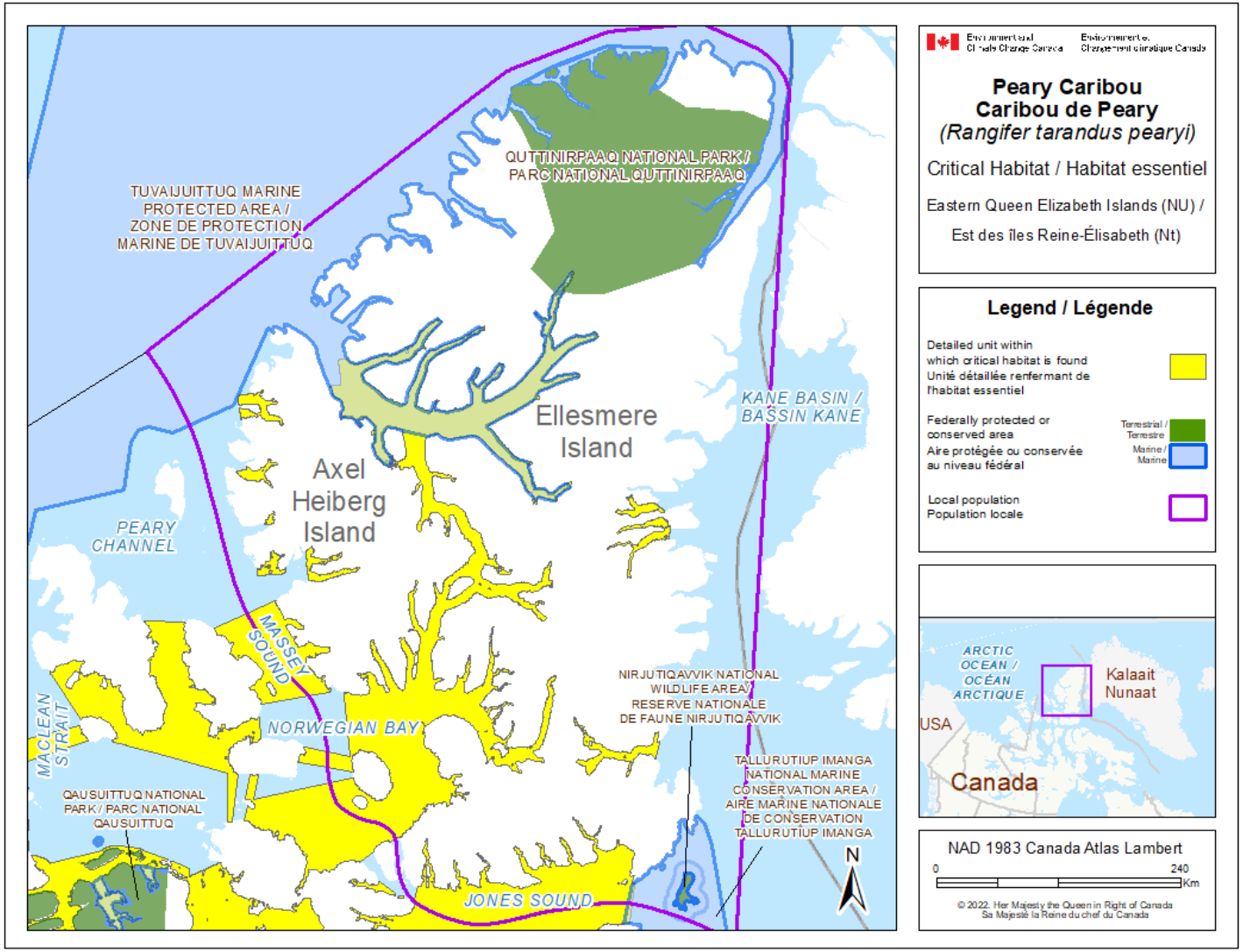


Figure 6. Areas that contain critical habitat for Peary Caribou in the Eastern Queen Elizabeth Islands local population (NU).

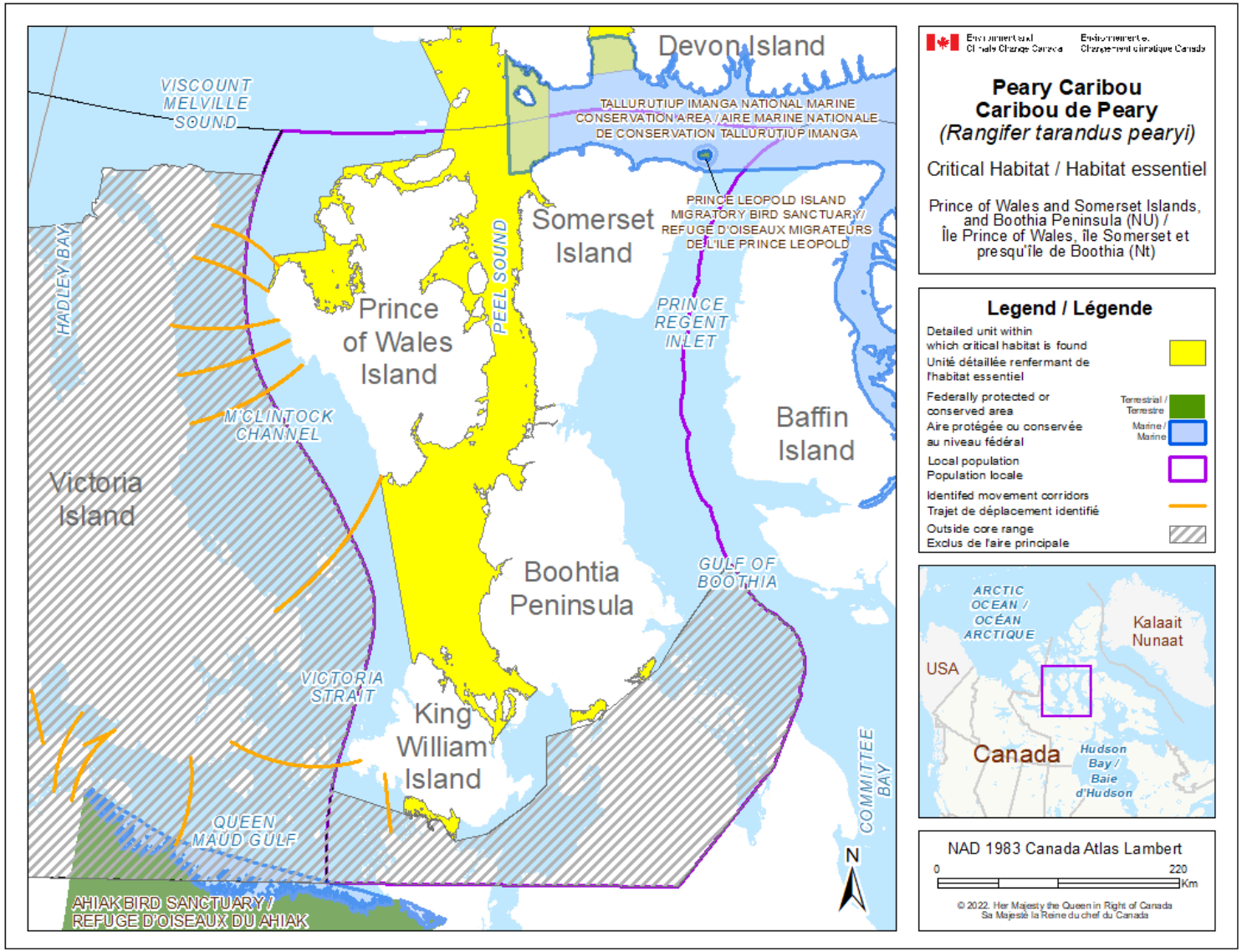


Figure 7. Areas that contain critical habitat for Peary Caribou in the Prince of Wales – Somerset Islands – Boothia Peninsula local population (NU).

7.2 Schedule of Studies to Identify Critical Habitat

A schedule of studies is required under SARA when the available information is inadequate to complete the identification of critical habitat. The schedule of studies (Table 8) outlines the studies required to complete the identification of critical habitat, necessary to meet the population and distribution objectives for Peary Caribou. The identification of critical habitat will be updated when the information becomes available, either in a revised recovery strategy or action plan(s).

Table 8: Schedule of studies to identify critical habitat

Description of Activity	Rationale	Timeline
Identify terrestrial movement corridors.	Build on existing IQ, TEK and scientific knowledge, identify, to the extent possible, terrestrial movement corridors that are essential for maintaining internal population dynamics (e.g. seasonal movements between winter foraging areas and calving areas), including those that allow for emigration/immigration between local populations (e.g. rescue effect).	2031
Habitat selection and Ecological studies (Land Habitat).	Studies identifying biophysical attributes at different life stages are very limited for Peary Caribou or do not exist for calving and rutting habitats. Research would help identify the biophysical attributes required by Peary Caribou at sensitive life stages, and would examine the relationship between biophysical attributes and Peary Caribou habitat use at the population level. Based on IQ, TEK and scientific knowledge, determining factors influencing Peary Caribou local population dynamics would allow to: - Determine how amount and type of habitats, including biophysical attributes, influence local population dynamics; - Determine both biotic and abiotic factors that influence local population dynamics, such as predators, other ungulate species, potential threats from disturbance, forage availability and climate. Knowledge of current abundance and location of Peary Caribou in the core range would support the identification of critical habitat.	2031
Conduct population surveys on Victoria Island (including Wollaston peninsula) to determine species distribution/range.	Peary Caribou have been reported on Victoria Island outside the core range, particularly on Wollaston peninsula. Surveys and/or research are needed to provide information on how many Peary Caribou use the area and how often. As Dolphin and Union Caribou are frequent on southern Victoria Island, such surveys must be done in a way that the two subspecies can be differentiated.	2031

7.3 Activities Likely to Result in the Destruction of Critical Habitat

This section describes the kinds of activities that are likely to cause the destruction of critical habitat. Understanding what constitutes destruction of critical habitat is necessary for the protection and management of critical habitat. Destruction would result if part of the critical habitat were degraded, either permanently or temporarily, such that it would not serve its function when needed by Peary Caribou. Destruction may result from single or multiple activities at one point in time, or from the cumulative effects of one or more activities over time. Destruction is determined on a case by case basis. Activities described in Table 9 include those likely to cause destruction of critical habitat for the species; however, destructive activities are not limited to those listed.

