SPECIES STATUS REPORT

Dolphin and Union Caribou

(Rangifer tarandus groenlandicus x pearyi)

Barren-ground caribou (Dolphin and Union population)
Kiilliniq caribou
Island caribou
Arctic-island caribou
Mainland caribou
Tuktu (Inuinnaqtun)
Tuktu/tuktut (Siglitun)
Tuttu (Ummarmiutun)
caribou du tropeau Dolphin-et-Union

in the Northwest Territories

NORTHWEST TERRITORIES SPECIES AT RISK COMMITTEE

Special Concern

December 2013

Species at Risk Committee status reports are working documents used in assigning the status of species suspected of being at risk in the Northwest Territories (NWT).

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ABOUT THE SPECIES AT RISK COMMITTEE
The Species at Risk Committee was established under the *Species at Risk (NWT) Act*. It is an independent committee of experts responsible for assessing the biological status of species at risk in the NWT. The Committee uses the assessments to make recommendations on the listing of species at risk. The Committee uses objective biological criteria in its assessments and does not consider socio-economic factors. Assessments are based on species status reports that include the best available Aboriginal traditional knowledge, community knowledge and scientific knowledge of the species. The status report is approved by the Committee before a species is assessed.

ABOUT THIS REPORT
This species status report is a comprehensive report that compiles and analyzes the best available information on the biological status of Dolphin and Union caribou in the NWT, as well as existing and potential threats and positive influences. Full guidelines for the preparation of species status reports, including a description of the review process, may be found at www.nwtspeciesatrisk.ca.

Northwest Territories Environment and Natural Resources

Environment and Natural Resources, Government of the Northwest Territories, provides full administrative and financial support to the Species at Risk Committee.

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NORTHWEST TERRITORIES SPECIES AT RISK COMMITTEE

Assessment of Dolphin and Union Caribou

The Northwest Territories Species at Risk Committee met in Yellowknife, Northwest Territories on December 11, 2013 and assessed the biological status of Dolphin and Union Caribou in the Northwest Territories. The assessment was based on this approved status report. The assessment process and objective biological criteria used by the Species at Risk Committee are available at www.nwtspeciesatrisk.ca.

Assessment: Special Concern in the Northwest Territories

The species is particularly sensitive to human activities or natural events but is not Endangered or Threatened.

Reasons for the assessment: Dolphin and Union Caribou fits criteria (a) and (b) for Special Concern.

(a) – The species has declined to a level at which its survival could be affected by population characteristics, genetic factors or environmental factors but the decline is not sufficient to qualify the species as Threatened.

(b) – The species may become Threatened if negative factors are neither reversed nor managed effectively.

Main Factors:

- Although there is too little information to assess long-term population trends of Dolphin and Union caribou, there is evidence that the population has declined between 1997 and 2007.
- There is no possibility of rescue from neighboring populations. Dolphin and Union caribou are considered to be discrete from Peary caribou and barren-ground caribou, based on their morphology, genetics and behaviour (i.e., the distinct rutting area as well the herd's seasonal migrations across the sea ice of the Dolphin and Union Strait).
- Dolphin and Union caribou are vulnerable to major environmental events such as changes in the timing of sea-ice formation, changes to the thickness of sea-ice, and icing and crusting events on their fall and winter range.

Additional Factors:

Threats to Dolphin and Union Caribou and its habitat:

- Two major mining exploration projects are located in core Dolphin and Union caribou winter range on either side of Bathurst Inlet and, should they move forward, could result in habitat loss, as well as disturbance to the caribou and habitat fragmentation.
- A possible and serious threat is the effect of increased ship traffic on the sea-ice crossed during fall migration. How a longer shipping season and more frequent ship passages will affect fall migration will depend on the timing of ship traffic in relation to when the caribou are preparing to cross the ice.
- There is evidence of warming temperatures in Dolphin and Union caribou range; summer temperatures on northwestern Victoria Island have been warmer over the last several decades and warming fall temperatures are also becoming evident (as well as associated delays in ice formation). Later sea-ice formation affects the fall migration, but may also cause a longer staging time along the south coast of Victoria Island as the caribou wait for sea-ice to form. This may increase foraging pressure on coastal plant communities and intra- and inter-specific competition for food.
- Dolphin and Union caribou may be especially vulnerable to the effects of a warmer climate if the current trend toward later formation of sea-ice continues and leads to increased risk of drowning deaths as the caribou attempt to cross on the thinner ice. Additionally, in the spring, caribou may swim through channels of water in the ice and not be able to get out, leading to drowning.
- Rain and icing events causing an ice crust to form over vegetation can prevent caribou from feeding effectively. Icing and crusting events could have potentially greater effects if warmer falls increase the frequency or severity of the events. There have been more cases of freezing rain and sporadic freeze-thaw cycles over the last 20 years.
- While the number of Dolphin and Union caribou harvested annually is uncertain, the annual harvest rate is believed to be 7-11 percent (%) of the total estimated population. This is an unsustainable harvest unless the herd is increasing rapidly and has strong calf recruitment. Harvesting may become an increasingly important threat, especially if mortality rates from predation or drowning increase.

Positive influences to Dolphin and Union Caribou and its habitat:

- With an increase in summer temperatures, plant productivity has also increased. Extended periods of higher quality forage could improve the condition of caribou before the fall migration.

- In 2011, Dolphin and Union caribou were added to Schedule 1 of the federal *Species at Risk Act* as a species of 'special concern'. This listing requires the development of a management plan for the population within 3 years.
- The Nunavut Planning Commission's draft Nunavut Land Use Plan references sea-ice crossings (although not calving grounds). These maps form the basis for discussions on how the Land Use Plan may direct and guide development once it is finalized and approved.
- The Olokhaktomiut Community Conservation Plan (2008) identifies a number of important areas for Dolphin and Union caribou and specifies intended levels of protection for these areas.

Recommendations:

- Management Authorities for Dolphin and Union caribou in the Northwest Territories should work with the Government of Nunavut to alleviate threats to Dolphin and Union caribou, including developing guidelines and best practices for industrial development and shipping, managing the harvest, increasing research and monitoring activities, and providing input into land use planning processes.
- Community hunts should have requirements for experienced hunters and Elders to provide education to younger and less experienced hunters.

Executive Summary

Traditional and Community Knowledge	Scientific Knowledge
Description Dolphin and Union caribou are intermediate in size and colour between the smaller, lighter-coloured Peary caribou and the larger, darker-coloured mainland barren-ground caribou herds. They are closer in size and colour to the Peary caribou. Dolphin and Union caribou taste different from other caribou. They are named after the Dolphin and Union Strait, which they cross twice yearly on their northward spring migration and southward fall migration.	**Description** Dolphin and Union caribou (*Rangifer tarandus groenlandicus* x *pearyi*) are relatively large-bodied with noticeably short legs and face. The winter coat is distinctive in being white with a pale brown back in early winter and light coloured legs. In summer, the coat is light to darker brown on the back and does not have the pronounced flank stripe typical of barren-ground caribou. The pale gray antler velvet is a distinguishing characteristic compared to the brown velvet of barren-ground or woodland caribou. Nuclear DNA analyses suggest that Dolphin and Union caribou are distinct from barren-ground caribou and they share haplotypes with members of adjacent herds, although the retention of some distinct genetic lineages suggests local adaptations by these caribou. Their physical similarity to Peary caribou may reflect similar evolutionary selection pressures, but mitochondrial DNA suggests a different post-glacial origin mixing caribou from Banks Island (west) and the mainland (south). The genetic uniqueness of Dolphin and Union caribou is reflective of a severe population bottleneck that may have occurred in the early 1990s.
Distribution Dolphin and Union caribou are a single population found on southern, central, and eastern Victoria Island, as well as sections of the mainland coast. Their range includes parts of both the Northwest Territories and Nunavut. They migrate seasonally between their summer	**Distribution** Dolphin and Union caribou are restricted to Victoria Island (except the northwest) and the nearby mainland coast of Nunavut (NU) and the Northwest Territories (NWT). Dolphin and Union caribou occur as a single geographical population (or herd). Dolphin and Union

range on Victoria Island and their winter range on the mainland around Bathurst Inlet and along the coast to the west. Their range might be increasing to the west towards Paulatuk and the south. Due to their annual migration, Dolphin and Union caribou numbers peak around Cambridge Bay in the months of November and May, but they can be harvested for most of the year there. Caribou migration routes generally stay the same. Weather, temperatures and other factors influence migration routes and timing. The migration path of Dolphin and Union caribou requires crossing the frozen Dolphin and Union Strait twice a year. As soon as the sea-ice is thick enough to cross, Dolphin and Union caribou will leave Victoria Island in large numbers. Some caribou die on pooly formed ice. Near the end of March, Dolphin and Union caribou move towards the northern shores of the mainland. They cross to Victoria Island in April and May. They then move northward and scatter, dispersing to calving areas.	caribou calving is dispersed across central Victoria Island. They calve and spend summer into fall in the Northern Arctic ecozone. They winter on the mainland in the Southern Arctic ecozone.
Habitat In general, Dolphin and Union caribou seek areas where there is healthy food and which provide relief from the elements, predation, difficult terrain, and insects. They seek islands, shorelines, snow patches, valleys, and spots that are either damp or shaded. Dolphin and Union caribou choose large flat areas for calving grounds. Dolphin and Union caribou eat many different types of plants. After the snow melts in mid-July, caribou feeding generally focuses on moist sites and their diets include sedges, grasses and willows, as well as mountain sorel. In the summer, they will eat any vegetation including willow buds, damp moss, Labrador tea, dwarf birch mountain avens, and moss campion. In the fall they start to eat lichens, and in the winter they eat lichens and grasses.	**Habitat** Dolphin and Union caribou use tundra habitats characterised by prostrate dwarf-shrubs, forbs, sedges, mosses and lichens. Plant cover is sparse throughout their range. Dolphin and Union caribou migrate between seasonal ranges, including pre-calving migration to more northern and central calving areas, which are in the high Arctic vegetation zone. Then the caribou migrate south during fall to their winter range, which is in the mid-Arctic vegetation zone. Fall migration includes sea-ice crossings to winter ranges along the mainland coast. Snow cover influences habitat selection as key habitat requirements are terrain and vegetation features that offer choices as caribou adjust their foraging to snow conditions. Little is known about the habitat requirements

They continue to eat lichens in the spring. Dolphin and Union caribou will also eat mushrooms. Changing climate patterns in the last three decades have promoted plant growth on the tundra, making some previously uninhabitable areas acceptable and increasing the quality and availability of forage overall for Dolphin and Union caribou.	for calving areas other than the generalities that calving areas are mostly upland inland sites with varied terrain, likely providing snow-free or shallow snow-covered sites. Habitat fragmentation caused by human activities has not been documented within Dolphin and Union caribou ranges.
Biology Caribou will start to calve when they are two or three years old and generally calve every year. Dolphin and Union caribou generally follow a seasonal cycle of migrating north in the spring to widely dispersed calving grounds; calving in late May to mid-June; gaining weight in summer feeding grounds; then breeding in the early fall (the rut begins mid-October) before or during the migration south to over-wintering grounds. Dolphin and Union caribou are found dispersed across the tundra and will preferentially go to areas where the tundra vegetation is particularly green and healthy. They roam during the winter months and do not stay in one location for long periods of time. High temperatures negatively affect caribou. Dolphin and Union caribou range overlaps with muskoxen and other barren-ground caribou herds. Muskoxen and Dolphin and Union caribou do not appear to compete for food or habitat. The overlap between Dolphin and Union caribou and other barren-ground caribou herds in the Dolphin and Union caribou winter range around Bathurst Inlet on the mainland is increasing, as Dolphin and Union caribou are moving further south and west, and other barren-ground herds are moving further north into Dolphin and Union	**Biology** Dolphin and Union caribou population dynamics are not well-documented although much can be assumed based on information from other northern caribou. Caribou usually calve at 3 years of age, although under high forage availability and a corresponding high rate of body growth, cows can calve at 2 years of age and have a single calf every year. Pregnancy rates are annually variable and are likely affected by forage availability as well as levels of oestrid (warble) fly and intestinal worm parasitism. Mortality due to accidents (breaking through sea-ice), predation and hunting is relatively high.

caribou areas. Wolves are likely the main predators of Dolphin and Union caribou. Wolf numbers appear to be increasing. Other predators and scavengers of caribou include grizzly bears, foxes, wolverines, and numerous types of birds and rodents.	
Population A large herd of barren-ground caribou used to migrate between Victoria Island and the mainland in the early part of the 20th century. This herd declined in number drastically and Inuit only rarely saw them after the 1920s, until more recent decades.	**Population** The Dolphin and Union caribou population is shared between Nunavut and NWT. Abundance of the whole population in the early 20th century was high and then abruptly declined by the 1920s, associated with a halt in migration between Victoria Island and the mainland coast. Abundance remained low until the 1970s and early 1980s. Between 1980 and 1994, two systematic aerial surveys of western and central Victoria Island indicated increasing abundance. In October 1997 and 2007, surveys of caribou staging along the south coast of Victoria Island led to population estimates of 27,948 ± 3,367 (Standard Error) and 21,753 ± 2,343 (SE) caribou, respectively (uncorrected to account for caribou assumed to be outside of the census zone). Survey results combined with other indicators suggest the population of Dolphin and Union caribou is stable to declining. Caribou cow survival as measured between 1999 and 2006 was relatively low, annual pregnancy rates were variable, and harvest rates are high. Calf survival rates are mostly unknown or based on small and infrequent samples.
Threats and limiting factors Icing on snow and vegetation is a threat to Dolphin and Union caribou. Ice may form due to a variable freeze/thaw cycle, freezing rain or other precipitation. Dolphin and Union	**Threats and limiting factors** The most important threats to Dolphin and Union caribou may be hunting, predation, changes in sea-ice formation, and other effects of climate change on vegetation and parasite

caribou are also potentially threatened by drowning during ice crossings, and drowning events are seen as being on the increase. Warmer temperatures cause a long and intense insect season, and extremely hot temperatures may also cause the caribou to lose condition. In addition, global climate change acts indirectly through impacts to the habitat (e.g. changes to forage conditions, changes to migration factors); these changes can impact caribou condition, population and survivorship. It is possible that industrial activities and other human disturbances such as mining can cause caribou to abandon a range. Over-harvesting and/or wounding loss was identified as a concern by residents of Kugluktuk and Cambridge Bay in the 1990s. Disease, forest fires, and predation were not considered threats to Dolphin and Union caribou.	loads. It is uncertain how limiting factors interact. Although exact numbers are unknown, hunting levels in Nunavut may be high relative to measured abundance and survival rates. Hunting levels may have changed as access to neighbouring caribou populations changed. At least for fall temperatures, there is a measurable warming trend although how this influences caribou movements and forage availability is uncertain. Warmer temperatures are already manifested as trends in higher indices of warble parasites, and trends in mean fall temperatures, which delay fall sea-ice freeze-up and crossings. The prevalence and intensity of parasite infections and diseases in Dolphin and Union caribou is only beginning to be described. Increased shipping both in support of industrial development but also for tourism is a likely threat for the caribou crossing the sea-ice. Other potential threats include industrial development on the winter range, which could results in direct and indirect habitat loss and increased harvest accessibility. Disturbance from human activity and contaminants at current levels do not appear to be threats, although mineral developments are increasing on the mainland winter range within Nunavut and data are lacking to properly assess impacts. There is uncertainty about which threats are responsible for the likely recent decline as although adult cow survival and productivity vary annually, the data are insufficient (too few years and low sample sizes to measure trends) to describe trends in these parameters.
Positive Influences More and better forage is increasingly available on Victoria Island due to climate change. The changes in vegetation relate to	**Positive Influences** Dolphin and Union caribou were added to Schedule 1 of the federal *Species at Risk Act* in 2011 as Special Concern. This will require a

warming temperatures in the last three decades promoting plant growth on the tundra. Some level of protection of important Dolphin and Union caribou habitat (such as calving grounds) has been conferred through the Olokhaktomiut Community Conservation Plan.	national management plan and the consultations and collaboration required for the management plan will themselves be a positive influence through the sharing of information about Dolphin and Union caribou. Discussions among wildlife management boards have recently been initiated regarding possible management or conservation actions that could be collaboratively implemented for Dolphin and Union caribou. In land use planning, reference is made to sea-ice crossing areas on Nunavut Polar Commission maps, but not calving areas (http://www.nunavut.ca). Several calving areas are recognized in the Olokhaktomiut Community Conservation Plan.