1983 **Table 9: Sample Activities Likely to Destroy Critical Habitat**

Description of Activity	Description of effect in relation to function loss	Details of effect
Sea Ice Critical Habitat		
Marine traffic that breaks sea ice or prevents ice from forming when needed by caribou	Icebreaking or marine traffic that prevents or temporarily prevents ice from forming will inhibit the use of the habitat (sea ice) as a safe passage between islands. Any activity that would break the ice just before caribou need it, or leave an open channel for a length of time that blocks the caribou, would be considered destruction of critical habitat. Sea ice can promptly reform (within a few days) after disturbance under specific conditions (such as weather conditions, and timing and frequency of the disturbance) and as such, it may be possible to break some sea ice within areas identified as critical habitat without destroying critical habitat, **if the sea ice critical habitat is available to Peary Caribou when needed**. The operationalization of avoiding destruction of sea ice critical habitat, the details of the specific conditions for which ice breaking would not be considered critical habitat destruction, will be defined in an agreement with all partners, including HTCs and HTOs, and be updated as new information becomes available.	Related to IUCN-CMP Threats: #4.3 Shipping lanes; #11.4 Storms & flooding To cause destruction of critical sea ice habitat, this activity must occur when sea ice is present or forming (or would have been present or forming in the absence of this activity) and caribou need to use the sea ice for movement. Any single event could temporarily destroy the habitat (sea ice), repeated activities could prolong the period during which the habitat is destroyed, removing the necessary function of this habitat which in turn increases the likelihood of harming the survival and recovery of Peary Caribou.

1984

8. Measuring Progress

Under SARA, the competent minister must report on the implementation of a recovery strategy and the progress towards meeting its objectives every five years.

Monitoring of Peary Caribou local populations based on performance indicators will be essential in order to have the information necessary to evaluate the effectiveness of management actions and to make necessary adjustments through an adaptive management process over time. The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives.

Table 10. Peary Caribou recovery strategy performance measures.

Population and Distribution Objectives	Performance Measure
Halt further declines outside the range of normal fluctuations and maintain Peary Caribou local populations within the bounds of normal population cycles.	Peary Caribou populations are monitored and the bounds of population cycles are understood and defined. Peary Caribou populations are increasing in areas of historically low numbers, and all other population numbers remain within the defined bounds.
All Peary Caribou local populations are healthy (self-sustaining) and available for future generations.	Peary Caribou local populations are large enough to survive and recover from natural events and human activities, do not need human support, and can persist over the long-term.
Peary Caribou local populations are able to support a sustainable Inuit/Inuvialuit harvest that is responsive to fluctuations in populations.	Harvest of Peary Caribou is responsive to population fluctuations and is not a mechanism for overall population declines.
Maintain Peary Caribou in all areas of Canada where they currently exist.	The distribution of Peary Caribou in their current range is maintained or enlarged.
Peary Caribou are able to move freely on the land and sea ice (within and between islands) to ensure natural habitat use and seasonal movement (limit unnatural movements / not forced to move), as well as movements during catastrophic events such as weather.	Peary Caribou movement is unrestricted and not hampered by human activity or human-made features that would otherwise modify their normal behaviour or habitat use.

8.1 Adaptive Management

The process of adaptive management planning and implementation acknowledges and supports the adjustment of management actions in light of new or more refined knowledge. Adaptive management identifies knowledge gaps, uncertainties, successes and failures, which are then evaluated to prioritize future information needs to improve outcomes and inform ongoing learning. As learning continues, implementation activities continue using revised and improved management actions.

To ensure adaptive management is applied effectively to Peary Caribou recovery, cooperation with federal and territorial governments, Inuit and Inuvialuit people, and others involved in the conservation, survival and recovery of Peary Caribou will be required.

9. Statement on Action Plans

One or more action plans for Peary Caribou will be posted on the Species at Risk Public Registry within five years of the posting of the recovery strategy.

Local community involvement and engagement in the development of these action plans will be critical for the successful recovery of Peary Caribou.

10. References

Ahern, F., J. Frisk, R. Latifovic, and D. Pouliot. 2011. Monitoring ecosystems remotely: A section of trends measured from satellite observations of Canada. Technical Thematic Report No. 17. Canadian Councils of Resource Ministers, Ottawa, ON.

AMAP. 2018. AMAP Assessment 2018: Biological Effects of Contaminants on Arctic Wildlife and Fish Tromsø, Norway.

Anderson, M. 2014. Distribution and abundance of Peary caribou (*Rangifer tarandus pearyii*) and muskoxen (*Ovibos moschatus*) on the Bathurst Island Group, May 2013. Status Report, Nunavut Department of Environment. Wildlife Research Section, Igloolik, NU. 39 pp.

Anderson, M. 2016a. Distribution and Abundance of Muskoxen (*Ovibos moschatus*) and Peary Caribou (*Rangifer tarandus pearyi*) on Prince of Wales, Somerset, and Russell Islands August 2016. Status Report 2016-06, Nunavut Department of Environment, Wildlife Research Section, Igloolik, NU. 27 pp.

Anderson, M. 2016b. Distribution and Abundance of Peary Caribou (*Rangifer tarandus pearyi*) and Muskoxen (*Ovibos moschatus*) on Devon Island March 2016. Status Report 2016-01, Nunavut Department of Environment, Wildlife Research Section, Igloolik, NU. 37 pp.

Anderson, M. 2016c. Distribution and Abundance of Peary Caribou (*Rangifer tarandus pearyi*) on Lougheed Island, July 2016. Status Report 2016-02, Nunavut Department of Environment, Wildlife Research Section, Igloolik, NU. 13 pp.

Anderson, M., and M. C. Kingsley. 2015. Distribution and abundance of Peary caribou (*Rangifer tarandus pearyii*) and muskoxen (*Ovibos moschatus*) on southern Ellesmere Island, March 2015. Status report 2015-01, Nunavut Department of Environment. Wildlife Research Section, Igloolik, NU. 49 pp.

Arctic Council. 2009. Arctic Marine Shipping Assessment 2009 Report. Second printing ed.

Banfield, A. W. F. 1961. A revision of the reindeer and caribou, genus *Rangifer*. National Museum of Canada, Bulletin No. 177, Queen's Printer, Ottawa, ON.

Boulanger-Lapointe, N., E. Lévesque, S. Boudreau, G. H. Henry, and N. M. Schmidt. 2014. Population structure and dynamics of Arctic willow (*Salix arctica*) in the High Arctic. Journal of Biogeography 41: 1967-1978.

Canadian Environmental Assessment Agency and Privy Council Office. 2010. Strategic environmental assessment: The cabinet directive on the environmental assessment of policy, plan and program proposals - Guidelines for implementing the cabinet directive. Canadian Environmental Assessment Agency, Government of Canada. Ottawa, ON. 13 pp.

Canadian Wildlife Service. 2012. Summary of discussions at the 2012 meeting of the Peary Caribou Recovery Strategy Development Group - October 16-18, 2012. Canadian Wildlife Service unpublished report, Yellowknife, NT.

Canadian Wildlife Service. 2013. Summary of discussions at the 2013 meeting of the Peary Caribou Recovery Strategy Development Group - October 22-24, 2013. Canadian Wildlife Service unpublished report, Yellowknife, NT.

Canadian Wildlife Service. 2015. Summary of discussions at the 2015 meeting of the Peary Caribou Recovery Strategy Development Group - February 17-19, 2015. Canadian Wildlife Service unpublished report, Yellowknife, NT.

Canadian Wildlife Service. 2020. Summary of the consultations on the identification of critical habitat for the Peary Caribou Recovery Strategy in Grise Fiord, Resolute Bay, Cambridge Bay, Gjoa Haven, Kugaaruk, Taloyoak, Ulukhaktok, Sachs Harbour, Paulatuk and Tuktoyaktuk.January-February, 2020. Canadian Wildlife Service unpublished report, Yellowknife, NT.

Collins, M., R. Knutti, J. Arblaster, J.-L. Dufresne, T. Fichefet, P. Friedlingstein, X. Gao, W. J. Gutowski, T. Johns, G. Krinner, M. Shongwe, C. Tebaldi, A. J. Weaver, and M. Wehner. 2013. Long-term climate change: Projections, commitments and irreversibility. In: T. F. Stocker, D. Qin, G. K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P. M. Midgley (eds.). Climate Change 2013: The Physical Science Basis. Contribution of Working Group 1 to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Colman, J. E., C. Pedersen, D. O. Hjermann, O. Holand, S. R. Moe, and E. Reimers. 2003. Do wild reindeer exhibit grazing compensation during insect harassment? Journal of Wildlife Management 67: 11–19.

Community of Paulatuk, Wildlife Management Advisory Council (NWT), and Joint Secretariat. 2008. Paulatuk Community Conservation Plan. Version 20 December 2009.

Community of Paulatuk, The Paulatuk Hunters and Trappers Committee, Paulatuk Community Corporation, and The Wildlife Management Advisory Council (NWT), The Fisheries Joint Management Committee and the Joint Secretariat. 2016. Paulatuk Community Conservation Plan.

Community of Sachs Harbour, Wildlife Management Advisory Council (NWT), and Joint Secretariat. 1992. Sachs Harbour Community Conservation Plan.

Community of Sachs Harbour, Wildlife Management Advisory Council (NWT), and Joint Secretariat. 2000. Sachs Harbour Community Conservation Plan.

Community of Sachs Harbour, Wildlife Management Advisory Council (NWT), and Joint Secretariat. 2008. Sachs Harbour Community Conservation Plan. Version 20.

Community of Sachs Harbour, The Sachs Harbour Hunters and Trappers Committee, Sachs Harbour Community Corporation, and The Wildlife Management Advisory Council (NWT), The Fisheries Joint Management Committee and the Joint Secretariat. 2016. Sachs Harbour Community Conservation Plan.

Community of Ulukhaktok, Wildlife Management Advisory Council (NWT), and Joint Secretariat. 2008. Olokhaktomiut Community Conservation Plan. Version 18 December 2009.

Community of Ulukhaktok, The Olohaktomiut Hunters and Trappers Committee, Ulukhaktok Community Corporation, and The Wildlife Management Advisory Council (NWT), The Fisheries Joint Management Committee and the Joint Secretariat. 2016. Olokhaktomiut Community Conservation Plan.

Contaminants and Remediation Directorate. 2009. Contaminated site remediation: what's happening in the ISR. March 2009. Indian and Northern Affairs Canada, Ottawa, ON.

Cooley, S.W., J.C. Ryan, L.C. Smith, C. Horvat, B. Pearson, B. Dale and A.H. Lynch. 2020. Coldest Canadian Arctic communities face greatest reductions in shorefast sea ice. Nature Climate Change. Vol. 10, n°6, p. 533–538.

COSEWIC. 2004. COSEWIC assessment and update status report on the Peary caribou *Rangifer tarandus pearyi* and the barren-ground caribou *Rangifer tarandus groenlandicus* (Dolphin and Union population) in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa.

COSEWIC. 2015. COSEWIC assessment and status report on the Peary Caribou *Rangifer tarandus pearyi* in Canada. Committee on the Status of Endangered Wildlife in Canada: xii + 92 pp.

Culler, L., M. Ayres, and R. Virginia. 2015. In a warmer Arctic, mosquitoes avoid increased mortality from predators by growing faster. Proc. R. Soc. B 282: 20151549.

Dale, V. H., L. A. Joyce, S. McNulty, R. P. Neilson, M. P. Ayres, M. D. Flannigan, P. J. Hanson, L. C. Irland, A. E. Lugo, and C. J. J. A. B. Peterson. 2001. Climate change and forest disturbances: climate change can affect forests by altering the frequency, intensity, duration, and timing of fire, drought, introduced species, insect and pathogen outbreaks, hurricanes, windstorms, ice storms, or landslides. 51: 723-734.

Davison, T., and J. Williams. 2012. Caribou and muskoxen survey on Melville and Prince Patrick Islands, 2012 summary. Department of Environment and Natural Resources, Government of Northwest Territories, Inuvik Region.

Davison, T., and J. Williams. 2013. Peary caribou (*Rangifer tarandus pearyi*) and muskoxen (*Ovibos moschatus*) on northwest Victoria Island, Northwest Territories. Rangifer 33 Special Issue 21: 129-134.

Davison, T., and J. Williams. 2015. Caribou and muskox survey on Northwest Victoria Island, April/May 2015. Unpublished preliminary report. D. o. E. a. N. Resources. Inuvik Region.

Davison, T., J. Williams, and J. Adamczewski. 2014. Peary caribou and muskox survey on Bank Island, 2014 summary.

Dawson, J., L. Pizzolato, S. Howell, L. Copland, and M. Johnston. 2018. Temporal and spatial patterns of ship traffic in the Canadian Arctic from 1990 to 2015. Arctic, 71(1):15- 26.

Dumond, M. 2006. Muskoxen abundance and distribution, and caribou distribution and calving areas on Boothia Peninsula, Nunavut - field work summary. Department of Environment, Government of Nunavut. Status Report 20. Iqaluit, NU.

Ekaluktutiak HTO. 2013. Summary of HTO and public Peary Caribou federal recovery strategy development community technical meetings - February 26, 2013. Canadian Wildlife Service unpublished report, Cambridge Bay, NU.

Ekaluktutiak HTO. 2016. Summary of HTO and public meetings for the draft Peary caribou recovery strategy - February 22, 2016. Canadian Wildlife Service unpublished report, Cambridge Bay, NU.

Elmendorf, S. C., G. H. Henry, R. D. Hollister, R. G. Björk, A. D. Bjorkman, T. V. Callaghan, L. S. Collier, E. J. Cooper, J. H. Cornelissen, and T. A. Day. 2012a. Global assessment of experimental climate warming on tundra vegetation: Heterogeneity over space and time. Ecology Letters 15: 164-175.

Elmendorf, S. C., G. H. Henry, R. D. Hollister, R. G. Björk, N. Boulanger-Lapointe, E. J. Cooper, J. H. Cornelissen, T. A. Day, E. Dorrepaal, and T. G. Elumeeva. 2012b. Plot-scale evidence of tundra vegetation change and links to recent summer warming. Nature Climate Change 2: 453-457.

Environment and Natural Resources. 2011. NWT State of the Environment Report – Highlights 2011. Government of Northwest Territories, Yellowknife. NT.

Environment and Natural Resources. 2016. NWT State of the Environment Report – Highlights 2016. Government of Northwest Territories, Yellowknife, NT.

Environment Canada. 2011. Scientific assessment to inform the identification of critical habitat for Woodland caribou (*Rangifer tarandus caribou*), boreal population, in Canada: 2011 update. Environment Canada. Ottawa, ON. 102 pp.

Environment Canada. 2012. Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada. E. Canada. Ottawa. 138 pp.

Environment Canada. 2013. Planning for a sustainable future: A federal sustainable development strategy for Canada 2013-2016. Environment Canada. 93 pp.

Ferguson, M. A. D. 1991. Peary caribou and muskoxen on Bathurst Island, Northwest Territories, from 1961 to 1981. Department of Renewable Resources, Government of the Northwest Territories. File Report no. 88.

Festa-Bianchet, M., J. C. Ray, S. Boutin, S. D. Côté, and A. Gunn. 2011. Conservation of caribou (*Rangifer tarandus*) in Canada: An uncertain future. Canadian Journal of Zoology 89: 419-434.

Fitzhugh, W. 1976. Environmental factors in the evolution of Dorset culture: A marginal proposal for Hudson Bay. Memoirs of the Society for American Archaeology: 139-149.

Forbes, D. L. 2011. State of the Arctic Coast 2010 – Scientific Review and Outlook International Arctic Science Committee, Land-Ocean Interactions in the Coastal Zone, Arctic Monitoring and Assessment Programme, International Permafrost Association. p 178, Helmholtz-Zentrum, Geesthacht, Germany.

Friedli, H. R., L. F. Radke, J. Y. Lu, C. M. Banic, W. R. Leaitch, and J. I. MacPherson. 2003. Mercury emissions from burning of biomass from temperate North American forests: laboratory and airborne measurements. Atmospheric Environment 37: 253-267.

Friesen, T. M. 2013. The impact of weapon technology on caribou drive system variability in the prehistoric Canadian Arctic. Quaternary International 297: 13-23.

Gamberg, M., B. Braune, E. Davey, B. Elkin, P. F. Hoekstra, D. Kennedy, C. Macdonald, D. Muir, A. Nirwal, and M. Wayland. 2005. Spatial and temporal trends of contaminants in terrestrial biota from the Canadian Arctic. Science of the Total Environment 351: 148-164.

Gjoa Haven HTA. 2013. Summary of HTA Peary caribou federal recovery strategy development community technical meeting - February 28, 2013. Canadian Wildlife Service unpublished report, Gjoa Haven, NU.

Gjoa Haven HTO. 2016. Summary of HTO meeting for the draft Peary caribou recovery strategy - February 23, 2016. Canadian Wildlife Service unpublished report, Gjoa Haven, NU.

Government of Canada. 2014. Species at Risk Public Registry. www.registrelep-sararegistry.gc.ca/ Accessed December 15 2014.

Government of Nunavut. 2014. in collaboration with the Hunter and Trappers Organizations of Grise Fiord, Resolute Bay, Arctic Bay, Cambridge Bay, Gjoa Haven, Taloyoak, Kugaaruk, Nunavut Tunngavik Inc., and the Nunavut Wildlife Management Board. Management plan for Peary Caribou in Nunavut, 2014-2020. Third Draft. D. o. E. (DOE). Iqaluit, NU. 37 pp.

Grise Fiord Peary Caribou Workshop. 1997. Peary caribou workshop, Government office, October 19-22, 1997, Grise Fiord, NU

Gunn, A. 2005. The decline of caribou on northwest Victoria Island 1980-93. Department of Resources and Wildlife and Economic Development, Government of the Northwest Territories. File Report 133. Yellowknife, NT. 60 pp.

Gunn, A., and J. Dragon. 1998. Status of caribou and muskox populations within the Prince of Wales Island-Somerset Island-Boothia Peninsula Complex, NWT, July-August 1995. Department of Resources and Wildlife and Economic Development, Government of the Northwest Territories. File Report 122. Yellowknife, NT. 45 pp.

Gunn, A., and J. Dragon. 2002. Peary caribou and muskox abundance and distribution on the western Queen Elizabeth Islands, Northwest Territories and Nunavut June-July 1997. Department of Resources and Wildlife and Economic Development, Government of the Northwest Territories. 130. Yellowknife. 93 pp.

Gunn, A., and B. Fournier. 2000. Identification and substantiation of caribou calving grounds on the NWT mainland and islands. Department of Resources and Wildlife and Economic Development, Government of the Northwest Territories. File Report 123. Yellowknife, NT. 177 pp.

Gunn, A., and F. L. Miller. 1980. Responses of Peary caribou cow-calf pairs to helicopter harassment in the Canadian High Arctic. In: E. Reimers, E. Gaare and S. Skjenneberg (eds.). 2nd International Reindeer/Caribou Symposium, Røros, Norway. p 497-507. Direktoratet for vilt og ferskvannsfisk, Trondheim.

Gunn, A., F. L. Miller, and J. Nishi. 1998. Status of endangered and threatened caribou on Canada's arctic islands. In: The Eighth North American Caribou Workshop, Whitehorse, Yukon. p 39-50.