Technical Summary

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Population trends		
Generation time (*average age of parents in the population***) (indicate years, months, days, etc.)**	Information not available in sources; cows start to calve when they are two or three years old.	Estimated as 7-9 years.
Number of mature individuals in the NWT (or give a range of estimates)	Information not available in sources.	In October 1997 and 2007, surveys of caribou staging along the south coast of Victoria Island led to total population estimates of 27,948 ± 3,367 (Standard Error (SE)) and 21,753 ± 2,343 (SE) caribou, respectively (uncorrected to account for caribou assumed to be outside of the census zone). Ranges from very few to none during winter, to roughly 15% of the population during summer – approximately 4,200 caribou (all ages) based on the October 2007 census and the proportion of summer range within the NWT. There is insufficient information to determine the number of non-calf caribou.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Amount of change in numbers in the recent past; *Percent change in total number of mature individuals over the last 10 years or 3 generations, whichever is longer*	A large herd followed a similar migration up to the early 20th century but very few animals were seen after the mid-1920s.	Not enough systematic surveys to determine trends over the past 21-27 years (3 generations). Survey results combined with other indicators suggest the population of Dolphin and Union caribou is stable to declining.
Amount of change in numbers predicted in the near future; *Percent change in total number of mature individuals over the next 10 years or 3 generations, whichever is longer*	Information not available in sources, but see *Threats*.	Uncertain due to incomplete information and environmental variability.
Amount of change happening now; *Percent change in total number of mature individuals over any 10 year or 3 generation period which includes both the past and the future*	Sources are inconclusive.	Uncertain due to incomplete information and environmental variability.
If there is a decline (*in the number of mature individuals*), **is the decline likely to continue if nothing is done?**	Not Available	Uncertain.
If there is a decline, are the causes of the decline reversible?	Not Available	Uncertain.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
If there is a decline, are the causes of the decline clearly understood?	Not Available	Uncertain as causes of declines were likely interactions between factors including hunting, predation, and accidental deaths.
If there is a decline, have the causes of the decline been removed?	Not Available	No
Are there extreme changes in the number of mature individuals?	Information not available in sources.	There is evidence of fluctuations, but not extreme (not one order of magnitude).
Distribution Trends		
Where is the species found in the NWT?; *Estimated extent of occurrence in the NWT (in km^2)*	Dolphin and Union caribou migrate seasonally between their summer range on Victoria Island (NWT and Nunavut) and their winter ranges on the mainland (Nunavut) between Bathurst Inlet and along the coast to the west.	NWT: 116,841km^2 Entire population (both NWT and NU): 499,449 km^2
How much of its range is suitable habitat?; *Index of area of occupancy (IAO) in the NWT (in km^2; based on 2 × 2 grid)*	Information not available in sources.	NWT: 64,168km^2 including sea ice and 54,784 km^2 not including sea ice. Entire population (both NWT and NU): 391,292 km^2 including sea ice and 286,336 km^2 not including sea ice.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
How many populations are there? To what degree would the different populations be likely to be impacted by a single threat?; *Number of extant locations in the NWT*	Dolphin and Union caribou are a single population.	One
Is the distribution, habitat or habitat quality showing a decline that is likely to continue if nothing is done? ; *Is there a continuing decline in area, extent and/or quality of habitat?*	No. Distribution is increasing geographically, habitat quality is increasing through increased quality of forage.	Uncertain due to limited information.
Is the number of populations or amount of occupied area showing a decline that is likely to continue if nothing is done?; *Is there a continuing decline in number of locations, number of populations, extent of occupancy and/or IAO?*	No. The number of populations and amount of occupied range are not decreasing.	No decline in number of locations or populations. Declines in extent of occupancy are uncertain due to limited information.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Are there extreme fluctuations in the range or the number of populations? ; *Are there extreme fluctuations (>1 order of magnitude) in number of locations, extent of occupancy and/or IAO?*	No. The number of populations is stable, the range is increasing.	Uncertain due to limited information; likely occurs over many decades/long periods.
Are most individuals found within small and isolated populations? ; *Is the total population severely fragmented (most individuals found within small and isolated populations)?*	No	No
Immigration from populations elsewhere		
Does the species exist elsewhere?	There is only one population and it is shared with Nunavut.	No, but shared population with Nunavut.
Status of the outside population(s)	Information not available in sources.	Not Applicable
Is immigration known or possible?	Information not available in sources; however, modern Dolphin and Union caribou population may be hybrid of other herds, and is co-mingling with other herds currently.	No
Would immigrants be adapted to survive and reproduce in the NWT?	Information not available in sources.	Not Applicable

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Is there enough good habitat for immigrants in the NWT?	Information not available in sources.	Not Applicable
Is the NWT population self-sustaining or does it depend on immigration for long-term survival?	Dolphin and Union caribou are increasingly mixing with other herds, although information on sustainability of population is not available in sources.	Not applicable, but shared population with Nunavut.
Threats and limiting factors		
Briefly summarize negative influences and indicate the magnitude and imminence for each	Icing on snow and vegetation and heavy precipitation events, drownings and dangerous ice crossings, negative impacts of warmer temperatures, industrial activities and other human disturbances, and harvest and over-harvest are all noted as potential threats or limiting factors. In addition, global climate change acts indirectly through impacts to the habitat which impact caribou condition, population and survivorship.	• Over-hunting (unclear – could be increasing). • Wolf predation (unknown - could be significant). • Climate warming (could have significant implications). • Accidental drowning during sea-ice crossings (occurs, and may increase with climate warming). • Intra- and inter-specific forage competition (possible - unknown). • Disturbances from human activity (likely currently low [lack of data to assess] but increasing in winter range). • Contaminants (currently very low and localized).

Positive influences		
Briefly summarize positive influences and indicate the magnitude and imminence for each	• Habitat may be increasing in quantity and quality due to warming temperatures. • Acceptable forage is appearing in new areas and existing forage is increasing in quality. • Community conservation planning recognizes some areas of Dolphin and Union caribou habitat.	• Management planning required within 3 years through national listing in 2011 as Special Concern. • Recognition of some important areas in Nunavut land use planning in 2008. • Some effects of climate change may be positive, such as greater plant productivity, resulting in higher quantity and quality of forage. Both the interations of positive and negative effects from climate change remain uncertain.

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TRADITIONAL AND COMMUNITY KNOWLEDGE COMPONENT

Names and classification

Common name used in this report:	Dolphin and Union caribou
Other names:	Kiilliniq caribou (Inuinnaqtun; Nunavut); Killinik (Inuktituk) (Thorpe *et al.* 2002); Island caribou (NWT and Nunavut); Arctic-island caribou (NWT and Nunavut); Mainland caribou (Ulukhaktok); Dolphin and Union caribou; barren-ground caribou (Dolphin and Union population)
General Inuvialuktun names for caribou:	Tuktu (Inuinnaqtun); Tuktu/tuktut (Siglitun); Tuttu (Ummarmiutun) (ENR 2011)
Common name (French):	caribou du tropeau Dolphin-et-Union (Poole *et al.* 2010)
Scientific name:	*Rangifer tarandus groenlandicus x pearyi*
Life form:	Large land mammal; caribou

The history of name changes, differing and variable uses of local names and evolving scientific analyses (see COSEWIC 2011) that have grouped various caribou into specific units have caused a significant level of confusion for some. More information from, and shared with, local hunters is needed to resolve potential ambiguities and bring about a common understanding in the classification of Dolphin and Union caribou and Peary caribou.

Hunters and elders interviewed in the Ulukhaktok area recognize two types of caribou (Peary caribou and mainland caribou (Dolphin and Union caribou)) on Victoria Island, and tend to differentiate mainland (Dolphin and Union caribou) from other caribou by differences in size, colour and taste (Elias 1993). In addition to the use of the term ‘mainland caribou’, Ulukhaktok residents sometimes also refer to Dolphin and Union caribou as ‘island caribou’ or ‘arctic island caribou’ to distinguish them from Peary caribou. It should, however, be noted that the Bathurst herd of barren-ground caribou (*Rangifer tarandus groenlandicus*) can also be called ‘mainland caribou’ to distinguish them from Dolphin and Union caribou. Similarly, Cambridge Bay residents may call caribou from the Dolphin and Union population ‘Peary’ or ‘island’ caribou to

distinguish them from other barren-ground caribou (*Rangifer tarandus groenlandicus*) (Gunn 2005), while the Nunuvut Inuit from Brown Sound, Cambridge Bay, Bathurst Inlet, and Bay Chimo call Dolphin and Union caribou Kiilliniq – 'island caribou' (Thorpe *et al*. 2001) The Dolphin and Union population of caribou was named for the Dolphin and Union Strait as their annual migration path crosses this body of water (Elias 1993).

Description

Dolphin and Union caribou (Figure 1) are intermediate in size and colour compared to the Peary caribou that inhabit northern Victoria Island and the Bathurst herd of barren-ground caribou on the mainland to the south. Dolphin and Union caribou have a larger body size than Peary caribou near Minto Inlet and are darker in colour; they also have different tasting meat. Dolphin and Union caribou are smaller and lighter in colour than other barren-ground caribou (Elias 1993; Nishi 2000; Thorpe *et al.* 2001; Gunn 2005).

Generally, Dolphin and Union caribou are said to be more similar in body size, appearance and colour to Peary caribou than barren-ground caribou (Nishi 2000).

Figure 1. Dolphin and Union caribou. Photograph courtesy of Mathieu Dumond, Government of Nunavut.

Distribution

Dolphin and Union caribou exist in a single population found on southern, central and eastern Victoria Island, as well as sections of the NWT and Nunavut mainland coast. Their range includes parts of both the Northwest Territories and Nunavut (Nishi 2000). As the same population occurs in Nunavut and the NWT, information from both territories is included in this

report.

NWT and Nunavut distribution

Dolphin and Union caribou migrate seasonally between their summer range on Victoria Island and their winter ranges on the mainland between Bathurst Inlet and along the coast to the west. The caribou migrate north and inland of Prince Albert Sound in summer to calve. In late fall they migrate south and east towards the coast of Victoria Island, and cross the ocean ice to the mainland. Their annual range extends south to Brown Sound and Bathurst Inlet in the winter, and as far north as Stefansson Island (Nishi 2000). Dolphin and Union caribou are also known to travel to Read Island and Cambridge Bay (Elias 1993). Recently, Dolphin and Union caribou have been reported just north of Tuktut Nogait National Park (Gau pers. comm. 2011). More information on their seasonal ranges can be found in the *Habitat* section

Figure 2. Range of Dolphin and Union caribou (Environment and Natural Resources, unpubl. data 2012).

Search effort

"Search effort" is a way of describing how well people know where the Dolphin and Union caribou are. In the context of traditional and community knowledge, search effort may be approximated by hunters' efforts to locate Dolphin and Union caribou.

Inuit hunters from Nunavut communities of Cambridge Bay, Kugluktuk, Umingmaktok, and Bathurst Inlet hunt Dolphin and Union caribou in the fall, winter, and spring (Nishi 2000; Thorpe *et al.* 2001). Early in the winter these caribou are preferred eating because they can be very fat (Gunn 2008).

> *My father and mother used to do a lot of hunting. In late summer, people used to harvest caribou when the fur was nice and thick. People would move to the narrow channels and people would wait for the caribou to cross. They would hunt for their food and for their clothing. We survived… (Lena Kamoayok from Umingmaktok, in Golder 2003:42).*

Due to the seasonal movement patterns of Dolphin and Union caribou, there is a corresponding seasonal variation in harvesting intensity in most of the communities that hunt them. The Inuvialuit Harvest Study (Joint Secretariat 2003) is a systematic and comprehensive effort to collect harvest data from Inuvialuit communities. However, this study did not separate out the caribou harvest into the Peary, Dolphin and Union, and barren-ground caribou components. Therefore, the Inuvialuit Harvest Study cannot provide harvest of just Dolphin and Union caribou and an analysis has not been included in this report. Most hunting seems to take place in the fall and winter, during the southward migration and at the overwintering grounds (Bates 2006). Bulls are not hunted during the rut in the fall, nor afterwards. Summer hunters may select animals for their hides as well as for their meat since summer hides, with their finer hair, are desirable for use in mukluks (Carpenter pers. comm. 2013). Sometimes calves are also selected for their hides. Seasonal use of Dolphin and Union caribou in the community of Kugluktuk is compared to barren-ground caribou use in Figure 3.