Gunn, A., F. L. Miller, and J. Nishi. 2000. Status of endangered and threatened caribou on Canada's arctic islands. Rangifer: 39-50.

Gunn, A., F. L. Miller, and D. C. Thomas. 1981. The current status and future of Peary caribou *Rangifer tarandus pearyi* on the Arctic Islands of Canada. Biological Conservation 19: 283-296.

Gunn, A., D. Russell, and J. Eamer. 2011. Northern caribou population trends in Canada. Technical Thematic Report No. 10. Canadian Councils of Resource Ministers, Ottawa, ON.

Gunn, A., and T. Skogland. 1997. Responses of caribou and reindeer to global warming. In: W. C. Oechl (ed.). Global Change and Arctic Terrestial Ecosystems. p 191. Springer-Verlag, New York.

Hagemoen, R., and E. Reimers. 2002. Reindeer summer activity pattern in relation to weather and insect harassment. J. Anim. Ecol. 71: 883–892.

Hansen, B. B., R. Aanes, I. Herfindal, J. Kohler, and B.-E. Sæther. 2011. Climate, icing, and wild arctic reindeer: Past relationships and future prospects. Ecology 92: 1917-1923.

Harding, L. E. 2004. The future of Peary caribou (*Rangifer tarandus pearyi*) in a changing climate. In: Proceedings of the Species at Risk 2004 Pathways to Recovery Conference.

Hoberg, E. P., A. Abrams, P. A. Pilitt, and S. J. Kutz. 2012. Discovery and description of the “Davtiani” morphotype for *Teladorsagia boreoarcticus* (*Trichostrongyloidea: Ostertagiinae*) abomasal parasites in muskoxen, *Ovibos moschatus*, and caribou, *Rangifer tarandus*, from the North American Arctic: Implications for parasite faunal diversity. Journal of Parasitology 98: 355-364.

Howse, L. 2008. Late Dorset caribou hunters: Zooarchaeology of the Bell site, Victoria Island. Arctic anthropology 45: 22-40.

Hudson, J. M., and G. Henry. 2009. Increased plant biomass in a High Arctic heath community from 1981 to 2008. Ecology 90: 2657-2663.

Hung, H., P. Blanchard, C. J. Halsall, T. F. Bidleman, G. A. Stern, P. Fellin, D. C. G. Muir, L. A. Barrie, L. M. Jantunen, P. A. Helm, J. Ma, and A. Konoplev. 2005. Temporal and spatial variabilities of atmospheric polychlorinated biphenyls (PCBs), organochlorine (OC) pesticides and polycyclic aromatic hydrocarbons (PAHs) in the Canadian Arctic: Results from a decade of monitoring. Science of the Total Environment 342: 119-144.

IPCC. 1996. Climate Change 1995. Impacts, adaptations and mitigation of climate change: scientific-technical analyses. Cambridge University Press.

IPCC. 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. In: T. F. Stocker, D. Qin, G. K. Plattner, M. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P. M. Midgley (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

Iviq HTO. 2013. Summary of HTA and public Peary caribou federal recovery strategy development community technical meetings - February 20 and 21, 2013. Canadian Wildlife Service unpublished report, Grise Fiord, NU.

Iviq HTO. 2016. Summary of HTO meeting for the draft Peary caribou recovery strategy - February 29, 2016. Canadian Wildlife Service unpublished report, Grise Fiord, NU.

Jenkins, D. 2006. Estimating Peary caribou (*Rangifer tarandus pearyi*) and muskox (*Ovibos moschatus*) numbers, composition and distribtuion on Ellesmere Island, Nunavut. Department of Environment, Government of Nunavut. Status Report 21. Pond Inlet, NU. 10 pp.

Jenkins, D., M. Campbell, G. Hope, J. Goorts, and P. McLoughlin. 2011. Recent trends in abundance of Peary caribou (*Rangifer tarandus pearyi*) and muskoxen (*Ovibox moschatus*) in the Canadian Arctic Archipelago, Nunavut. Department of Environment, Government of Nunavut. Wildlife Report 1 Version 2. Pond Inlet, NU. 184 pp.

Jia, G. J., H. E. Epstein, and D. A. Walker. 2009. Vegetation greening in the Canadian Arctic related to decadal warming. Journal of Environmental Monitoring 11: 2231-2238.

Johnson, C. A., E. Neave, A. Blukacz-Richards, S. N. Banks, and P. E. Quesnelle. 2016. Knowledge assessment (community and scientific) to inform the identification of critical habitat for Peary caribou, *Rangifer tarandus pearyi*, in the Canadian Arctic. Environment and Climate Change Canada, Science and Technology, Ottawa, ON. http://publications.gc.ca/collections/collection_2017/eccc/CW66-560-2017-eng.pdf http://publications.gc.ca/collections/collection_2017/eccc/CW66-560-2017-fra.pdf

Kevan, P. G. 1974. Peary caribou and muskoxen on Banks Island. Arctic 27: 256-264.

Klein, D. R. 1992. Comparative ecological and behavioral adaptations of *Ovibos moschatus* and *Rangifer tarandus*. Rangifer 12: 47-55.

Kokelj, S., T. Lantz, S. Solomon, M. Pisaric, D. Keith, P. Morse, J. Thienpont, J. Smol, and D. Esagok. 2012. Using multiple sources of knowledge to investigate northern environmental change: Regional ecological impacts of a storm surge in the outer Mackenzie Delta, N.W.T. Arctic 65: 257–272.

Kurairojuark HTO. 2016. Summary of HTO and public meeting for the draft Peary caribou recovery strategy - February 25, 2016. Canadian Wildlife Service unpublished report, Kugaaruk, NU.

Kutz, S. J., E. P. Hoberg, P. K. Molnar, A. Dobson, and G. G. Verocai. 2014. A walk on the tundra: Host-parasite interactions in an extreme environment. International Journal of Parasitology: Parasites and Wildlife 3: 198-208.

Larter, N. C. 2013. Diet of Arctic Wolves on Banks and Northwest Victoria Islands, 1992-2001. Department of Environment and Natural Resources, Government of the Northwest Territories. Manuscript Report 230. 11 pp.

Larter, N. C., and J. A. Nagy. 1997. Peary caribou, muskoxen and Banks Island forage: assessing seasonal diet similarities. Rangifer 17: 9-16.

Larter, N. C., and J. A. Nagy. 2000a. Calf production and overwinter survival estimates for Peary caribou, *Rangifer tarandus pearyi*, on Banks Island, Northwest Territories. Canadian Field-Naturalist 114: 663-672.

Larter, N. C., and J. A. Nagy. 2000b. A comparison of heavy metal levels in the kidneys of High Arctic and mainland caribou populations in the Northwest Territories of Canada. The Science of the Total Environment 246: 109-119.

Larter, N. C., and J. A. Nagy. 2001a. Seasonal and annual variability in the quality of important forage plants on Banks Island, Canadian High Arctic. Applied Vegetation Science 4: 115-128.

Larter, N. C., and J. A. Nagy. 2001b. Variation between snow conditions at Peary caribou and muskox feeding sites and elsewhere in foraging habitats on Banks Island in the Canadian High Arctic. Arctic, Antarctic, and Alpine Research 33: 123-130.

Larter, N. C., and J. A. Nagy. 2004. Seasonal changes in the composition of the diets of Peary caribou and muskoxen on Banks Island. Polar Research 23: 131-140.

Larter, N. C., J. A. Nagy, and D. S. Hik. 2002. Does seasonal variation in forage quality influence the potential for resource competition between muskoxen and Peary caribou on Banks Island? Rangifer 22: 143-153.

Law, K. S., and A. Stohl. 2007. Arctic air pollution: Origins and impacts. Science 315: 1537-1540.

Leighton, F. A. 2011. Wildlife pathogens and diseases in Canada. Technical Thematic Report No. 7. Canadian Councils of Resource Ministers, Ottawa, ON.

Liston, G. E., and C. A. Hiemstra. 2011. The changing cryosphere: Pan-Arctic snow trends (1979-2009). Journal of Climate 24: 5691-5712.

Macdonald, R. W., T. Harner, and J. Fyfe. 2005. Recent climate change in the Arctic and its impact on contaminant pathways and interpretation of temporal trend data. Science of the Total Environment 342: 5-86.

Manseau, M., L. Dick, and N. Lyons. 2005. People, caribou and muskoxen on northern Ellesmere Island: Historical interactions and population ecology ca. 4300 BP to present. Parks Canada, Western Canada Service Centre, Winnipeg, MB.

Meldgaard, J. 1960. Origin and evolution of Eskimo cultures in the Eastern Arctic, February 1960. Canadian Geographical Journal No. 60. p 64-75.

Miller, F. L. 1991. Peary caribou calving and postcalving periods, Bathurst Island complex, Northwest Territories, 1989. Canadian Wildlife Service, Environment Canada. Technical Report Series 118. Edmonton, AB. 72 pp.

Miller, F. L. 1992. Peary caribou calving and postcalving periods, Bathurst Island complex, Northwest Territories, 1990. Canadian Wildlife Service, Environment Canada. Technical Report Series 151. Edmonton, AB. 87 pp.

Miller, F. L. 1993a. Peary caribou calving and postcalving periods, Bathurst Island complex, Northwest Territories, 1991. Canadian Wildlife Service: Western and Northern Region, Environment Canada. Technical Report 166. 99 pp.

Miller, F. L. 1993b. Status of wolves in the Canadian Arctic Archipelago. Canadian Wildlife Service: Western and Northern Region, Environment Canada. Technical Report Series 173. Edmonton, AB.

Miller, F. L. 1994. Peary caribou calving and postcalving periods, Bathurst Island complex, Northwest Territories, 1992. C. W. Service, Environment Canada. Technical Report 186. Edmonton, AB.

Miller, F. L. 1995. Peary caribou conservation studies, Bathurst Island complex, Northwest Territories, July-August 1993. Canadian Wildlife Service Technical Report Series No. 230. Canadian Wildlife Service, Prairie and Northern Region, Environment Canada. Edmonton, AB.