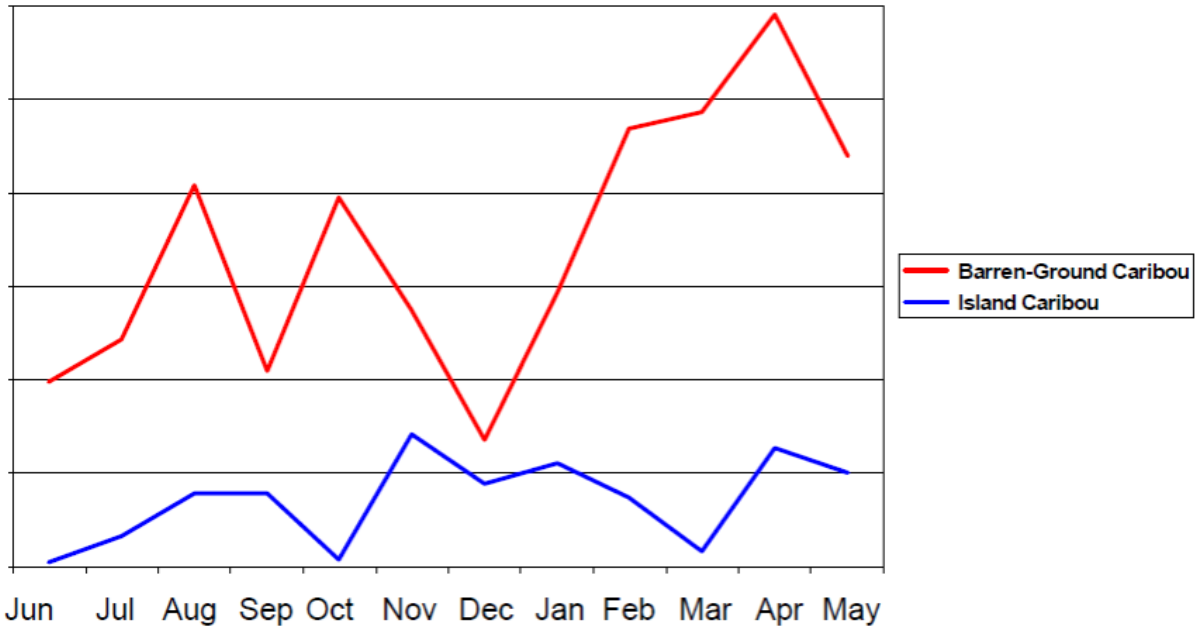

Figure 3. Seasonal relative harvest of barren-ground caribou and Dolphin and Union caribou (Island caribou) by Kugluktuk harvesters (based on the NWMB Nunavut Harvest Study, 1996-2001) (map reproduced from Dumond 2007 with permission).The y-axis has no scale in the original.

In September and October, hunters' attention is focused around the southern coast of Victoria Island where the caribou arrive and await freeze-up of the sea-ice for their continued migration south (Figure 4):

> *Attention now becomes focused ... on the coast of the island, especially around Wellington Bay. This deep bite into the island's southern shoreline, and the Surrey River which flows into it, give access for boats a good distance inland, allowing interception of the migrating herds. While this journey is much easier than that across the straits to the mainland, the arrival of the Dolphin and Union herd coincides with a turn for the worse in the weather. Nonetheless, at this time of year this area is the most frequently visited coast by boats from Cambridge Bay and it can seem as though much of the community is out patrolling the shore (Bates 2006).*

The caribou also 'muster' in large numbers around Cambridge Bay waiting for freeze-up before crossing the Dease Strait. Cambridge Bay hunters use skidoos to access hunting locations and this is considered a peak period of harvest for the community. Caribou numbers peak around Cambridge Bay in the months of October-November and May during their south-north migrations, but they can be harvested for most of the year there (Bates 2006). In contrast, Kuglukluk's primary period of harvest is in April and May, when Dolphin and Union caribou are gathered on the sea coast and are starting to cross the sea ice on their way to Victoria Island. The Kuglukluk harvesters travel by snowmobile to Three River to harvest these caribou (Leclerc, pers. comm. 2013) (Figure 4). As many as 15 animals may be taken by a single household over a few days, to provide a winter's worth of meat. Once the sea-ice supports their migration south,

caribou hunting in the area around the community ceases (Bates 2006).

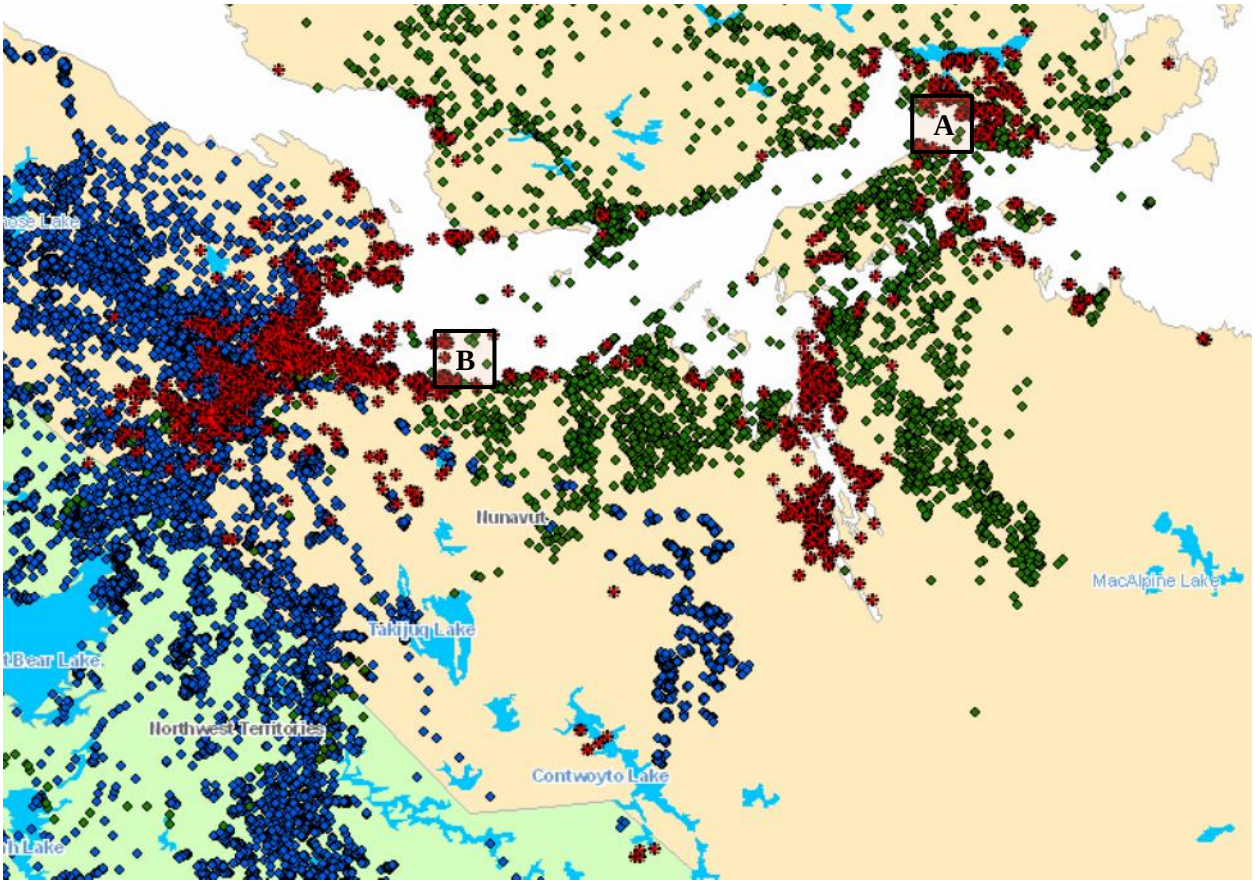

Figure 4. Caribou harvest locations (red dots) based on the Nunavut Wildlife Harvest Study (1996-2001). The blue dots are the collar locations of the Bluenose-East caribou herd (1996-2006) and the green dots are the collar locations for the Dolphin and Union caribou herd (2002-2004) (map reproduced from Dumond 2007 with permission). A = Wellington Bay. B = Tree River.

While the fall aggregation along the south coast of Victoria Island increases a hunter's likelihood of finding and harvesting a caribou, in general, Dolphin and Union caribou do not tend to be tracked or encountered randomly during hunting at any time of the year; "...instead, hunters will generally already have a rough idea of where to find the caribou, largely based on knowledge of the seasonal cycles in caribou movements, and an understanding of the land and of how caribou typically move within it" (Bates 2006). A common practice is to drive to a specific area and hunt caribou when they are seen (Bates 2006).

Because overland all-terrain vehicle (ATV) travel is more limited than skidoo travel, and the summer terrain more difficult to traverse, the summer months are a comparatively quiet period in terms of caribou hunting. In addition, the caribou tend to be more scattered at this time of year, possibly making them more difficult to encounter (Bates 2006).

Inuit hunters have camps along migration routes to hunt caribou but do not generally hunt at

calving grounds. Calving grounds and the calving period are considered special and sacred, and avoidance is culturally appropriate. However, in the past, some Inuit may have hunted at calving grounds for calf skins to make clothing (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001; Dumond pers. comm. 2012).

Distribution trends

Archaeological evidence on Victoria Island indicates that Dolphin and Union caribou have been crossing the sea-ice for hundreds or thousands of years. However, the abundance and specific crossing locations have shifted over time (Poole *et al.* 2010).

Distribution trends in Dolphin and Union caribou are closely linked to changes in abundance and patterns in migration cycles (see *Population*). Distribution changes may be responsible for the appearance of increases or decreases in Dolphin and Union caribou numbers.

> *"The same elder who had previously linked caribou and muskoxen by competition for their forage told of an autumn rainfall that had left a crust of ice over the snow. This had prevented caribou from foraging through it, and was a single and catastrophic event that had wiped out the caribou population. Another elder suggested that the caribou had gone away long ago because shamans had made the mistake of fighting over the caribou. It is also worth noting that, with the exception of the man who had heard from his uncle of the single freezing event that killed the caribou, most respondents told of the caribou having gone away and then having come back, and they would sometimes suggest routes by which the caribou had returned. While ecological science describes a decline in population, Inuit respondents generally seemed to consider that the caribou had gone elsewhere." (Bates 2006).*

As described in *Population*, a large herd of caribou followed a similar migration to the Dolphin and Union caribou before 1924. Given their location, these caribou are most likely Dolphin and Union caribou. The herd was very rarely seen until the 1940s. Elders interviewed in Ulukhaktok said that there were no caribou at Prince Albert Sound during the 1940s, but some (likely Peary caribou) were north of Minto Inlet (Elias 1993).

In the past, Dolphin and Union caribou were hunted on the mainland; then for a period of decades they were not seen or not around and people had to travel to Victoria Island to hunt. The caribou may have been across the bay from Umingmaktok. Later, the caribou appeared or re-appeared and people moved to Umingmaktok again to harvest them. The return of Dolphin and Union caribou to the area around Umingmaktok on the Nunavut mainland started around and after the 1970s (Thorpe *et al.* 2001).

In the mid-1970s "a few" Dolphin and Union caribou were crossing the sea-ice to the mainland, and Inuit hunters began to report more caribou sightings on southern and central Victoria Island by the late 1970s (Gunn *et al.* 1997). Hunters' reports supported biologists' surveys that found a progressive shift in the winter distribution of Dolphin and Union caribou to the south and east on

southern Victoria Island during the 1980s (Gunn *et al.* 1997).

Hunter observations from outpost camps near Read Island, Ross Point (Nakyoktok) and Cambridge Bay suggest that the Dolphin and Union caribou's annual fall migration was consistent and extensive through the early and mid-1990s (Nishi and Gunn 2004). Ulukhaktok hunters also reported seeing Dolphin and Union caribou along the northern shoreline of Prince Albert Sound during that timeframe; it was not known whether those animals overwintered on Victoria Island, or continued migrating east and then south to the mainland (Nishi and Gunn 2004).

More recently, the Dolphin and Union caribou winter range is extending further south than in the past, into areas used by other barren-ground caribou in the summer (Thorpe *et al.* 2001).

> *We know caribou migrate all the way down to the tree line. So the elders from what we heard go from the coast line to the barren lands to go hunting because they know where the caribou are. The Victoria Island caribou herd is starting to migrate to the tree line. These are the white coated caribou. But that was not the case years ago. And they are starting to mix with the mainland herds. You can see them mixing (Phillip Kadlun in Golder 2003).*

Kugluktuk hunters are now seeing Dolphin and Union caribou on the north side of Great Bear Lake and in the Hope Lake area (ENR 1998). Dolphin and Union caribou have recently been repored west to Tuktut Nogait National Park (WMAC(NWT) unpubl. data 2012).

Smaller-scale changes in calving areas, migration, and wintering areas are discussed further in *Habitat* and *Population* sections below.

Habitat

Habitat requirements

The seasonal movements of Dolphin and Union caribou are broadly similar to those of Peary caribou on Victoria Island and Bathurst barren-ground caribou on the mainland, in that the caribou move north in the spring to calve and south in the fall to over-winter (Elias 1993; Thorpe *et al.* 2001). Much of the detailed information on Dolphin and Union caribou habitat requirements presented in this section comes from a study done with Nunavut Inuit from the following communities: Brown Sound, Cambridge Bay, Bathurst Inlet, and Bay Chimo (Thorpe *et al.* 2001). This information may apply to Dolphin and Union caribou and/or Bathurst barren-ground caribou.

Seasonal and regional differences in availability and quality of vegetation contribute to the need for caribou to migrate. In general, caribou seek areas where high quality forage is available and which provide relief from the elements, predation, difficult terrain, and insects. Particular

favourites include "islands, shorelines, snow patches, valleys, and spots that are either damp or shaded" (Thorpe *et al.* 2001). If it's too hot the plants dry up, forcing caribou to feed on food of low value; likewise, iIf there's too much variation in the weather, the animals suffer (Dumond 2007).

Caribou seek easy terrain when migrating. They will take a route around rocky mountains instead of over them, but will go over hilltops. They are known to travel along eskers which are like 'roads' and have the added benefit of the wind, which keeps insects away (Thorpe *et al.* 2001).

Inuit hunters determine that caribou have been feeding in an area based on signs such as feces and snagged hair, browsing, broken branches, and full rumen. The Inuit say that diet affects differences in the taste of the meat (Thorpe *et al.* 2001; Dumond 2007).

Caribou eat many different types of plants, depending on the time of year and plant availability, although they depend heavily on lichens, including reindeer lichen, snow lichen and worm lichen (Bandringa 2010). Caribou calve and over-winter in areas which offer different plants and conditions (Thorpe *et al.* 2001). Generally, caribou start eating greening willow and then grass in the summer, and lichens in the fall and winter (Dumond 2007). Caribou eat dwarf birch, willows, and mountain avens (Thorpe *et al.* 2001), as well as the young leaves of various willows and the leaves of Arctic sorrel (Bandringa 2010). Caribou are known to seek mushrooms - they dig them out of flat areas on the ground, and from under the snow (Thorpe *et al.* 2001; Golder 2003). They find the mushrooms by scent under the snow. They also prefer feeding on moss campion, which grows in sandy areas (Olokhaktomiut Community Conservation Plan 2008, Bandringa 2010). Further information on particular seasonal habitat requirements is presentened in the remainder of this section.

Spring

Caribou often seek cool patches of snow in the spring and lay in them to cool down. They avoid iced over ('sleet-covered') deep snow as it prevents them from accessing food. Caribou will also stay in areas where there is less snow when the snow is hard from very cold weather (Thorpe *et al.* 2001). They continue to eat lichen in the spring (Thorpe *et al.* 2001; Olokhaktomiut Community Conservation Plan 2008).

During the spring migration, certain coastal areas are important for "staging" (i.e. areas where Dolphin and Union caribou concentrate to feed and rest). It is suggested that the caribou use these areas to feed intensively before crossing the sea-ice to Victoria Island (Gunn *et al.* 1997). The Ekaluktutiak Hunters and Trappers Association in Cambridge Bay reported that Melbourne Island is one important staging area in early spring for caribou migrating from the mainland back to Victoria Island (Gunn *et al.* 1997).

Although little is known about the habitat requirements for calving areas, caribou likely choose

large flat areas for calving grounds in order to facilitate effective detection of predators. They avoid shaded areas and areas of high elevation. They select areas with less snow and ice, although patches of snow provide relief from the heat. Although a flat open area may be chosen largely for safety, it should also have a good supply of food for the newborn calf and its mother, who has high nutritional needs. For this reason, caribou may seek areas exposed to sunlight earlier than other areas. Cottongrass may be the first vegetation consumed by calves after their mothers' milk (Thorpe *et al.* 2001).

Caribou will use the same general region for calving year after year, but the specific location shifts over time based on many factors. The condition of the tundra may impact where cows choose to calve; over-grazed and trampled areas might be avoided. Some Inuit interviewees indicated that caribou return to the area where they were born to calve (Thorpe *et al.* 2001).

Kugluktuk residents felt that there is not enough information available on calving locations of Dolphin and Union caribou (ENR 1998). Most Inuit hunters have not seen calving grounds for several reasons: they are generally far from the community, calving happens when snow conditions are not good for travel, and many Inuit feel that calving caribou should be left alone. Inuit have knowledge of calving grounds since in some years calving grounds are closer to communities and some Inuit will hunt at calving grounds (Thorpe *et al.* 2001).

Some important calving areas for Dolphin and Union caribou are identified in the Olokhaktomiut Community Conservation Plan (2008). Habitat/harvesting areas south of Wynniatt Bay are made up of two sites: a large area southeast of Glenelg Bay and an area along the Kuukuak River (Figure 5). These areas are considered important year-round habitat for a number of species, including caribou. Anmalokitak Lake and Tahek Lake Region consists of two regions, one of which, a large area east of Prince Albert Sound, is relevant to Dolphin and Union caribou (Figure 5). This area is considered important year-round habitat for a number of species, including caribou. Hikongiyoitok Lake and the Kugaluk River Region consists of two areas, one of which is relevant to Dolphin and Union caribou: an area on the Wollaston Peninsula south of Prince Albert Sound, which includes the Kugaluk River (Figure 5). This area is considered important for caribou. Finally, Colville Mountains Wildlife Area of Special Interest encompasses the calving ground for Dolphin and Union caribou (Figure 5) (Olokhaktomiut Community Conservation Plan 2008). With the exception of the Colville Mountains Wildlife Area of Special Interest, the Olokhaktomiut Community Conservation Plan (2008) doesn't mention Dolphin and Union caribou specifically; however, the relevance of these areas to Dolphin and Union caribou can be inferred by their location.

These areas fall under Management Categories D, C, D, and C, respectively. Category C areas are "lands and waters where cultural or renewable resources are of particular significance and sensitivity during specific times of the year. These lands and waters shall be managed so as to eliminate, to the greatest extent possible, potential damage and disruption." Category D areas are "lands and waters where cultural or renewable resources are of particular significance and

sensitivity throughout the year. As with Category C, these areas shall be managed so as to eliminated, to the greatest extent possible, potential damage and disruption." (Olokhaktomiut Community Conservation Plan 2008: 22)

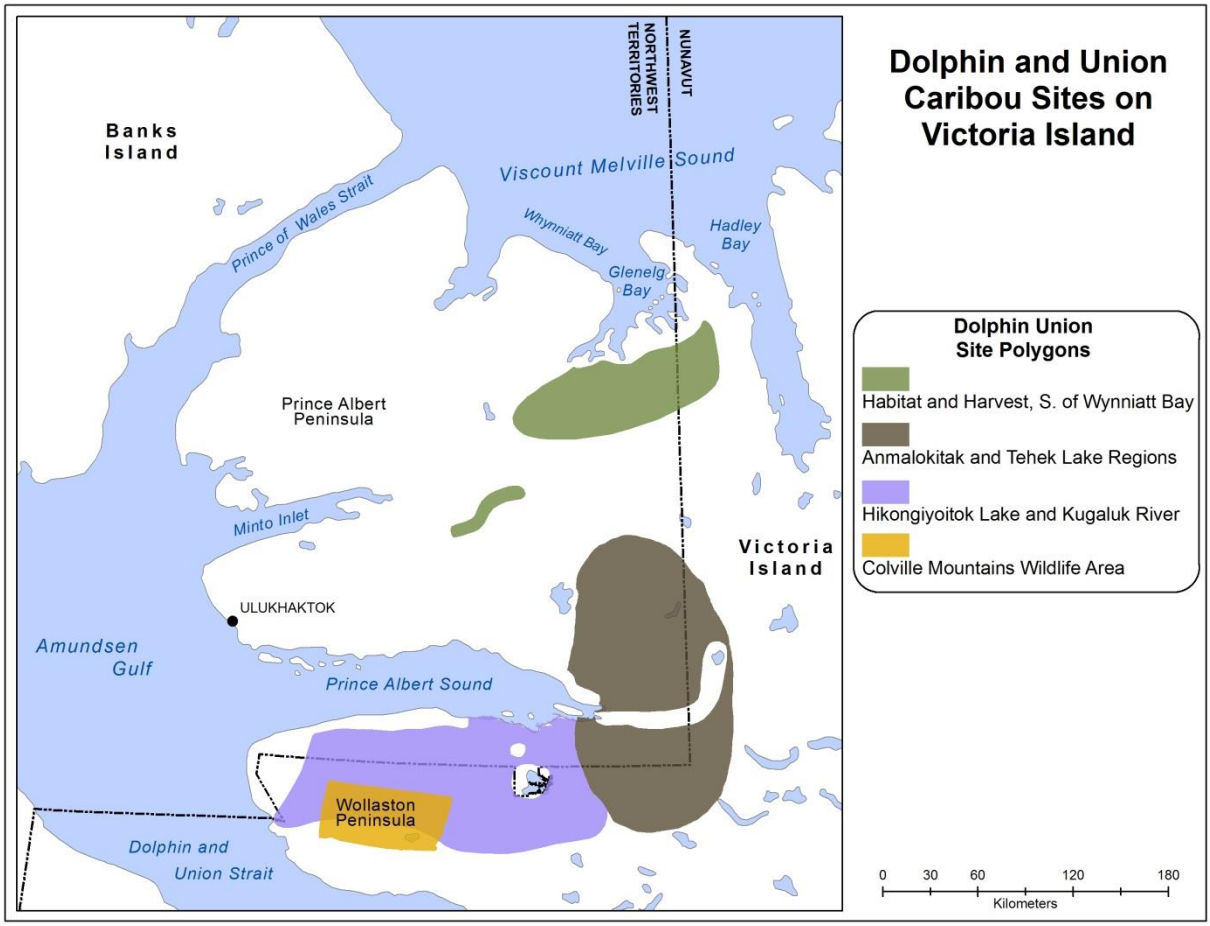

Figure 5. Habitat/harvesting areas south of Wynniatt Bay (green areas), Anmalokitak Lake and Tahek Lake Regions (brown areas), Hikongiyoitok Lake and Kugaluk River Region (purple regions) and Colville Mountains Wildlife Area of Special Interest (yellow area) (Olokhaktomiut Community Conservation Plan 2008).

Summer

Calves must grow quickly and store 'backfat' for the coming winter, so high quality forage is important at this time of year (Thorpe *et al.* 2001). After the snow melts (mid-July), generally caribou feeding focuses more on moist sites and their diets include sedges, grasses and willows, as well as mountain sorel (Olokhaktomiut Community Conservation Plan 2008). Caribou taste like grass in the summer, when they will eat any vegetation including willow buds, damp moss and Labrador tea. They will also eat 'moist mud' and occasionally pebbles are found in their stomachs with the damp moss and grass (Thorpe *et al.* 2001).

Caribou are known to seek cooler and moist areas in the summer, including shorelines but also the wet areas at the base of hills or marshy areas. They feed on the lush vegetation in these areas (Thorpe *et al.* 2001).

Caribou prefer shorelines and islands for several reasons. High winds provide escape from insects and the summer heat. The caribou may also go into the water to escape heat and predators, and can be seen standing in water and swimming in lakes. They use ocean and lake shorelines to escape the heat in June and July. The moist soil provides large and lush vegetation used for forage and shade. In the summer evenings, caribou may walk along shorelines and graze. They graze during the day and lay down at night. Shorelines provide protection from wolves in particular at night, so caribou will head to shorelines during the night time (Thorpe *et al.* 2001). Caribou may also go to the ocean shore to lick salt. Occasionally they eat seaweed (Thorpe *et al.* 2001).

Inuit hunters start finding mushrooms in caribou stomachs in August. The mushrooms are considered to be like a 'water bottle' to the caribou and keep the caribou's mouth moist during warm temperatures. They are also known to contain fat or promote fat. Finding mushroom 'peels' indicates that caribou have been eating them. Two types of mushrooms are eaten by caribou (Thorpe *et al.* 2001):

> *Maybe you have seen those ones with the really smooth top. Some of those that get really big, they feed on those and some of those little ones with red on top, red coloured on top and sort of mesh in the bottom, just like a cone on the bottom. They have those ones also (Bobby Algona, Kugluktuk in Thorpe et al. 2001:119).*

Fall and Winter

In the fall, Dolphin and Union caribou start to eat lichens and are also known to eat seaweed as they wait for the sea ice to form (Carpenter, pers. comm. 2013) and in the winter they eat lichen and grasses (Thorpe *et al.* 2001; Olokhaktomiut Community Conservation Plan 2008). The mainland wintering areas tend to have more abundant winter feeding – willows, moss, and lichens (Thorpe *et al.* 2001).

Habitat availability

Habitat availability is not well covered in traditional and community knowledge sources. Caribou on Victoria Island may be impacted by freezing rain events (discussed in *Threats and Limiting Factors*).

Habitat fragmentation

Habitat fragmentation is not well covered in traditional and community knowledge sources.

Habitat trends

Inuit hunters interviewed by Thorpe *et al*. (2001) have identified some changes in the winter and summer habitat of the Dolphin and Union caribou. These changes relate to climate warming in the last three decades, which has promoted plant growth on the tundra. The hunters interviewed by Thorpe *et al*. (2001) indicated that better forage is increasingly available on Victoria Island and some of these hunters also note an increase in caribou numbers, with Dolphin and Union caribou seen as increasingly healthy, even as individuals, in the late 1990s (Thorpe *et al.* 2001). In contrast, in records provided by Environment and Natural Resources, hunters in Kugluktuk noted that grass was quite sparse on the Dolphin and Union summer range (ENR 1998).

Table 1 summarizes Inuit observations of climate change impacts in the two ecological regions relevant to Dolphin and Union caribou, as compiled from various sources by Golder (2003). In general, Inuit state that earlier spring melt and much later fall freeze-up are causing longer summers, particularly since the mid-1990s. Temperatures are also warmer overall. Sea-ice and other ice crossings may have changed: leads in the sea-ice open earlier, ice is thinner overall due to warmer temperatures and shorter winters, and summer water levels are lower. Lower water levels cause creeks and lakes to dry out in late summer, and shorelines to drop, exposing new areas. Early spring melts and increased snow can cause changes in break-up; streams and rivers may open earlier and the current may be very strong, sometimes carrying ice. Dolphin and Union caribou have benefitted from some changes to the landscape, such as an increase in quality and quantity of tundra forage, but they have also suffered from changes in sea-ice conditions and variable freeze/thaw cycles in spring and fall (Thorpe *et al.* 2001).

Table 1. Documented Inuit knowledge of climate change in the Kitikmeot region (from Golder 2003).

Ecological Region	Observations	Source cited in Golder (2003)
Mainland	• Profound changes in climate, particularly since the 1980s • Longer period of summer-like conditions (late fall freeze-up) and shorter period of winter-like conditions (early spring break-up) • Sporadic freeze-thaw cycles in the spring • Spring melt happens quickly and leads in the sea-ice open much earlier • Ice thinning (both lake and sea-ice) • Not as much snow • Lower water levels (lakes, rivers and sea-ice) • Temperatures not as cold in the winter but much warmer in the summer • Shifts in caribou migrations • Changes in flora and fauna (increase in species diversity and abundance; new bird species being seen; changes in ranges of grizzly bears, polar bears, caribou, etc.) • Changes in weather are more variable and unpredictable	Nunavut Tunngavik Incorporated (NTI). 2001. Proceedings from the Elders' Conference on Climate Change 2001. March 29th-31st, Cambridge Bay, NU. Thorpe *et al.* 2001
Arctic Island	• Sea-ice is freezing later and breaking up sooner than in the past • Sea-ice is not reaching the thickness it once did • Icebergs have disappeared from the ocean north of King William Island • Multi-year ice has been drastically reduced • Snow accumulation is later in the season and the yearly accumulation has declined • The snow pack has become harder • Fresh water ice is freezing later and breaking up earlier • Fresh water ice is not reaching the thickness it once did • The prevailing wind has shifted and the orientation of snowdrifts has changed • Water levels in rivers have gone down • More rough ice • Fewer icebergs • Less multi-year ice	Atatahak, G. And V. Banci. 2001. Traditional Knowledge Polar Bear Report. Government of Nunavut, Department of Sustainable Development. Kugluktuk, NU. Keith, D., J Arqviq, L. Kamookak, and J. Ameralik. 1992. Inuit Qaujimaningit Nanurnat: Inuit Knowledge of Polar Bears. Unpublished report for the Gjoa Haven Hunters and Trappers Organization.