Miller, F. L. 1998. Status of Peary caribou and muskox populations within the Bathurst Island complex, south-central Queen Elizabeth Islands, Northwest Territories, July 1996. Canadian Wildlife Service Technical Report Series No. 317. Canadian Wildlife Service: Prairie & Northern Region, Environment Canada. Edmonton, AB. 147 pp.

Miller, F. L. 2002. Multi-island seasonal home range use by two Peary caribou, Canadian High Arctic Islands, Nunavut, 1993-1994. Arctic 55: 133-142.

Miller, F. L. 2003. Chapter 46: Caribou *Rangifer tarandus*. In: G. A. Feldhamer, B. C. Thompson and J. A. Chapman (eds.). Wild mammals of North America: biology, management, and conservation. JHU Press, Baltimore, Maryland.

Miller, F. L., and S. J. Barry. 1992. Nonrandom distribution of antlers cast by Peary caribou bulls, Melville Island, Northwest Territories. Arctic 45: 252-257.

Miller, F. L., and S. J. Barry. 2003. Single-island home range use by four female Peary caribou, Bathurst Island, Canadian High Arctic, 1993-94. Rangifer Special Issue No. 14: 267-281.

Miller, F. L., S. J. Barry, and W. A. Calvert. 2005. Sea-ice crossings by caribou in the south-central Canadian Arctic Archipelago and their ecological importance. Rangifer 25: 77-88.

Miller, F. L., E. J. Edmonds, and A. Gunn. 1982. Foraging behaviour of Peary caribou in response to springtime snow and ice conditions. Canadian Wildlife Service, Environment Canada. Occasional Paper 48. Ottawa, ON. 41 pp.

Miller, F. L., and A. Gunn. 1978. Inter-island movements of Peary caribou south of Viscount Melville Sound, Northwest Territories. Canadian Field-Naturalist 92: 327-331.

Miller, F. L., and A. Gunn. 2001. Status, population fluctuations and ecological relationships of Peary caribou on the Queen Elizabeth Islands: Implications for their survival. In: The Ninth North American Caribou Workshop, Kuujjuaq, QC. p. 213-226.

Miller, F. L., and A. Gunn. 2003a. Catastrophic die-off of Peary caribou on the Western Queen Elizabeth Islands, Canadian High Arctic. Arctic 56: 381-390.

Miller, F. L., and A. Gunn. 2003b. Status, population fluctuations and ecological relationships of Peary caribou on the Queen Elizabeth Islands: Implications for their survival. Rangifer: 213-226.

Miller, F. L., A. Gunn, and E. Broughton. 1985. Surplus killing as exemplified by wolf predation on newborn caribou. Canadian Journal of Zoology 63: 295-300.

Miller, F. L., and F. D. Reintjes. 1995. Wolf-sightings on the Canadian Arctic islands. Arctic 48: 313-323.

Miller, F. L., R. H. Russell, and A. Gunn. 1977. Distributions, movements and numbers of Peary caribou and muskoxen on western Queen Elizabeth Islands, Northwest Territories, 1972-1974. Canadian Wildlife Service, Environment Canada. Report Series 40. Ottawa, ON. 55 pp.

Moen, J. 2008. Climate change: effects on the ecological basis for reindeer husbandry in Sweden. Ambio 37: 304-311.

Mörschel, F., and D. Klein. 1997. Effects of weather and parasitic insects on behavior and group dynamics of caribou of the Delta Herd, Alaska. Can. J. Zool. 75: 1659–1670.

Nagy, J. A., N. C. Larter, and V. P. Fraser. 1996. Population demography of Peary caribou and muskox on Banks Island, N.W.T., 1982-1992. Rangifer: 213-222.

NatureServe. 2017. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. http://explorer.natureserve.org Accessed Web Page 2017.

Northern Contaminants Program. 2003. Highlights. Indian and Northern Affairs Canada. Canadian Arctic Contaminants Assessment Report II. Ottawa, ON. 118 pp.

Northern Contaminants Program. 2012. Mercury in Canada's North. Aboriginal Affairs and Northern Development Canada. Canadian Arctic Contaminants Assessment Report III. Ottawa, ON. 276 pp.

Northern Contaminants Program. 2017. Contaminants in Canada's North: State of Knowledge and Regional Highlights Canadian Arctic Contaminants Assessment Report. Indigenous and Northern Affairs Canada. Ottawa, ON. 52 pp.

Nunavut Planning Commission. 2021. Nunavut Land Use Plan [draft]. 110 pp.

Olohaktomiut HTC. 2013. Summary of HTC and public Peary caribou federal recovery strategy development community technical meetings - March 4, 2013. Canadian Wildlife Service unpublished report, Ulukhaktok, NT.

Olohaktomiut HTC. 2016. Summary of HTC and public meeting for the draft Peary caribou recovery strategy - March 9, 2016. Canadian Wildlife Service unpublished report, Ulukhaktok, NT.

Panikkar, B., B. Lemmond, B. Else and M. Murray. 2018. Ice over troubled waters: navigating the Northwest Passage using Inuit knowledge and scientific information. Climate Research. Vol. 75, n°1, p. 81–94.

Parker, G. R. 1978. The diets of muskoxen and Peary caribou on some islands in the Canadian High Arctic. Canadian Wildlife Service, Environment Canada. Canadian Wildlife Service Occasional Paper 35. 19 pp.

Parker, G. R., and R. K. Ross. 1976. Summer habitat use by muskoxen (*Ovibos moschatus*) and Peary caribou (*Rangifer tarandus pearyi*) in the Canadian High Arctic. Polarforschung 46: 12-25.

Parker, G. R., D. C. Thomas, E. Broughton, and D. R. Gray. 1975. Crashes of muskox and Peary caribou populations in 1973-74 on the Parry Islands, Arctic Canada. Canadian Wildlife Service, Environment Canada. Progress Notes No. 56.

Parks Canada. 2009. Quttinirpaaq National Park of Canada - Management Plan. 76 pp.

Parks Canada. 2012. Aulavik National Park of Canada - Management Plan. 52 pp.

Paulatuk HTC. 2013. Summary of HTC and public Peary caribou federal recovery strategy development community technical meeting - March 6, 2013. Canadian Wildlife Service unpublished report, Paulatuk, NT.

Paulatuk HTC. 2016a. Summary of HTC and public meeting for the draft Peary caribou recovery strategy - March 10, 2016. Canadian Wildlife Service unpublished report, Paulatuk, NT.

Paulatuk HTC. 2016b. Summary of Hunters and Trappers Committee and public meeting for the draft Dolphin and Union caribou management plan – April 21, 2016. . Canadian Wildlife Service unpublished report, Paulatuk, NT.

Pearson, R. G., S. J. Phillips, M. M. Loranty, P. S. Beck, T. Damoulas, S. J. Knight, and S. J. Goetz. 2013. Shifts in Arctic vegetation and associated feedbacks under climate change. Nature Climate Change 3: 673-677.

Pelletier, B. R., and B. E. Medioli. 2014. Environmental atlas of the Beaufort coastlands. Earth and Sciences Sector: Canada Centre for Mapping and Earth Observation, Natural Resources Canada. Geological Survey of Canada, Open File 7619. 271 pp.

Petersen, S. D., M. Manseau, and P. J. Wilson. 2010. Bottlenecks, isolation, and life at the northern range limit: Peary caribou on Ellesmere Island, Canada. Journal of Mammalogy 91: 698-711.

Pizzolato, L., S. E. Howell, C. Derksen, J. Dawson, and L. Copland. 2014. Changing sea ice conditions and marine transportation activity in Canadian Arctic waters between 1990 and 2012. Climatic change 123: 161-173.

Poole, K. G., A. Gunn, B. R. Patterson, and M. Dumond. 2010. Sea ice and migration of the Dolphin and Union caribou herd in the Canadian Arctic: An uncertain future. Arctic 63: 414-428.

Post, E., U. S. Bhatt, C. M. Bitz, J. F. Brodie, T. L. Fulton, M. Hebblewhite, J. Kerby, S. J. Kutz, I. Stirling, and D. A. Walker. 2013. Ecological consequences of sea-ice decline. Science 341: 519-524.

Post, E., and M. C. Forchhammer. 2008. Climate change reduces reproductive success of an Arctic herbivore through trophic mismatch. Philosophical Transactions of the Royal Society of London B 363: 2369–2375.

Post, E., M. C. Forchhammer, M. Bret-Harte, T. V. Callahan, T. R. Christensen, B. Elberling, A. D. Fox, O. Gilg, D. S. Hik, and P. Aastrup. 2009. Ecological dynamics across the Arctic associated with recent climate change. Science 325: 1355-1358.

Reed, A., R. J. Hughes, and H. Boyd. 2002. Patterns of distribution and abundance of Greater Snow Geese on Bylot Island, Nunavut, Canada 1983-1998. Wildfowl 53: 53-65.

Resolute Bay HTO. 2013. Summary of HTO and public Peary caribou federal recovery strategy development community technical meetings - February 19, 2013. Canadian Wildlife Service unpublished report, Resolute Bay, NU.

Resolute Bay HTO. 2016. Summary of HTO and public meetings for the draft Peary caribou recovery strategy - March 1, 2016. Canadian Wildlife Service unpublished report, Resolute Bay, NU.

Riewe, R. R. 1973. Final report on a survey of ungulate populations on the Bjorne Peninsula, Ellesmere Island. Determination of numbers and distribution and assessment of the effects of seismic activities on the behaviour of these populations. University of Manitoba Winnipeg for Department of Indian and Northern Affairs. Ottawa, ON. 59 pp.

Russell, R. H., E. J. Edmonds, and J. Roland. 1979. Caribou and muskoxen habitat studies. Prepared by Canadian Wildlife Service, Fisheries and Environment Canada for Environmental-Social Program and Northern Pipelines, Indian and Northern Affairs. AIPP Report 1978. ESCOM Report No. AI-26. Ottawa, ON. 127 pp.