In the Wildlife Management Advisory Council (NWT) (WMAC (NWT)) co-management plan for Minto Inlet, several gaps in information were noted, including: the condition of seasonal ranges for caribou; how year to year changes in winter conditions affect the availability of ranges for caribou and muskoxen; and whether caribou and muskoxen compete for the food that is available (WMAC (NWT) 1997). While this document focused primarily on Minto Inlet Peary caribou, these information gaps likely apply to Dolphin and Union caribou also.

Biology

Life cycle and reproduction

Caribou follow a seasonal cycle of migrating north in the spring to calving grounds, calving, gaining weight in summer feeding grounds, then breeding in the early fall before or during the migration south to over-wintering grounds. The information on life cycle and reproduction in this section comes from a study done with Nunavut Inuit from the following communities: Brown Sound, Cambridge Bay, Bathurst Inlet, and Bay Chimo (Thorpe *et al.* 2001). This information likely applies to Dolphin and Union caribou and/or barren-ground caribou (Thorpe *et al.* 2001).

Bulls will normally migrate together as a group; the cows migrate separately except during the rut. The rut begins in mid-October after a summer of feeding when the animals are at their healthiest. Cows and bulls come together at this time to mate and remain together for about a month; the groups will separate in November. During the rut, bulls make loud snorting sounds and may fight for one or more cows. When they fight, their antlers are heard by Inuit hunters as a thundering sound that carries across the tundra for miles. Inuit hunters avoid hunting during the rut as bulls are dangerous and their meat is unpleasantly flavoured. Non-breeding animals such as yearlings and calves stay with 'barren cows' a short distance away from the mating animals. Yearlings and calves continue to eat during this time and 'get fat' (Thorpe *et al.* 2001). Bulls are not healthy after the rut, until spring, and Dolphin and Union bulls have more fat in the spring than mainland herd bulls (Dumond 2007).

Cows are pregnant for the migration south, during the winter, and during the migration north. Pregnant cows lead the northward migration with bulls travelling behind. Just prior to calving, cows become very restless. Caribou may calve on their spring migration before they reach their calving grounds. If this happens, the caribou and calf will rest for a time and then move again to the calving grounds. Warm weather increases the likelihood of calf survival (Thorpe *et al.* 2001).

A caribou calf can walk and join the other caribou within an hour after birth, once their fur is dry enough. The new calf and its mother will walk around the calving area for a time, feeding and gaining strength, before walking further distances. The calves drink their mothers' milk and eat forage soon after birth. Calves learn how to eat from watching their mothers and from experimenting. They also learn how to migrate. Calves run and play around their mothers. Sometimes the mothers lay and rest while their calves run around them (Thorpe *et al.* 2001).

Physiology and adaptability

There was limited information on physiology and adaptability in the available traditional and community knowledge sources.

Dolphin and Union caribou are found dispersed across the tundra. They are not 'fussy' about their general location although they will preferentially go to areas where the tundra vegetation is particularly green and healthy. They move or 'roam' around during the winter months, and are not known to stay in one location for long periods of time (Thorpe *et al.* 2001).

Caribou may gather and move in a circle to avoid mosquitoes (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001).

High temperatures affect caribou. One Inuit interviewee indicated that when suffering from the heat, a caribou's meat may be different and green in colour (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001). This is discussed further in *Threats and Limiting Factors*.

Participants in workshops said that some individual caribou can adapt to some types of noise quite well:

> *We know caribou and muskoxen are less sensitive to noise. They've gotten used to it. Caribou and muskox have gotten used to airplanes, skidoos. They're probably more tolerant. Many years ago, when the wildlife had contact with machinery, they were easily spooked. That's not the case today. They have adapted to trucks, skidoos, and air planes. They've adapted. And all terrain vehicles too. They have adapted to almost every day noise levels. That wasn't the case years ago (Moses Koihok in Golder 2003:29).*

It was also noted that their response to noise pollution can vary depending on the weather; for example, on still, clear and cold days the caribou tend to shy away, but on cloudy days, they allow people to drive closer (Golder 2003). People indicated that all wildlife are less tolerant of noise when they are about to have their young; "Those are critical times in their life" (Phillip Kadlun, Kugluktuk in Golder 2003:30). Caribou are known to have good hearing and eyesight and are particularly sensitive to disturbance when calving (Thorpe *et al.* 2001, Golder 2003).

Interactions

Interactions with predators

The impact of wolf predation on Dolphin and Union caribou numbers is unknown (Gunn 2005). However, knowledge about wolves and caribou in general tells us that wolves are the main predators of caribou in many areas, and in places where the wolf population increases, caribou numbers decrease (Adjun 1990; Dumond 2007). A wolf pack can consume an entire caribou in one night. Wolves kill more caribou than any other predator (aside from humans), including healthy adults and injured, ill or young caribou. Wolves have the greatest success of all predators because they hunt in packs and are fast (especially the lighter females who make the initial grab from the rear, allowing the slower male to catch up and kill the caribou). They

pursue caribou until the caribou are tired. Wolves may kill bulls after the rut when the bulls are tired. Wolves are often seen around the calving grounds in May and also den near caribou crossings. Wolf populations cycle with caribou populations, and during times with low caribou numbers wolf pups may perish (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001). Wolves are known to keep caribou in good health by removing sick individuals from the population (Dumond 2007).

Other predators and scavengers may finish the caribou remains, such as grizzly bears, foxes, hares, wolverine, and numerous types of birds and rodents. Although wolves most often make the kill, grizzly bears, wolverine, and even foxes may 'tackle' caribou.

> *"Caribou get eaten fast. No matter what, caribou get eaten alive. A whole pack of wolves can finish one big caribou in half the night. I've come across caribou carcasses that have just been recently eaten, you can usually tell when it is been eaten or when it is been caught or how long it was there by fresh blood. On the ground, no blood on the ground, few days old. Wolf is usually the one [to kill caribou], but I witnessed a bear tackle caribou. I witnessed wolf tackle caribou, I witnessed wolverine tackle caribou, even a fox try to tackle a caribou. Everything likes caribou meat. It is pretty much similar the way they hunt caribou. Stalk and kill, stalk and kill, stalk and kill, stalk and kill." (Bobby Algona, Kugluktuk in Thorpe et al. 2001:105).*

Grizzly bears kill young caribou and may harass the herd but are not dependent on caribou. Grizzly bear numbers have been increasing. They are known to chase caribou so the caribou will leave their calves. In the past when a bear was seen, it was shot for food, skin and grease; nowadays, very few are harvested (Dumond 2007). Grizzly bears may wait by the ocean shore to hunt caribou. Foxes and grizzly bears may hunt sick caribou co-operatively – the fox will bark when it finds the caribou (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001).

Wolverine are another predator but they mainly feeds on wolf kills and bear kills. Wolverine can also kill caribou; they chase them for a long time – one observation was of a wolverine chasing a caribou for over 80 km (Dumond 2007).

Caribou cows may charge predators to prevent predation of calves, but this is not seen as successful very often (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001).

Hunters and elders interviewed in Ulukhaktok in 1990 indicated that wolf numbers had increased over the last 10 to 20 years [1970s-80s] (Adjun 1990). Prior to that, the government poisoned wolves around the west end of Victoria Island and east of Ulukhaktok; interviewees said that the poisoning program was effective. Since the poisoning program ended, more wolves were being seen in a number of areas, including northeast of Walker Bay, the Minto Inlet area, Fish Lake,

Glenelg Bay, Kaglokyoak, the west side of Victoria Island, Berkley Point, and Prince Albert Sound. In addition to the cessation of the poisoning program, the return or re-appearance of Dolphin and Union caribou in the 1960s was cited as another reason for higher wolf numbers around 1990 than in the past (Adjun 1990).

In the late 1990s, people from Kugluktuk reported seeing more grizzly bears and wolves on Victoria Island. However, predators and competition were not considered problems for Dolphin and Union caribou at that time (ENR 1998).

Interactions with muskoxen

There is some overlap in the feeding areas of muskoxen and Dolphin and Union caribou during the growing season, but they tend to feed in different areas for the rest of the year (Olokhaktomiut Community Conservation Plan 2008). Hunters and elders interviewed in Ulukhaktok indicated that muskoxen and caribou did not appear to compete for food or habitat, and could be observed in close proximity to each other (Elias 1993).

Hunters and elders interviewed in Ulukhaktok have observed fluctuations (ups and downs) in both caribou and muskox numbers within living memory (Gunn 2005). Muskox and caribou numbers had both increased between the 1960s and the 1980s, when Peary and/or Dolphin and Union caribou, but not muskoxen, started to decline; a few people in Ulukhaktok suggested that the caribou had moved toward Cambridge Bay to escape the muskoxen at Minto Inlet (Gunn 2005). However, it was also suggested that there are as many muskoxen around Cambridge Bay, and the movements toward Cambridge Bay were part of the annual cycle of the Dolphin and Union caribou (Gunn 2005).

A possible consequence of higher numbers of muskoxen is that they provide alternate prey for wolves and therefore could maintain high numbers of wolves even while caribou are declining. This could possibly lead to relatively high predation on the remaining caribou or slow their future recovery (Gunn 2005). Cambridge Bay residents indicated that interactions with muskoxen could be the reason caribou migrate ‘so soon,’ i.e. to avoid a high density of muskoxen on Victoria Island (ENR 1998).

Interactions with other barren-ground caribou

Since the 1970s, overlap in the ranges of Dolphin and Union caribou and other barren-ground caribou herds has increased in Nunavut, “especially in the areas between Kingauk (Bathurst Inlet) and Umingmaktuuk (Bay Chimo),” (Thorpe *et al.* 2001). The summer range of barren-ground caribou has extended north and the winter range of Dolphin and Union caribou has extended south. Barren-ground caribou may even be moving onto Victoria Island in the spring or summer. One interviewee described this as a ‘return’ of non-Dolphin and Union caribou to

Victoria Island.

Interactions between Dolphin and Union and other barren-ground caribou in the Dolphin and Union wintering area are seen to be increasing. The increase in interaction is believed to be due to warming in the last three decades with resulting increase in availability of forage on the tundra. Mixed groups of caribou from the Dolphin and Union population and other barren-ground caribou are a common sight on hunting trips. Since the mid-1980s, migration routes have come together more frequently and some individual caribou from different herds were reported as migrating together in small groups before joining a larger herd (Thorpe *et al.* 2001). People in Cambridge Bay and Umingmaktok observed mixing between the herds in that area (the Bathurst, Ahiak and Dolphin and Union), as well as changes in their ranges, in the early 2000s (Golder 2003). However, Kugluktuk residents did not know how much mixing of herds takes place between mainland (Bathurst and Bluenose) caribou and the Dolphin and Union caribou (ENR 1998). One interviewee indicated he felt the Dolphin and Union caribou is possibly a mix of Peary caribou and the Bathurst herd of barren-ground caribou; "Do you know how the Kiilliniq caribou came to be? The Bathurst caribou met up with the Peary caribou. Might not be, but that is what I think," (Naikak Hakongak, Ikaluktuuttiak in Thorpe *et al.* 2001:81). Similarly, some Inuit interviewed by Thorpe *et al*. (2001) indicated that a new herd has formed from individuals of the Dolphin and Union caribou and other barren-ground caribou (i.e., the Bathurst herd), known locally as 'Heinz 57'.

Population

Structure and rates

Caribou will start to calve when they are two or three years old and generally calve every year until they reach a certain age, after which they will not have calves (this may apply to Dolphin and Union caribou and/or Bathurst caribou; this is uncertain given the sometimes overlapping ranges of the two herds (refer to *Interactions with other barren-ground caribou* for more information on this overlap)) (Thorpe *et al.* 2001). Other information on population structure and rates was not well covered in traditional and community knowledge sources.

Movements

Caribou migration routes change in a small-scale perspective but stay generally the same on a broad scale. Over time, some migration routes become wide or well-worn paths. Caribou may walk in trails in the soft snow or may avoid soft snow and travel on hard ground. In particular, soft snow in the spring may hamper caribou and tire them out. The hard snow of the winter allows for easier movement. Freezing rain and resulting slippery ground may alter the way caribou travel as well. During hot times caribou will walk into the wind to alleviate the effects

of mosquitoes, which will alter their direction. They will also walk into the wind in the winter. However, caribou do not seem to migrate during storms; they lay down and conserve energy instead (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001). Interviewees from Brown Sound, Cambridge Bay, Bathurst Inlet and Bay Chimo (Thorpe *et al.* 2001) had different opinions about whether caribou move faster on their southward or northward migration. One indicated that if the spring temperatures are warm, the caribou will move more quickly towards their calving grounds; likewise, during cooler temperatures they move more slowly. Some interviewees indicated that when heading south, caribou will walk more directly rather than the dispersed movement north in the spring. Others said that the caribou have one route south (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001).

Changes to vegetation that result from climate change can cause a shift in migration patterns. Changes to freeze up, spring melt, ice thickness, and water levels can also force caribou to migrate along different routes (Thorpe *et al.* 2001).

Hunters frequently report variability in use of winter ranges (Gunn 2005). Dolphin and Union caribou (and other barren-ground caribou) will "shift their migration routes once they "eat up" most of the tundra along their traditional routes" resulting in lower-quality vegetation (Thorpe *et al.* 2001). The caribou will also trample and consume the food available in one area and will seek other areas for calving. Community knowledge in Nunavut largely agrees that it can take 50-100 years for vegetation damaged during caribou migrations to recover (Leclerc, pers. comm. 2013). Dolphin and Union caribou will also shift their migration route due to insects, ice and snow conditions, seasonal changes, temperatures, and other weather factors such as heat and wind (Thorpe *et al.* 2001; Bates 2006). For example, in the 1970s, the Dolphin and Union caribou did not pass close to Cambridge Bay, but in the 1980s hunters could find them about 30 miles (48 km) from the community. They moved even closer in the late 1980s, and continued to migrate closer to the community, a small amount every year (Thorpe *et al.* 2001). In the 2000s, the Dolphin and Union caribou passed by Cambridge Bay twice a year and were hunted regularly by Inuit from that community (Bates 2007).

Inuit recognize the importance of the leaders to the migration. Several interviewees indicated that the leader will be a cow without a calf. There are different beliefs with regard to whether or not the leaders of a herd of caribou should be harvested. Some Inuit hunters trying to harvest a whole group of migrating caribou know to shoot the leader first. The remaining caribou will stop, or scatter in all directions, instead of continuing on their route (this may apply to Dolphin and Union caribou and/or Bathurst caribou, Thorpe *et al.* 2001). Other hunters do not necessarily shoot the leaders; "We were told not to shoot the leader of the caribou, the matriarch, or else they could not continue on their journey. They are following the leader," (Joseph Niptanatiak in Golder 2003).

Migration can be dangerous for caribou, whose instinct to travel is very strong. Their speed is

such that a calf that trips on the rocky ground may be killed by the hooves of other caribou. River crossings may also cause calves to drown due to being caught under the group, as the caribou form a tight pack when swimming across. Caribou may swim two miles, but five miles would be considered 'a bit of a stretch' (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001).

Fall migration

The migration path of the Dolphin and Union caribou requires crossing between the mainland coast and Victoria Island twice a year. In August, caribou cows and calves start to migrate with a few bulls. Most bulls migrate a week or two afterwards. Young caribou will follow the main group (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001). In September and October, the caribou move south, congregating along the southern coastline of Victoria Island (Nishi and Gunn 2004, Bates 2006).

As soon as the sea-ice forms, Dolphin and Union caribou will leave the island and head south (Nishi and Gunn 2004; Bates 2006). Thousands of Dolphin and Union caribou cross from the Cape Colbourne area to Kent Peninsula (south of Trap Point) within a matter of days (Nishi and Gunn 2004). The caribou pass through Iqalulialuk (Ekalulia Island) Island (Thorpe *et al.* 2001). They pass Umingmaktok in mid-November, although a few may remain on Victoria Island over the winter (Thorpe *et al.* 2001; Bates 2007).

Some caribou die during this crossing, particularly on newly formed, weak sea-ice (Nishi and Gunn 2004). Drowning deaths are considered common and Inuit often find frozen caribou remains in the sea-ice (Bates 2006); "A lot of caribou drown in the fall time because they fall in the water and drown from October to November," (Moses Koihok, Iqaluktuuttiaq in Golder 2003:42).

Hunters based out of the outpost camps near Read Island, Ross Point (Nakyoktok) and Cambridge Bay have observed fall migrations of Dolphin and Union caribou towards and along the southern coast of Victoria Island through the early and mid-1990s, indicating that the Dolphin and Union caribou's annual fall migration was consistent and extensive at that time (Nishi and Gunn 2004).

Some Elders indicate that the Dolphin and Union caribou have always crossed the sea-ice on their yearly migration south, although some said it was a new pattern or perhaps a return to this pattern (Thorpe *et al.* 2001).

Spring migration

As spring approaches and temperatures start to rise near the end of March, Dolphin and Union caribou shift towards the northern shores of the mainland and the first groups start to appear on the coast and on Melbourne Island (Bates 2006). In 1998-1999, interviewees discussed the

northward migration of Dolphin and Union caribou in the spring, indicating that they leave the Brown Sound area in April. The caribou travel "from Arctic Sound and Rideout Island towards Elu Inlet then across to Cambridge Bay" on their migration to Victoria Island (Archie Komak, Ikaluktuuttiak in Thorpe *et al.* 2001:94). Inuit interviewees recorded caribou crossing Coronation Gulf west of Bathurst Inlet, between the Kent Peninsula and Victoria Island north of Bathurst Inlet, and from Kent Peninsula to near Cambridge Bay (Thorpe *et al.* 2001). Most of the Dolphin and Union caribou move back to Victoria Island in April and May, when cows can be seen crossing from the mainland; the caribou stay on Victoria Island for the spring thaw (Thorpe *et al.* 2001). Cambridge Bay hunters indicate the timing is later, and the crossing is in May and not before (Bates 2006).

Caribou may disperse across the landscape including over rough areas as they migrate north, perhaps due to the heat:

> *"They do not always go in one direction; they are all over the land around here and here. The land is full of caribou. They would walk in all directions* (this may apply to Dolphin and Union caribou and/or other barren-ground caribou) *(May Algona, Kugluktuk in Thorpe et al. 2001:90).*

> *"[A]round the beginning of June... the Dolphin and Union herd has by this time moved into the interior of the island north of Ferguson Lake for calving and is scattered widely." (Bates 2006).*

There was no information on immigration or emigration in the traditional and community knowledge sources available, although it is not likely that most traditional/community knowledge holders would talk about immigration/emigration in those terms (refer to *Interactions with other barren-ground caribou* for more information on potential movements between herds).

Abundance

Information on abundance was not well-covered in available traditional and community knowledge sources.

Fluctuations and trends

> *"When I was young, there was no bears, no muskox, no caribou those years [on Victoria Island]. A lot of changes happened over the past 18 years. Now there are bears. In the 1950s nothing on Victoria Island, only fish, rabbit and birds" (Marion Bolt, Kugluktuk in Dumond 2007:18).*

According to historical and scientific sources, a large herd of caribou was noted to migrate between Victoria Island and the mainland in the late 19th century and the early part of the 20th century, although it appeared to stop migrating in the early 1920s (Anderson 1922; Manning

1960; COSEWIC 2004; Gunn 2008). Observations from Cape Lambert in the spring of 1916 were of "...countless caribou - mainly bulls, their antlers already starting to grow - crossing the straits from the mainland..." (Charles Denny LaNauze *in* Jenkins 2005). A few years later, it was reported that an entire population of caribou from south-east Victoria Island migrated to the Kent Peninsula. From the locations noted in these reports, these caribou undoubtedly belonged to the Dolphin and Union caribou.

Most hunters had rifles by this time and the rate of hunting indicated that few would be left in a decade's time in the vicinity of the Coronation Gulf. In 1919, Diamond Jenness recorded the following passage in his journals:

> *Bows and arrows have passed with other weapons into the darkness of the past, and a new mechanical age has brought magazine rifles, shotguns, steel traps, and even gasoline engines. The caribou are passing with the bows and arrows; of all the herds that once crossed the narrow strait to Victoria Island hardly one now reaches the Arctic shore... (in Jenkins 2005).*

While the cessation of the herd's migration coincided with the introduction of rifles and hide trading in the area in the late 19th century, Banks Island muskoxen also disappeared at this time; their disappearance was attributed to an ice storm. It is not known which factors impacted the caribou (Gunn 2008).

However, some Cambridge Bay residents argued that the migration did not cease and continued throughout the 1900s in numbers small enough to appear undetectable. As well, Inuit still reported sightings of a very few caribou on Victoria Island (Bates 2006; Gunn 2008). Although a few were seen by Inuit hunters, caribou were very scarce in the 1920s and 1930s. In 1937, hunters reported that it was necessary to go toward Richard Collinson Inlet on the north side of Victoria Island to find caribou; these were likely Peary caribou. Dolphin and Union caribou were reported in southern Victoria Island again in the 1950s (Olokhaktomiut Community Conservation Plan 2008).

Elders and hunters interviewed in Ulukhaktok said that there were no caribou at Prince Albert Sound during the 1940s, but some (likely Peary caribou) were north of Minto Inlet (Elias 1993). However, as noted in *Distribution*, some Inuit indicate that Dolphin and Union caribou had left or moved off, rather than decreased in numbers (Bates 2006). The herd has been increasing in number and sightings at least since the 1970s or 1980s (Gunn *et al.* 1997; COSEWIC 2004; Bates 2006; Gunn 2008).

When discussing population trends in 1998-1999, Inuit had differing understandings of whether caribou numbers were increasing or decreasing at that time.

> *The question of whether caribou numbers are increasing or decreasing is not easy to answer. It depends on people's perception of change as well as references to particular time frames or seasons. Some people believe that the population is generally increasing. At the same time,*

many others say that there are increases in certain types of caribou fatalities, most of which are directly linked to climatic influences (Thorpe et al. 2001).

There were also indications that the caribou seemed to be declining or possibly moving east due to climate change, although other interviewees also described fewer caribou seen as possibly relating to changes in migration path (Thorpe *et al.* 2001). Kugluktuk residents did not know what the Dolphin and Union caribou short term population trend was in the late 1990s. In the same time period, Cambridge Bay hunters indicated that there appeared to be fewer bulls available to hunt during the fall (ENR 1998).

In Ulukhaktok in 1998, community members commented that the caribou were really skinny in early-July across Prince Albert Sound, and that overall the caribou used to be in better condition. They had less fat and a different taste than in the past (ENR 1998). People suggested that these changes in body condition might be due to changes in food or because the animals are migrating farther than in the past, saying that in the fall, caribou simply walk south and do not feed very much (ENR 1998). Hunters in Kugluktuk said that the Dolphin and Union caribou seemed healthy (ENR 1998).

Threats and limiting factors

Threats to Dolphin and Union caribou are presented here approximately in order of greater to lesser relative importance, as indicated in traditional and community knowledge sources. Icing on snow and vegetation and heavy precipitation events, drownings and dangerous ice crossings, the impacts of warmer temperatures, industrial activities and other human disturbances are all noted as potentially important threats or limiting factors. In addition, global climate change acts indirectly through impacts to the habitat (e.g. changes to forage conditions and changes to factors that influence migration); these changes can impact caribou condition and survivorship. Disease, forest fires, and predation were not considered major threats to Dolphin and Union caribou. Over-harvesting and/or wounding loss is also a potential threat (ENR 1998; Nishi and Gunn 2004).

Icing on snow and vegetation/heavy precipitation events

Ice-covered snow and/or tundra vegetation have caused problems for Dolphin and Union caribou in the past. The ice crust prevents the caribou from feeding as they cannot ‘dig’ through it, and it may be difficult for the caribou to walk over. Additionally, a variable freeze/thaw cycle in the fall may cover vegetation in ice and starve caribou. One particular event was described near Wellington Bay where rain occurring after snowfall caused starvation in the herd. The effects were locally variable; some areas were affected and others were not based on local conditions and presence of rainfall. Interview participants in Ulukhaktok noted that during freezing rain caribou could die of starvation or would move away to better grazing land; however, the

population of caribou was not specified for this observation (Elias 1993). An example was given in which interviewees noted that following a heavy snowfall and big rain one fall, muskoxen and caribou died of starvation as a result of the extreme weather; it was not specified whether this observation was of Peary or Dolphin and Union caribou (Elias 1993). It was also noted that because Victoria Island is a huge island, the caribou have no trouble finding ice-free vegetation (Elias 1993).

Peary caribou experienced drastic population declines in the early 1970s, which some sources attributed to two years of ice-covered vegetation. A lack of other caribou (Dolphin and Union or Bathurst) was noted during that time as well (Thorpe *et al.* 2001; Harding 2004).

These icing and crusting events could have potentially greater effects on Dolphin and Union caribou if climate change increases the frequency or severity of the events. Knowledge holders interviewed by Thorpe *et al.* (2001) reported that there are more cases of freezing rain and sporadic freeze-thaw cycles over the last 20 years. Years with increased freeze-thaw cycles during spring and/or fall have been associated with decreases in caribou populations since lichen and other plants can become covered in ice and unavailable as caribou forage, which can result in starvation (Thorpe *et al*. 2001).

> *The snow was covered in ice. It had rained after a big snowfall. That is when some of the caribou starved to death, but in another area of land, where it is not so rough, they were fine…Some areas were fine where it did not rain… (Archie Komak, Ikaluktuuttiak in Thorpe et al. 2001:84).*
>
> *One spring, a lot of caribou died because of freezing rain and sleet. There were no areas for them to feed around…They had starved to death because of sleet. They had nowhere to eat. The ice was too think…They could not dig through it (Moses Koihok, Ikaluktuuttiak in Thorpe et al. 2001:148).*

Freezing temperatures during calving may also result in the death of calves (Thorpe *et al.* 2001). In addition, snow and hail in large amounts have been seen in summer time when this was not seen in the past (Thorpe *et al.* 2001).

Drowning and dangerous ice crossings

Caribou may fall through ice and drown if the ice is not strong enough to hold their weight. Both spring and fall ice crossings are affected. In years when freeze-up has been late, Inuit hunters have recorded hundreds of Dolphin and Union caribou dying after breaking through the ice (Gunn 2008). During the 1990s, Inuit hunters saw hundreds of caribou frozen along shorelines after they had drowned (Thorpe *et al.* 2001). There were observations of a drowning event of Dolphin and Union caribou during a fall migration to the wintering grounds in the late 1990s:

> *Last year I noticed the ice close fairly late from the years before. That is when a few caribou*

were trying to cross from Cape Peel, in Victoria Island (Kiilliniq). I heard from the guys that were working from the North Warning System, that some caribou drowned near Cape Peel, about 70 miles west from Cambridge Bay (Ikaluktuuttiak). They were trying to migrate across towards Surrey Lake and Wellington Bay (Iqaluktuuq), come towards Cambridge Bay (Ikaluktuuttiak) area. I heard not lots drowned but not hundred, but less than a hundred, I think. (George Kavanna, Ikaluktuuttiaq in Thorpe et al. 2001:142).

Increasing numbers of Dolphin and Union caribou are being observed on the mainland in December with a thick coat of ice on their fur; this is thought to be the result of falling through the ice during migration (Poole *et al.* 2010).

In the spring, caribou may swim through channels of water in the ice and not be able to get out, leading to drowning (Thorpe *et al.* 2001). Community members in Kugluktuk have also noticed some drowning occurring in the spring leads where the edges of the ice are too slippery, or where fresh snow covers the leads (ENR 1998).

Warmer temperatures resulting from climate change are reducing the extent of sea-ice and delaying the timing of freeze-up (see Table 1 in Golder 2003; Gunn 2008). If the ice is too thin to cross but other factors (like length of daylight, sun, or seasonal triggers) cause the caribou to migrate anyway, they may either waste energy by looking for a better place to cross, or attempt to cross on thin ice and possibly fall through the ice and drown (Thorpe *et al.* 2001). As a result, drowning events are seen as being on the increase (Thorpe *et al.* 2001).

Shipping activities may impact migrating caribou; however, there were few references to this possible threat in the traditional and community knowledge sources available for this report. Inuit interviewees did indicate that ships can run during the summer months when the Dolphin and Union caribou are on Victoria Island, but that shipping activities should cease in September, October, and November for the southern migration, and in April and May for the northward migration (Thorpe *et al.* 2001; Golder 2003). In Cambridge Bay, there are concerns about the impact ship traffic can have on Dolphin and Union caribou during the fall (ENR 1998).