Sachs Harbour HTC. 2013. Summary of HTC, elder and public Peary caribou federal recovery strategy development community technical meetings - March 5, 2013. Canadian Wildlife Service unpublished report, Sachs Harbour, NT.

Sachs Harbour HTC. 2016. Summary of HTC and public meetings for the draft Peary caribou recovery strategy - March 8, 2016. Canadian Wildlife Service unpublished report, Sachs Harbour, NT.

Sachs Harbour HTC. 2021. Summary of HTC meeting on local knowledge on Peary caribou - January 27, 2021. WMAC-NWT unpublished report, Sachs Harbour, NT.

Salafsky, N., D. Salzer, A. J. Stattersfield, C. HILTON-TAYLOR, R. Neugarten, S. H. Butchart, B. Collen, N. Cox, L. L. Master, and S. J. C. B. O'connor. 2008. A standard lexicon for biodiversity conservation: unified classifications of threats and actions. 22: 897-911.

Schaefer, J. A., S. D. Stevens, and F. Messier. 1996. Comparative winter habitat use and associations among herbivores in the High Arctic. Arctic: 387-391.

Semmens, K. A., J. Ramage, A. Bartsch, and G. E. Liston. 2013. Early snowmelt events: Detection, distribution, and significance in a major sub-arctic watershed. Environmental Research Letters 8: 1-11.

Shank, C. C., D. F. Penner, and P. F. Wilkinson. 1978. Diet of Peary caribou, Banks Island, NT. Arctic 31: 125-132.

Sharma, S., S. Couturier, and S. D. Côté. 2009. Impacts of climate change on the seasonal distribution of migratory caribou. Global Change Biology 15: 2549-2562.

Slaney, F. F., and Co. Ltd. 1974. Peary caribou and muskoxen and Panarctic's seismic operations n Bathurst Island, N.W.T., 1974. Panarctic Oils Ltd., Calgary, Alberta.

Slaney, F. F., and Co. Ltd. 1975. Peary caribou and muskoxen and Panarctic's seismic operations on Bathurst Island, N.W.T., 1975. Supplemental Report. Panarctic Oils Ltd., Calgary, Alberta.

Sou, T., and G. Flato. 2009. Sea ice in the Canadian Arctic Archipelago: Modeling the past (1950-2004) and the future (2041-60). Journal of Climate 22: 2181-2198.

Species at Risk Committee. 2012. Species status report for Peary caribou (*Rangifer tarandus pearyi*) in the Northwest Territories. Species at Risk Committee, Yellowknife, NT.

Species at Risk Committee. 2013. Species status report for Dolphin and Union caribou (*Rangifer tarandus groenlandicus x pearyi*) in the Northwest Territories. Species at Risk Committee, Yellowknife, NT.

Spence Bay HTA. 2013. Summary of HTA Peary caribou federal recovery strategy development community technical meeting - February 27, 2013. Canadian Wildlife Service unpublished report, Taloyoak, NU.

Spence Bay HTO. 2016. Summary of HTO and public meetings for the draft Peary caribou recovery strategy - February 24, 2016. Canadian Wildlife Service unpublished report, Taloyoak, NU.

Spreen, G., R. Kwok, and D. Menemenlis. 2011. Trends in Arctic sea ice drift and role of wind forcing: 1992–2009. Geophysical Research Letters 38: 6.

Staaland, H., J. Z. Adamczewski, and A. Gunn. 1997. A comparison of digestive tract morphology in muskoxen and caribou from Victoria Island, NT. Rangifer 17: 17-19.

Stern, G. A., R. W. Macdonald, P. M. Outridge, S. Wilson, J. Chetelat, A. Cole, H. Hintelmann, L. L. Loseto, A. Steffen, and F. J. S. o. t. t. e. Wang. 2012. How does climate change influence arctic mercury? 414: 22-42.

Stocks, B. J., M. A. Fosberg, T. J. Lynham, L. Mearns, B. M. Wotton, Q. Yang, J. Z. Jin, K. Lawrence, G. R. Hartley, and J. A. Mason. 1998. Climate change and forest fire potential in Russian and Canadian boreal forests. Climatic change 38: 1-13.

Taylor, A. D. M. 2005. Inuit Qaujimajatuqangit about population changes and ecology of Peary caribou and muskoxen on the High Arctic islands of Nunavut, Queen's University, Kingston, ON.

Tews, J., A. D. Ferguson, and L. Fahrig. 2007a. Potential net effects of climate change on High Arctic Peary caribou: Lessons from a spatially explicit simulation model. Ecological Modelling 207: 85-98.

Tews, J., M. A. D. Ferguson, and L. Fahrig. 2007b. Modeling density dependence and climatic disturbances in caribou: a case study from the Bathurst Island complex, Canadian High Arctic. Journal of Zoology 292: 209-217.

Tews, J., R. Jeppesen, and C. Callaghan. 2012. Sensitivity of High Arctic caribou population dynamics to changes in the frequency of extreme weather events. In: J. F. Brodie, E. S. Post and D. F. Doak (eds.). Wildlife conservation in a changing climate. p 282-300. The University of Chicago Press, Chicago.

Thomas, D. C., and E. Broughton. 1978. Status of three Canadian caribou populations north of 70˚ in winter 1977. Canadian Wildlife Service, Environment Canada. Progress Notes 85. 12 pp.

Thomas, D. C., and E. J. Edmonds. 1983. Rumen contents and habitat selection of Peary caribou in winter, Canadian Arctic Archipelago. Arctic and Alpine Research 15: 97-105.

Thomas, D. C., and E. J. Edmonds. 1984. Competition between caribou and muskoxen, Melville Island, NWT, Canada. In: Klein, D. R., White, R. G & Keller, S. (eds.). Proc. First Internat. Muskox Symp., Biol. Papers. Univ. Alaska. . p pp. 93-100.

Thomas, D. C., E. J. Edmonds, and H. J. Armbruster. 1999. Range types and their relative use by Peary caribou and muskoxen on Melville Island, NWT. Canadian Wildlife Service, Environment Canada. Technical Report Series 343. Edmonton, AB.

Thomas, D. C., and P. Kroeger. 1980. In vitro digestibilities of plants in rumen fluids of Peary caribou. Arctic 33: 757-767.

Thomas, D. C., R. H. Russell, E. Broughton, E. J. Edmonds, and A. Gunn. 1977. Further studies of two populations of Peary caribou in the Canadian Arctic. Canadian WIldlife Service, Environment Canada. Progress Notes 80.

Urquhart, D. R. 1973. Oil exploration and Banks Island wildlife: A guideline for the preservation of caribou, muskox, and arctic fox populations on Banks Island, N.W.T. Game Management Division, Government of Northwest Territories. Yellowknife, NT.

van Zyll de Jong, C. G., and L. N. Carbyn. 1999. (unpublished report). COSEWIC status report on the grey wolf *Canis lupus* in Canada in COSEWIC assessment and status report on the grey wolf *Canis lupus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1 - 59 pp.

Vincent, D., and A. Gunn. 1981. Population increase of muskoxen on Banks Island and implications for competition with Peary caribou. Arctic 34: 175-179.

Walker, M. D., C. H. Wahren, R. D. Hollister, G. H. Henry, L. E. Ahlquist, J. M. Alatalo, M. S. Bret-Harte, M. P. Calef, T. V. Callaghan, and A. B. Carroll. 2006. Plant community responses to experimental warming across the tundra biome. Proceedings of the National Academy of Sciences of the United States of America 103: 1342-1346.

Wan, H., X. L. Wang, and V. R. Swail. 2010. Homogenization and trend analysis of Canadian near-surface wind speeds. J. Climate 23: 1209-1225.

Wang, M., and J. E. Overland. 2009. A sea ice free summer Arctic within 30 years? Geophysical Research Letters 36: 1-5.

Yadav, J., A. Kumar, and R. Mohan. 2020. Dramatic decline of Arctic sea ice linked to global warming. Natural Hazards. Vol. 103, p. 2617–2621.

Wang, X. L., Y. Feng, and V. R. Swail. 2015. Historical changes in the Beaufort-Chukchi-Bering Seas surface winds and waves, 1971-2013. J. Climate 28: 7457-7469.

Wang, X. L., H. Wan, and V. R. Swail. 2006. Observed changes in cyclone activity in Canada and their relationships to major circulation regimes. J. Climate 19: 896-915.

Warren, F. J., and D. S. Lemmen. 2014. Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation. Government of Canada. Ottawa, ON. 286 pp.

Weladji, R., H. Øystein, and T. Almøy. 2003 Use of climatic data to assess the effect of insect harassment on the autumn weight of reindeer (*Rangifer tarandus*) calves. J. Zool. Lond. 260: 79–85.

Weladji, R. B., and B. C. Forbes. 2002. Disturbance Effects of Human Activities on *Rangifer Tarandus* Habitat: Implications for Life History and Population Dynamics. Polar Geography 26: 171-186.

Wilkinson, P. F., C. C. Shank, and D. F. Penner. 1976. Muskox-caribou summer range relations on Banks Island, N.W.T. The Journal of Wildlife Management 40: 151-162.

Witter, L., C. Johnson, B. Croft, A. Gunn, and L. Poirier. 2012. Gauging climate change effects at local scales: weather-based indices to monitor insect harassment in caribou. Ecol. Appl. 22: 1838–1851.

World Wildlife Fund. 2015. The Last Ice Area. http://wwf.panda.org/what_we_do/where_we_work/arctic/last_ice_area/ Accessed September 1 2015.

Xu, L., R. Myneni, F. Chapin Iii, T. Callaghan, J. Pinzon, C. Tucker, Z. Zhu, J. Bi, P. Ciais, and H. Tømmervik. 2013. Temperature and vegetation seasonality diminishment over northern lands. Nature Climate Change 3: 581-586.

Zhang, X., R. Brown, L. Vincent, W. Skinner, Y. Feng, and E. Mekis. 2011. Canadian climate trends, 1950-2007. Technical Thematic Report No. 5. Canadian Councils of Resource Ministers, Ottawa, ON.

Zittlau, K., J. Nagy, A. Gunn, and C. Strobeck. 2003. Do subspecific divisions make good conservation units? In: C. Strobeck (ed.). Caribou Genetics and Relationships Workshop, March 8-9, 2003, Edmonton, AB. p 103-134. Department of Resources, Wildlife and Economic Development, Government of the Northwest Territories, Yellowknife, NT.

Zoltai, S. C., P. N. Boothroyd, and G. W. Scotter. 1981. A natural resource survey of eastern Axel Heiberg Island, Northwest Territories. Canadian Wildlife Service, prepared for Parks Canada. Ottawa, ON. 156 pp.

Appendix 1: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*[14]. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or any of the Federal Sustainable Development Strategy's[15] (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

It is anticipated that the activities identified in this recovery strategy will benefit several species and the environment. Two mammal species listed under SARA are present and use significantly the identified sea ice critical habitat for Peary Caribou : Dolphin and Union Caribou (*Rangifer tarandus groenlandicus*) migrate between Victoria Island and the mainland on a seasonal bases, and polar bear (*Ursus maritimus*) inhabits the sea ice during most of the year. Sea ice is also important for many species of seabirds that use this feature to feed on fish and crustaceans. For example, Ivory Gull (*Pagophila eburnea*), listed as Endangered under SARA, depends on the sea ice for foraging. Other seabirds who could be affected by a change in the sea ice dynamic include Common Eider, King Eider and Long-tailed Duck (Gilchrist and Rebortson, 2000; Lovvorn et al, 2015). Likewise, Snowy Owl has also been observed to depend on the polynias and the presence of these seabirds to prey upon (Therrien et al. 2011). Two marine species under consideration for listing under SARA will also benefit from the conservation of the sea ice critical habitat identified in this document, the Ringed Seal inhabits a large part of the identified sea ice, and the Atlantic Walrus, although not present in the western arctic, they can use the Jones sound area. Furthermore, the Inuit and Inuvialuit have always travelled on the sea ice and continue to do so, the conservation and/or protection of this important feature will ensure their security and their access to traditional food.

Conserving the sea ice critical habitat will help this caribou recover. Predators of Peary Caribou, like the Arctic wolf (*Canis lupus arctos*), may benefit from an increase in caribou populations particularly if other prey species such as muskoxen (*Ovibos moschatus*) decline. However, increases to predator populations may have adverse

[14] www.canada.ca/en/environmental-assessment-agency/programs/strategic-environmental-assessment/cabinet-directive-environmental-assessment-policy-plan-program-proposals.html
[15] www.fsds-sfdd.ca/index.html#/en/goals/

impacts to Peary Caribou if their populations become very large. Conversely, a reduction in Peary Caribou populations may have negative implications for predators. Species that share the same area with Peary Caribou but have different forage preferences, such as muskoxen, may increase their populations as a result of protections to Peary Caribou. This could negatively impact Peary Caribou given their aversion to being in close proximity to muskoxen. For species that share forage with Peary Caribou, such as snow geese (*Chen caerulescens*), an increase in caribou populations could lead to greater competition for available habitat and forage.

No negative effects on other species are anticipated that may result from the implementation of the Peary Caribou recovery strategy.

This recovery strategy will contribute to the achievement of the goals and targets of the *Federal Sustainable Development Strategy for Canada* (Environment Canada 2013). In particular, the strategy directly contributes to the Government of Canada's commitment to restore populations of wildlife to healthy levels, protect natural spaces and wildlife, and protect the natural heritage of our country.

Appendix 2: Engagement With Inuit And Inuvialuit Partners In The Development Of The Recovery Strategy For Peary Caribou

- In Nunavut (NU) and the Northwest Territories (NT), there are nine communities (NU: Grise Fiord, Resolute Bay, Gjoa Haven, Taloyoak, Kugaaruk, Cambridge Bay; NT: Sachs Harbour, Ulukhaktok and Paulatuk), two regional wildlife boards (Kitikmeot Regional Wildlife Board (KRWB) and Qikiqtaaluk Wildlife Board (QWB)) and two wildlife management boards (Nunavut Wildlife Management Board (NWMB) and Wildlife Management Advisory Council (NWT) (WMAC (NWT)) within the range of Peary Caribou. These communities are all actively engaged in the recovery planning process. Additionally, the Tuktoyaktuk Hunters and Trappers Committee which is located outside the range of Peary Caribou was consulted on the draft Recovery Strategy in 2016 and 2020.

- Environment and Climate Change Canada (ECCC) committed early to the inclusion of Inuit Qaujimajatuqangit (IQ), Traditional Ecological Knowledge (TEK) and local knowledge and expertise in the development of the Peary Caribou recovery strategy.

- An Administrative Committee was established and included agencies with legal responsibility for *Species at Risk Act* (SARA) implementation or caribou management. The Committee provides direction and advice on process, policy, inter-governmental issues and resources. This committee included the NWMB and WMAC (NWT). The Committee appointed members and provided advice on which Inuit/Inuvialuit communities should be actively engaged.

- Having local Hunters and Trappers Committees and Organizations (HTC/HTO) as full partners in the drafting of key elements of the recovery strategy, including the identification of critical habitat, is very important as their long-term knowledge of Peary Caribou is able to tell a story. This partnership with HTCs/HTOs also provides a different perspective, examines different spatial and temporal scales, and incorporates a different worldview and belief system, which is complementary to western science. Given the challenging logistics and significant costs of doing work in the High Arctic, the surveys and western science on Peary Caribou are limited and fully benefit from the inclusion of IQ/TEK and local knowledge.

- Introductory meetings were held in communities (November 2011 and March 2012) to inform HTCs/HTOs and the communities about the purpose of a recovery strategy, the proposed process to develop the recovery strategy and how their engagement and knowledge was an important part of the process.

- A preparatory meeting was held in Yellowknife, NT, in October 2012 with technical representatives from the territorial governments, Parks Canada Agency (PCA) and the chairs from the HTCs/HTOs. The purpose was to share the best available information on Peary Caribou, and to seek their input on the best methods to distribute information, as well as to receive input from communities during the

planned community technical meetings in each community within the range of Peary Caribou. The Chairs helped guide the information to be shared, how best to share it, and how best to engage their communities. This process was vital for ensuring the community technical meetings were successful. The group discussed at length the population and distribution objectives and developed draft objectives that would be used to gather feedback at the community technical meetings.

- Community technical meetings were held in each community (February and March 2013) within the range of Peary Caribou with the HTCs/HTOs and public. The Canadian Wildlife Service (CWS) gathered IQ/TEK and local knowledge and mapping of information, which was used equally with the science to inform the drafting of the recovery strategy. The Inuit/Inuvialuit perspective, knowledge and expertise has been used to:
  - Draft the population and distribution objectives
  - Identify areas used by Peary Caribou on maps, which augmented available survey/collar data
  - Identify habitat and climate characteristics important to Peary Caribou
  - Identify threats to Peary Caribou
  - Identify management actions to recover Peary Caribou

- PCA and the GN have been collaborating with High Arctic communities on a project that will use non-invasive techniques to increase the knowledge base on Peary Caribou landscape genetics, population structure and phylogeny. ECCC has provided Grants and Contributions funding to the GN in support of this work. The project is being expanded to include the Inuvialuit Settlement Region. This information will help inform recovery planning for Peary Caribou.

- HTC/HTO representatives held a teleconference with the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to discuss the re-assessment of Peary Caribou conducted in November 2015. The HTC/HTO representatives decided that the information gathered through the recovery strategy process (community technical meetings, etc.) should be shared with COSEWIC to help inform the re-assessment.

- Information gathered from community meetings has informed ECCC comments on major projects. An example is the Canada Coal project north of Grise Fiord and Resolute Bay, NU, where ECCC used IQ and local knowledge as part of its response.

- Wildlife management boards, including WMAC (NWT) and NWMB, have a role in the decision-making processes, therefore wildlife management board engagement and consultation is required on the recovery strategy development, including the process, material and the draft recovery strategy.

- There are several land managers whose jurisdictions overlap Peary Caribou range (Inuvialuit, Inuit-owned lands, PCA, ECCC, Crown-Indigenous Relations and Northern Affairs Canada, Department of National Defense, GNWT and GN).

- Inuit and Inuvialuit communities play a key role in the ongoing co-management of Peary Caribou through the settled land claim co-management boards.

Inuit have also developed collaborative working relationships with ECCC to undertake stewardship programs for wildlife and wildlife habitat. Resolute Bay and Grise Fiord have received funding for Peary Caribou stewardship projects from the Habitat Stewardship Program since 2006-07. Sachs Harbour and Ulukhaktok undertook a project for Habitat Stewardship Program in 2008-2009. These projects helped support community conservation and stewardship through preservation and transfer of Peary Caribou traditional knowledge among the community members and to scientists, and planning and development of stewardship and management activities.

Appendix 3: Additional needs identified to help the recovery of Peary Caribou

The following list is not exhaustive, but illustrates some of the suggestions provided by co-management partners, HTC/HTO representatives and community members to address the threats and limitations to Peary Caribou and their habitat in order to help the recovery of Peary Caribou. This list is complementary to the recovery planning table and gives more detailed actions relevant to an Action Plan.