Impacts of warmer temperatures

Warm and dry weather causes a more intense, longer insect season, especially in regards to mosquitoes, while warm and wet years produce more warble flies and nose bots (Dumond 2007). An increase in insect harassment for caribou has been seen since the 1970s (Thorpe *et al.* 2001; Bates 2006; Dumond 2007).

Mosquitoes cause caribou to gather, move in circles and shake to get the insects off. This wastes energy and prevents feeding. If they lose too much body fat they may not survive migration, water crossings and the winter. Cambridge Bay hunters said that during hot summers with many mosquitoes the caribou migrating past the town in the autumn would be thin, as they would have suffered constant insect harassment, whereas after cool summers the animals would be relatively

fat (Bates 2006). In 1998, however, the temperatures were too hot for mosquitoes and they disappeared (Thorpe *et al.* 2001). It has also been reported that warble flies are being seen in spring as well as summer now (Dumond 2007).

Hot, windless days are also a threat to caribou as they may overheat while escaping insects and not feed (Thorpe *et al.* 2001). Extremely hot weather can cause caribou to lose body condition. Inuit interviewees have noted an increase in deaths from heat-related and insect-induced exhaustion (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001).

Participants in a caribou workshop in Kugluktuk indicated that hot weather can influence the quality of caribou food and that climate change is causing weather to be less predictable and causing animals to suffer (Dumond 2007).

Industrial activities and other human disturbances

Some people are concerned that mining may cause caribou to shift their annual migration routes, causing hardship for hunters. However, others have indicated that mines do not bother caribou (this may apply to Dolphin and Union caribou and/or Bathurst caribou, Thorpe *et al.* 2001). It has been suggested that there should be no flights and mines should not operate or should only conduct quiet activities when calving caribou are nearby and when caribou are migrating by the mine. Flights, particularly helicopter flights, should be higher over calving areas. A recommended distance for a buffer around mines or other industrial development was 13-16 kms (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001; Dumond 2007). Inuit have requested that mining be restricted, or should not happen near caribou calving grounds, as it will disturb the caribou (Thorpe *et al.* 2001; Golder 2003).

Hunters on some arctic islands have associated industrial exploration with unusual movements of caribou, but hunters from Ulukhaktok did not (Freeman 1975 *in* Gunn 2005). Increased industrial activity may cause caribou to scatter rather than staying in a large herd (Dumond 2007).

Community concerns in regard to potential impacts of a proposed gold mine (the Doris North Project) located at the north end of Doris Lake, Nunavut, approximately 160 km southwest of Cambridge Bay in the Hope Bay Belt, were summarized by Golder (2003). Concerns relevant to Dolphin and Union caribou are summarized in Table 2.

Table 2. Community comments related to caribou and mineral activity (from Golder 2003).

Comment	Sources cited in Golder (2003)
• Mining companies do not bother caribou; when caribou aren't being bothered, they don't run away. Caribou usually stand outside mine buildings	M. Algona *in* Thorpe *et al.* 2001
• Mining companies should shut down when caribou come through. They have good ears and eyes; it bothers them. They get more sensitive when calving	K. Haniliak *in* Thorpe *et al.* 2001
• Should not allow mining companies to explore and use explosives on calving grounds; caribou get afraid	A. Komak *in* Thorpe *et al.* 2001
• There is too much mining going on in the north; caribou might change their routes and not come around at all	Anonymous C *in* Thorpe *et al.* 2001
• Some caribou do not mind the mining and the helicopters in the summer and spring. The caribou run away or sometimes just stand there	C. Keyok *in* Thorpe *et al.* 2001
• Helicopters fly too low and the caribou start running	A. Kapolak *in* Thorpe *et al.* 2001
• Caribou habitat should be protected	Nunavut Planning Commission. 2002. West Kitikmeot Land Use Plan. www.npc.nunavut

Hunters in Kugluktuk have also noticed a shopping bag in a caribou stomach, and have seen bulls tangled in wire during the rut (ENR 1998). Garbage left out on the land; in particular plastic bags, was noted as a general threat to wildlife (Dumond 2007).

It was generally noted that road-building near Bathurst Inlet may impact caribou in several ways, particularly if the number of caribou is low: traffic on the road and the physical presence of the road itself may change caribou behaviour. As well, disturbance during road construction may cause avoidance (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001).

Water pollution and dust pollution from new and old mines were a concern for Kugluktuk hunters. They also identified a lack of resources at the Hunters and Trappers Organization level as a threat because there are not enough resources to properly review and comment on development permits (Dumond 2007).

Harvesting/Over-harvesting

While over-harvesting has been a cause of past decline for Peary caribou on Victoria Island, it has not generally been identified in traditional and community knowledge sources as a concern or negative impact for Dolphin and Union caribou (Elias 1993; Gunn 2005), although some biologists, resource managers and residents of Kugluktuk and Cambridge Bay have identified overharvesting and/or wounding loss as a potential threat (Nishi and Gunn 2004; ENR 1998). However, information from Gunn (2005) indicates that there was an increase in harvesting in Prince Albert Sound (i.e. Dolphin and Union caribou) from 1983 to 1996, based on harvests

reported to the Kitikmeot Harvest Study and the Inuvialuit Harvest Study (Table 3).

Table 3. The reported harvest documented by the Kitikmeot Harvest Studies for 1983-84 to 1986–87 and the Inuvialuit Harvest Study for 1987–88 to 1995-96 (Gunn 2005). Harvest information from the Kitikmeot Harvest Studies includes only the harvested caribou for which a location was recorded. Holman [Ulukhaktok] had a self–imposed ban on hunting caribou on northwest Victoria Island in April 1993. Hunters reported that the caribou taken in the summer were different in appearance from the type of caribou taken in the fall and winter (Gunn 2005). The reported harvest assumes that caribou taken in June through to September would be by boat and all-terrain vehicles in Prince Albert Sound area (Dolphin and Union caribou) and that caribou taken October to May would be northeast and north of Ulukhaktok and from the Minto Inlet Herd (Peary caribou) (Gunn 2005).

Year	Minto Inlet (Peary)	Prince Albert Sound (Dolphin and Union)	Total Harvest
1983–84	931	172	1103
1984–85	247	134	381
1985–86	836	154	990
1986–87	757	76	833
1987–88	600	44	644
1988–89	405	110	515
1989–90	420	189	609
1990–91	329	222	551
1991–92	192	308	500
1992–93	155	202	357
1993–94	0	351	351
1994–95	7	277	284
1995–96	0	381	381

In response to Peary caribou declines on northwest Victoria Island, the Olokhaktomiut Hunters and Trappers Committee initiated a zero-harvest by-law for northwestern Victoria Island that is enforced by GNWT legislation (WMAC (NWT) 1997; Nishi 2000; Gunn 2005). There followed some concern that Ulukhaktok hunters would shift their summer and fall hunting efforts to Dolphin and Union caribou (Nishi 2000), and it was noted that harvesting shifts to caribou in the Prince Albert Sound area (Dolphin and Union) when northern/Minto Inlet animals are scarce (Olokhaktomiut Community Conservation Plan 2008). However, traditional and community knowledge sources do not report whether there has been a negative impact on Dolphin and Union caribou as a result.

The communities of Cambridge Bay, Kugluktuk, Umingmaktok, and Bathurst Inlet harvest Dolphin and Union caribou on the mainland during the winter months (Nishi 2000). Nunavut hunters may take between five and 70 caribou per year for their own use and for their families' needs (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001). There have been some concerns among biologists and resource managers that this harvest, when added to the harvest by Ulukhaktok hunters, would result in a risk of overharvest for

Dolphin and Union caribou.

> *With an extrapolated harvest of 2000-3000 caribou (based on the reported harvest from the Kitikmeot Harvest Study (Gunn et al. 1986), and the proportion of arctic island caribou reported in recent harvest studies (see Gunn and Nishi 1998), the current rate of harvest with respect to the October 1997 population estimate is high* ***(Gunn et al. 1986 in Nishi and Gunn 2004).***

In the late 1990s, Kugluktuk residents suggested that the harvest of Dolphin and Union caribou might be too high, and that they might have to stop hunting during migrations, as well as stop hunting pregnant cows (ENR 1998). In 2007, there were additional concerns that there may be some over-harvesting and wasting of meat in the community, in particular during years when the caribou migrate close to the community. Workshop participants said that people eat mainly caribou these days, and less of a variety of traditional foods (Dumond 2007). Hunters are cautioned to hunt for bulls, but one Kugluktuk hunter feels that the focus on bulls (in particular by sport hunters who seek large bulls of a particular appearance) may be negatively impacting the caribou herds and feels that a more balanced hunting approach is warranted (Dumond 2007). Subsistence harvests of barren-ground and Dolphin and Union caribou are shown in Figure 6 for a 10 year period in Kugluktuk.

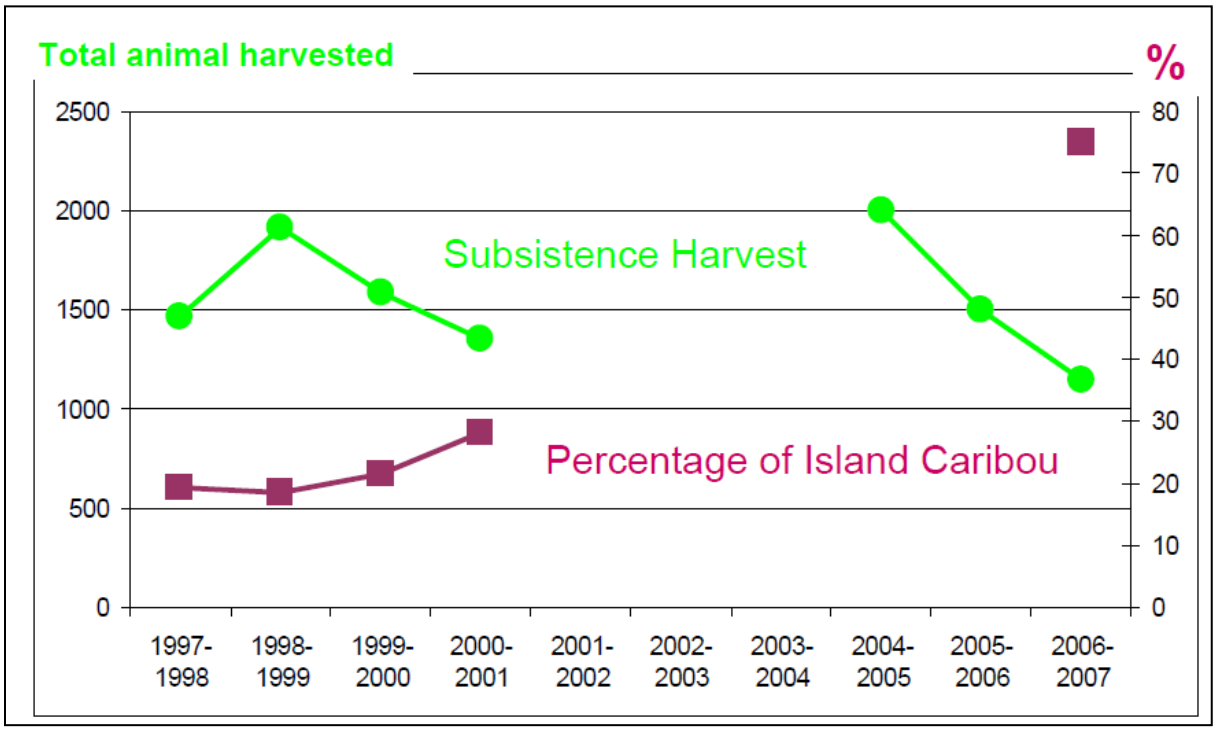

Figure 6. Total caribou subsistence harvest in Kugluktuk and proportion of Dolphin and Union caribou (Island caribou) in the harvest (reproduced from Dumond 2007, used with permission). Dumond (2007) notes that limited information is available regarding the subsistence harvest of caribou and does not include an explanation or interpretation of the results presented in the figure. The data presented in this figure was drawn from the Kitikmeot

Harvest Study (Gunn, Jungfors and Avalik. 1986. The Kitikmeot harvest study as a successful example for the collection of harvest statistics in the NWT. Pg. 249-259 in 'Native people and renewable resource management'. Proceedings of the 1986 symposium of the Alberta Society of Professional Biologists, Edmonton, AB), the Nunavut Harvest Study (produced by the Nunavut Wildlife Management Board) and a 2006-2007 hunter survey conducted by Kugluktuk's Conservation Officers.

There have been suggestions that harvest levels in Kugluktuk may have been higher in the 1950s, when caribou meat was used to feed dog teams. However, the community was also smaller at that time, so trends in harvesting patterns over that period have not been confirmed (Dumond 2007).

In Cambridge Bay, meeting participants did not know how many Dolphin and Union caribou were being harvested, and it was suggested that there was the possibility of high wounding loss impacting the herd (ENR 1998). Wounding loss can be exacerbated if hunters are inexperienced. Recommendations arose as part of Dumond's (2007) work on the Western Kitikmeot Caribou Workshop, including: community hunts should have requirements for experienced hunters and Elders to provide education to those in need, and other educational initiatives should also be implemented.

Levels of commercial harvesting appear to vary. Kugluktuk and some communities in Nunavut's Kivalliq region (Kivalliq region includes: Rankin Inlet, Arviat, Baker Lake, Chesterfield Inlet, Coral Harbour, Repulse Bay, and Whale Cove) support some commercial harvesting (Dumond 2007), while the Ekaluktutiak Hunters and Trappers Association (Cambridge Bay) stopped distributing commercial caribou harvesting tags in 1997 until a hunt could be organized in a mainland location (ensuring that only barren-ground caribou would be harvested and protecting Dolphin and Union caribou from commercial harvest) (Nishi and Buckland 2000). Peaks in the Kugluktuk commercial harvest occur when the caribou are close by and other communities ask for some meat; otherwise the commercial harvest is usually low (Dumond 2007).

Other threats and potential impacts

Diseases and parasites

Diseases and parasites were not identified as a major concern in traditional and community knowledge sources reviewed. Hunters did not report diseased caribou during the 1980-1993 study of caribou on Victoria Island (Gunn 2005). However, in more recent community meetings, some people in Cambridge Bay noticed that Victoria Island caribou appeared less healthy in the late 1990s, but they did not specify if these caribou were Dolphin and Union or Peary caribou (ENR 1998). Cambridge Bay community members said that they noticed an increase in the incidence of brucellosis in Dolphin and Union caribou (ENR 1998); however, more recent local knowledge suggests that Dolphin and Union caribou are healthy (Dumond 2007).