Monitoring		
Threat or Limitation Addressed	**Activity**	**Needs**
Climate change	Monitor and study the impacts of climate change on Peary Caribou and their habitat	Investigate the full range of impacts of climate change projections to Peary Caribou, including insects and diseases, sea ice changes, and changes to water courses/streams.
		Coordinate monitoring of climate-related habitat disturbances/changes with territorial and federal programs assessing ecosystem vulnerability to climate change to develop a better understanding of the habitat conditions on each local population range.
		Assess the potential for climate-related northward expansion and/or increased prevalence/intensity of existing and novel diseases and parasites that could affect individual caribou health.
	Education and awareness	Encourage recycling, control of emissions and energy conservation in Arctic communities as well as elsewhere.
		Develop a communications strategy to educate people nationally and internationally about the effects of climate change on Peary Caribou, and other northern species (ex. share stories of how climate change is impacting the Peary Caribou, the people and food security to help with climate change mitigation efforts).
Knowledge gap: Peary Caribou population dynamics	Conduct population studies to better understand population structure, trends, distribution and movement routes/migration	Refine understanding of the structure of Peary Caribou local populations, as well as movement routes/migration. Knowledge should be gathered from IQ/TEK and local knowledge and western science. All kinds of knowledge need to be updated frequently.
		Monitor rates of exchange of individuals between different islands.
		Determine rates of exchange between the four local population delineations.
		Monitor population size and/or trend, as well as changes in Peary Caribou distribution over time.
		Population modeling to assess the range of demographic and environmental conditions that would support a self-sustaining population of Peary Caribou.
		Determine sensitivity to the assumption of closed populations in predicted estimates of probability of maintaining a self-sustaining population.
		Determine use of the Boothia Peninsula and its potential independence as a demographic unit.

		Refine understanding of the location of movement corridors (e.g. direction of movement, intensity of use and potential for change, shifts or range contraction in response to changing environmental conditions, etc.).
Monitoring		
Threat or Limitation Addressed	**Activity**	**Needs**
Knowledge gap: Peary Caribou population dynamics	Conduct population studies to better understand population structure, trends, distribution and movement routes/migration	Investigate use of habitats outside of the core survey areas (e.g. seasons, frequency of use, patterns of movement).
		Improve understanding of habitat use and requirements in more remote locations (e.g. Axel Heiberg and Ellesmere Islands, unidentified movement corridors, etc.).
		Determine the influence of development on movement patterns, and the potential influence of barriers to movement on population condition (viability) at the local population and species distribution scales.
		Develop standardized methodology so that to the extent possible, surveys are comparable across the Peary Caribou distribution and through time.
		Encourage the collection of incidental observations of Peary Caribou and their habitat from people who are travelling or working in the Peary Caribou area. A communications plan and a mechanism of receiving and quality controlling the observations will be required.
Peary Caribou health and condition	Monitor Peary Caribou health and condition	Gather information on Peary Caribou health (e.g. note parasites, diseases, abnormalities) from hunters and when investigating mortalities. Program to support collection of samples when already harvesting.
		Investigate wolf-caribou interactions in terms of disease.
		Investigate implications of caribou diseases on human health.
		Monitor for new insects and diseases and investigate their impact on Peary Caribou.
		Monitor for industrial contaminants in both vegetation and in Peary Caribou meat.
Introduced genetic material	Monitor interbreeding between Peary Caribou and other caribou subspecies	Monitor range overlap and interbreeding between Peary Caribou and other caribou subspecies.
		Investigate whether interbreeding makes Peary Caribou more susceptible to parasites and disease.
Relationship between Peary Caribou and muskoxen population trends (problematic native species)	Assess and monitor relationship between muskoxen and Peary Caribou populations	Increase understanding of the relationship between muskoxen, Peary Caribou and wolves.
		Determine the mechanism behind the relationship between muskoxen and Peary Caribou abundance and account for regional variation.
		Where necessary, develop management strategies to reduce negative effects of muskoxen on Peary Caribou populations.
Cumulative effects	Monitor cumulative effect of threats	Determine the cumulative effect of threats to Peary Caribou (e.g. climate change, human development, sensory disturbances, wolves, muskoxen, etc.).

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Mortality and Population Management		
Threat or Limitation Addressed	**Activity**	**Needs**
Predation (problematic native species)	Assess and monitor relationship between predator and Peary Caribou populations	Investigate predator management as a tool for helping Peary Caribou populations.
		Increase understanding of the relationship between muskoxen, Peary Caribou and wolves.
		Diet study on wolves using stable isotopes.
		Monitor change in other predator populations and the rate of predation of Peary Caribou (grizzly bear, wolverine, polar bear).
Hunting	Manage direct human-caused mortality of Peary Caribou	Assess and address the impacts of specific harvesting strategies (e.g. preferential harvest of large males) and quota systems.
		Develop and implement strategy to minimize unreported harvest, particularly where Peary Caribou overlap other caribou herds.
		Maintain and encourage community-based approach for regulating harvest and monitoring local population numbers. Use voluntary restrictions to adjust the harvest when numbers are low, or to certain times of year.
		Encourage hunters to avoid wastage (e.g. shoot in neck, sight rifles properly) and develop resources to aid in accurate species identification.
		Discourage illegal harvest from non-resident harvesters through awareness campaigns and increased enforcement of existing regulations.
		Promote use of alternative food sources and food sharing projects to provide food security during periods when Peary Caribou harvests are low.
Habitat management and landscape level planning		
Ship traffic	Manage timing of ship traffic and ice-breaking to minimize disruption of inter-island movements	Develop a best practices plan to minimize the disruption of Peary Caribou inter-island movements from ship traffic and ice-breaking.
		Work with industry stakeholders as well as other sources of shipping traffic to implement the best practices plan.
		Improve knowledge on when and where caribou are crossing. Include the collection of community data on the importance of ice crossings for Peary Caribou.
		Research to understand the impacts of ice breaking.
		Discourage the dumping of ballast water through an education campaign and/or the development of stricter regulations or enforcement.
Energy production and mining	Undertake landscape level protection and planning that considers current and future Peary Caribou populations	Undertake coordinated land and/or resource planning to ensure that development activities are planned and implemented at appropriate spatial and temporal scales in order to minimize disruption to Peary Caribou (e.g. consider sensitive periods/areas such as movements between seasonal ranges, calving, etc.).
		Protect calving areas from disturbance.
		Monitor impact of exploration activities.

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Habitat management and landscape level planning		
Threat or Limitation Addressed	**Activity**	**Needs**
Energy production and mining	Undertake landscape level protection and planning that considers current and future Peary Caribou populations	Develop regional standard mitigation advice for environmental assessment and Nunavut Impact Review Board reviews. Communities should have input at the beginning of permitting process.
		Research to better understand the impact of energy production and mining activities on Peary caribou.
All threats	Undertake landscape level protection	Investigate designating high priority areas as protected sites.
		Develop cumulative effects assessment approaches.
Critical habitat identification	Standardize approach to describe critical habitat	Develop a tool that links population condition to habitat requirements, which could potentially lead to the identification of thresholds to define the amount of critical habitat required to support the population and distribution objectives outlined in the federal recovery strategy.
		Improvement in the georeferenced layers used for habitat modelling (e.g. better characterization of vegetation across the arctic; better characterization of snow conditions and rain on snow events (climatic conditions at a scale impacting Peary Caribou grazing conditions); finer scale data on climate to better match scale of habitat selection for Peary Caribou).
		Uncertainty measures for each step of the data standardization process to bracket population estimates. Investigate infilling methodology and comparison to Bayesian methodology.
Pollution (garbage and solid waste and air-borne pollution)	Clean-up contaminated sites and other waste from past activities and manage pollution from new industrial activities	Develop and implement a plan to clean-up contaminated sites and other waste in the Peary Caribou range. Plan needs to include the small and medium scale sites, not just large ones.
		Manage local pollution (e.g. extent, timing, location) to ensure that Peary Caribou health is not adversely affected. Pollution is not exclusive to industry; community and research camps also need to be cleaned up.
		Develop a system to track, monitor and clean-up fuel caches. Enforcement is needed, with penalties for anyone who does not follow through with clean-up of fuel caches.
		Implement an appropriate security deposit system to cover clean-up costs for all projects. Local people could be hired to monitor clean-up.
Sensory disturbances		
Energy production and mining	Manage sensory disturbance of Peary Caribou	Assess the extent, distribution and possible consequences of sensory disturbance (e.g. airplanes, helicopters, snow machines and the equipment associated with industrial exploration and development) on Peary Caribou and where required, reduce its effects, particularly during sensitive periods (e.g. seasonal movements, calving).

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Sensory disturbances		
Threat or Limitation Addressed	**Activity**	**Needs**
Tourism and recreational activities	Manage sensory disturbance of Peary Caribou	Minimize disturbance of Peary Caribou during monitoring and research programs (e.g. trapping, handling and collaring), and select monitoring and research techniques that are least intrusive.
Military exercises		Investigate alternative approaches to surveys.
Work & other activities		Develop a best practices guide for air and ship traffic. Make the guide widely available.
		Encourage consultation with communities for best practices prior to beginning any project.
Monitoring		Coordinate monitoring approach to consider spatial and temporal effects to Peary Caribou.

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Appendix 4: Mitigation measures to avoid destruction or minimize impact on Peary Caribou and their habitat

Mitigation of the adverse effects that may result from a proposed project on Peary Caribou and their habitat could include various measures. These measures include: avoiding destruction of habitat necessary for the species to carry out life processes, reducing noise or pollution, or minimizing disturbance by adapting its shape or adjusting the timing of disturbance. The table below provides examples of considerations and possible mitigation measures when planning exploration, development and activities within the Peary Caribou range.

Considerations when planning development	Examples of possible mitigation measures
Cumulative impacts of disturbance in the short- and long-term	Minimize the footprint of development, consider locations where habitat is already disturbed, consider spatial configuration of various specific disturbances to address barriers to movement across terrestrial habitat and access to sea ice.
Spatial configuration	Minimize disturbance by adapting its shape (small polygon vs. linear). Spatial configuration should allow Peary Caribou to move freely within their range to access different habitats or areas, including sea ice, when needed.
Ecological factors	Avoid destruction or disturbance at and near sensitive areas such as known calving or rutting areas.
Sensory disturbances	Mitigation of noise, light, scents, and vibrations to prevent harassment of Peary Caribou.
Timing of disturbance	Certain types of disturbance could be limited to seasons when Peary Caribou are not using the area, or are less sensitive to disturbance.
Pollution	Mitigate pollution through scrubbers or other techniques. Ensure sites are completely cleaned up at the conclusion of a project.