Some hunters in Kugluktuk reported seeing Dolphin and Union caribou with very thin skin that

tears during skinning in the fall time (ENR 1998). There were also concerns raised around the levels of radioactive materials in caribou; increased incidence of taenia (tapeworm); and the possibility that the caribou are being exposed to more disease by travelling farther to the south (ENR 1998).

Predation

Wolves, wolverines and grizzly bears are known predators of caribou within the range of the Dolphin and Union herd (Golder 2003, Dumond 2007, see *Interactions with predators*). There is little information in the available sources to indicate the magnitude or imminence of this as a threat.

Wolf numbers are reported to have increased over the last 10 to 20 years (1970s and 1980s), possibly in response to increases in caribou and muskoxen abundance during the 1970s (Adjun 1990). The impact of this increased wolf abundance on Dolphin and Union caribou herd was not discussed in interviews conducted in Holman [Ulukhaktok] in the 1990s (Gunn 2005). Despite an increase of grizzly bears and wolves noted by Kugluktuk community members in the 1990s, it was not felt that predators were a problem for Dolphin and Union caribou (ENR 1998), although more recent community consultations note concerns regarding the number of grizzly bears and wolves and how their predation affects caribou and muskox (Leclerc, pers. comm. 2013). Overall, predators are reported to have increased and the number of people who are experienced in hunting wolves has decreased (Dumond 2007), potentially increasing predation pressure on caribou.

Positive Influences

There is little information on positive influences available in the traditional and community knowledge sources. In the Olokhaktomiut Community Conservation Plan (2008), certain parts of the Dolphin and Union caribou range on Victoria Island have been recommended for special land management. For example, the Colville Mountain Wildlife Area of Special Interest (Site No. 526C) encompasses the calving ground for Dolphin and Union caribou, and as a category "C" management zone, defined as:

> *Lands and waters where cultural or renewable resources are of particular significance and sensitivity during specific times of the year. These lands and waters shall be managed so as to eliminate, to the greatest extent possible, potential damage and disruption (Olokhaktomiut Community Conservation Plan 2008).*

The plan recommends various conservation measures to protect caribou (Olokhaktomiut Community Conservation Plan 2008). These include:

- Identify and protect important habitats from disruptive land uses.
- Share your harvest with others in the community.

- Do not harvest more than is needed.
- Harvest on sustainable basis, and in manner consistent with recommendations of the HTC [Hunters' and Trappers' Committee].
- The HTC will encourage a voluntary ban on caribou hunting where required.
- A management plan for Victoria Island Caribou will be developed.

As noted in *Habitat Trends*, more and better forage is increasingly available on Victoria Island due to climate change. The changes relate to warming temperatures in the last three decades promoting plant growth on the tundra. Vegetation is richer and more abundant: plants used for forage and shade are taller, and tundra plants on Victoria Island are more variable and widespread with an increased number of plants growing there. Some areas of Victoria Island had no vegetation in the past and are now supporting plant life. Shrubs have increased in particular. The change in vegetation brings caribou to these areas of rich forage, also changing their previous migration (this may apply to Dolphin and Union caribou and/or Bathurst caribou) (Thorpe *et al.* 2001). The increase in forage has perhaps led to an increase in caribou numbers and Dolphin and Union caribou are seen as increasingly healthy (Thorpe *et al.* 2001).

Educating hunters about wastage of caribou meat is considered a positive influence in the Kugluktuk area (Dumond 2007):

> *Wastage has gone way down compared to past years due to education. However, we used to (with my parents) use even the legs right down to the hoofs but I don't do that anymore. I still bring the legs but we give them away to other people or the dogs. Same for the caribou heads (Allen Niptanatiak, Kugluktuk in Dumond 2007:25).*

Conservation officers are also educating Kugluktuk community members about efficient and humane hunting practices to decrease wounding loss of caribou, and to ensure hunters understand how to select caribou to promote conservation (Dumond 2007).

One of the primary recommendations arising from Dumond's (2007) work was to improve compliance of minimum flying altitude by involving the public in reporting violations (communicating to them the rules respecting minimum flying altitude and the actions they're able to take) and requesting that the Hunters and Trappers Organization (HTO) look into enforcing a minimum flying altitude for ultra light aircraft (Dumond 2007).The reporting of low-flying aircraft by hunters is considered a positive influence as it could cause changes in pilot behaviour.

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Biographies of Preparers

Two preparers were involved in compiling the information for this report. Ms. Benson and Ms. Winbourne both have experience assessing published and unpublished local and traditional knowledge for appropriate quality in methodology, reporting, and ethical considerations. They are also both familiar with the requirements of traditional knowledge policies and procedures. Their individual strengths are outlined below.

Kristi Benson, B.A., M.A. ***Heritage Specialist*** Ms. Benson has over ten years of experience in conducting anthropological, oral history, traditional knowledge, archaeological, heritage policy, GIS, and other heritage projects. Her experience in the heritage field has taken place primarily in Canada's western Arctic. Ms. Benson and Ms. Winbourne prepared the ***Species Status Report (Traditional and Community Knowledge Component) for Boreal Woodland Caribou*** in 2012 for the NWT Species at Risk Committee. Ms. Benson has also acted as research manager for two projects specifically relating to species at risk. She conducted research, prepared relevant reports, and managed the review process (including verification sessions) for the ***Gwich'in Traditional Knowledge of the Rat River Char*** study. She also managed the recent ***Gwich'in Traditional Knowledge of Boreal Woodland Caribou*** study. During this project she conducted interviews, managed information and files, trained and supervised a local interviewer, and prepared a final report. Ms. Benson has also provided traditional knowledge about barren-ground caribou for the designatable units assessment in 2011, and has compiled traditional knowledge for other species at risk assessments (pika, polar bear, and others). Ms. Benson also has experience as the project director for a multi-year Gwich'in Traditional Knowledge study relating to the Mackenzie Gas Project, where she managed the budget, participated in the hiring committee for assistants, conducted community consultation, conducted interviews, handled contracts for transcribing, wrote reports, and many other tasks. Ms. Benson has conducted numerous studies with the Gwich'in Social and Cultural Institute since her first association with them in 2004. She has also worked with the Inuvialuit and in the Sahtu; and worked with the International Polar Year with scientists and communities across the NWT.

Janet Winbourne B. Sc., M.E.S., R.P.Bio. ***Ethnobiologist*** Over the last 15 years, Ms. Winbourne has conducted TK research amongst and for many Aboriginal groups, including numerous First Nations on the BC coast, as well as Inuvialuit and Gwich'in communities in the western Arctic. She is primarily a research ethnobiologist, but also worked as Community Knowledge Coordinator for the Gwich'in Renewable Resource Board in Inuvik in 2003-2004, managing all traditional and local knowledge research conducted by the GRRB, as well as the Gwich'in Harvest Study. Ms. Winbourne has previous experience compiling TK specific to species at risk planning. Ms. Winbourne and Ms. Benson prepared the ***Species Status Report (Traditional and Community Knowledge Component) for Boreal Woodland Caribou*** in 2012 for the NWT Species at Risk Committee. In 2009 she prepared **Haida Traditional Knowledge**

of Abalone for use in the ***2010 SARA Draft Abalone Action Plan***, and has continued to compile traditional knowledge of species at risk such as abalone and sea otters with the Haida in 2011-2012. She was the principal researcher on the Haida Marine Traditional Knowledge Study, responsible for collecting, compiling, analyzing and reporting information from hundreds of hours of interviews on approximately 200 species topics. This information was summarized in three report volumes, a TK database and GIS maps. Most recently, she has assisted on processing information for the ***Gwich'in Traditional Knowledge of Boreal Woodland Caribou*** study.

SCIENTIFIC KNOWLEDGE COMPONENT

Names and classification

Scientific Name:	*Rangifer tarandus groenlandicus* x *pearyi* T. H. Manning 1960
Common Name (English):	Dolphin and Union caribou; barren-ground caribou (Dolphin and Union population)
Common Name (French):	caribou du tropeau Dolphin-et-Union

Commonly used local names: People from Ulukhaktok, Paulatuk, Cambridge Bay, Kugluktuk and Umingmaktok refer to the Dolphin and Union caribou as Victoria Island caribou, Island caribou, and even Peary caribou to distinguish them from barren-ground 'Mainland' caribou (WMAC(NWT) unpubl. data 2012). The Inuktitut names are Killinik for caribou (Dolphin and Union, Victoria Island) and Ahiarmiut for barren-ground caribou (Thorpe *et al.* 2002). The common Inuvialuktun name is Tuktu.

Name of population(s):	Dolphin and Union herd
Class:	Mammal
Order:	*Artiodactyla*
Family:	*Cervidae* Deer Family
Life Form:	Vertebrate, terrestrial mammal, deer, caribou

Dolphin and Union caribou were first assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as part of Peary caribou, but COSEWIC's latest assessment (COSEWIC 2004) and COSEWIC's (2011) designatable units report treat Dolphin and Union caribou as a discrete and evolutionarily significant unit (Designatable Unit [DU2]).

The history of name changes, differing and variable uses of local names, and evolving scientific analyses (see COSEWIC 2011) that have grouped various caribou into specific units have caused a significant level of confusion for some. More information from and shared with local hunters is needed to resolve potential ambiguities and bring about a common understanding in the classification of Dolphin and Union caribou and Peary caribou.

Systematic/Taxonomic Clarifications

The current taxonomy is based on Manning (1960) and Banfield (1961). It is conventional to use the current taxonomy until it is replaced even if it has been questioned. Manning (1960:47) "tentatively" assigned Dolphin and Union caribou to *R. t. arcticus*. Banfield (1961) changed *arcticus* to *groenlandicus* on the basis of some skull measurements. However, characters such as

larger hooves and gray antler velvet were also discontinuous between Dolphin and Union and the barren-ground caribou *groenlandicus*. Manning (1960) did not have summer skins for Dolphin and Union caribou nor did he see live animals. He only had a few specimens to study (seven skulls and eight winter skins). The specimens had been collected on the nearby mainland (Bernard Harbour) in 1915-16 and were labelled as migrants from Victoria Island. Manning (1960) reported that the Dolphin and Union population "...was separated rather sharply from neighbouring mainland caribou in pelage colour, and the available skulls indicate that the migrants were distinctively smaller although the difference in skull shape was comparatively slight". Banks Island caribou and the migrant Dolphin and Union population were classified as having characteristics of barren-ground and Peary caribou. Subsequently, the Dolphin and Union caribou were named as both *R. t. groenlandicus x pearyi* and Banks Island caribou as *R. t. pearyi x groenlandicus* which recognized that while Dolphin and Union were larger and darker, they did resemble Peary caribou and were distinct from barren-ground caribou.

Between 1987 and 1990, Gunn and Fournier (1996) collected 70 adult female caribou skulls taken near Cambridge Bay and compared measurements with published information on caribou from Melville Island, Boothia Peninsula, Prince of Wales Island, the 'type specimens' of Dolphin and Union caribou collected in 1915-16 and barren-ground caribou collected near Pelly Bay. Skulls from barren-ground caribou taken from Pelly Bay were significantly larger than Dolphin and Union caribou skulls. The smallest skulls were from Melville and Prince of Wales Islands. Except for nasal length, they found no significant differences in skull measurements between the earlier and the recent collection and concluded that it is still the Dolphin and Union population. The significant difference in nasal length was probably a difference in measuring technique.

McFarlane *et al.* (2009) used nuclear DNA analyses to assess genetic diversity and describe the relationships within and among caribou on the Arctic islands. In this regard, Dolphin and Union caribou are distinct from barren-ground caribou. While Dolphin and Union caribou share haplotypes with members of adjacent Designatable Units (DUs), the retention of some distinct genetic lineages suggests local adaptations by these caribou. Their physical similarity to Peary caribou (DU1) may reflect similar evolutionary selection pressures, but genetic information suggests a different origin (Eger *et al.* 2009). The uniqueness of this population also may be reflective of a severe population bottleneck that may have occurred in the early 1900s (Manning 1960; Zittlau 2004; Zittlau *et al.* 2009). Eger *et al.* (2009) reported that the divergence time based on mitochondrial DNA was relatively recent and surmised that as the Laurentian Ice Sheet receded from around Banks Island (up to 12,000 years before present (ybp)), some sections of which were refugia during the last glaciation, caribou from Banks Island colonized Prince Patrick, Eglinton, and Melville islands (approximately 6,300 ybp), Victoria Island to the east (approx. 3,000 ybp) and Prince of Wales Island by 1,500 ybp. Alternatively, Dolphin and Union caribou may have reached Victoria Island from the south, following the retreating ice sheet

(Gunn 2008).

COSEWIC (2011) categorizes Dolphin and Union caribou (DU2) as discrete from Peary caribou (DU1) and barren-ground caribou (DU3) based on their morphology, the DNA evidence (microsatellite differentiation), and on behaviour (the staging during the rut as well as the scale (thousands of animals) of their regular, gregarious seasonal migrations across sea-ice is unique). Dolphin and Union caribou differ morphologically from barren-ground caribou in skull shape, antler velvet colour, hoof size, and breeding pelage pattern. Dolphin and Union caribou are structured as a discrete population relative to neighbouring caribou, and are geographically or temporally isolated from most other caribou throughout the year, including for calving and rutting (Gunn and Fournier 2000; Nishi and Gunn 2004; Poole *et al.* 2010; Nagy *et al.* 2011).

Description

Dolphin and Union caribou are highly recognizable and Inuvialuit easily distinguish them from both barren-ground (mainland) and Peary caribou. Compared to Peary caribou, Dolphin and Union caribou are relatively large in stature and with longer legs (Carpenter pers. comm. 2013) and face. Barren-ground caribou are larger than Dolphin and Union caribou and generally darker in colour. The early winter coat of Dolphin and Union caribou is distinctive, being white with a pale brown back. In summer, the coat is light to darker on top and has a less pronounced flank stripe than is typical for barren-ground caribou (Fig. 7). The belly is white and the legs are mostly white except for a narrow frontal brownish stripe. Pelage color is variable between individuals. The pale gray antler velvet is a striking distinguishing characteristic compared to the brown velvet of barren-ground or woodland (*R. t. caribou*) caribou.

Figure 7. Dolphin and Union caribou near High Lake, west of Bathurst Inlet, April 2008. Photo by K. Poole, used with permission.

Distribution

Continental distribution

Dolphin and Union caribou only occur in Canada (Figure 8) and are restricted to Victoria Island and the mainland coast opposite Victoria Island. In Canada, Dolphin and Union caribou only occur in Nunavut (NU) and Northwest Territories (NWT).

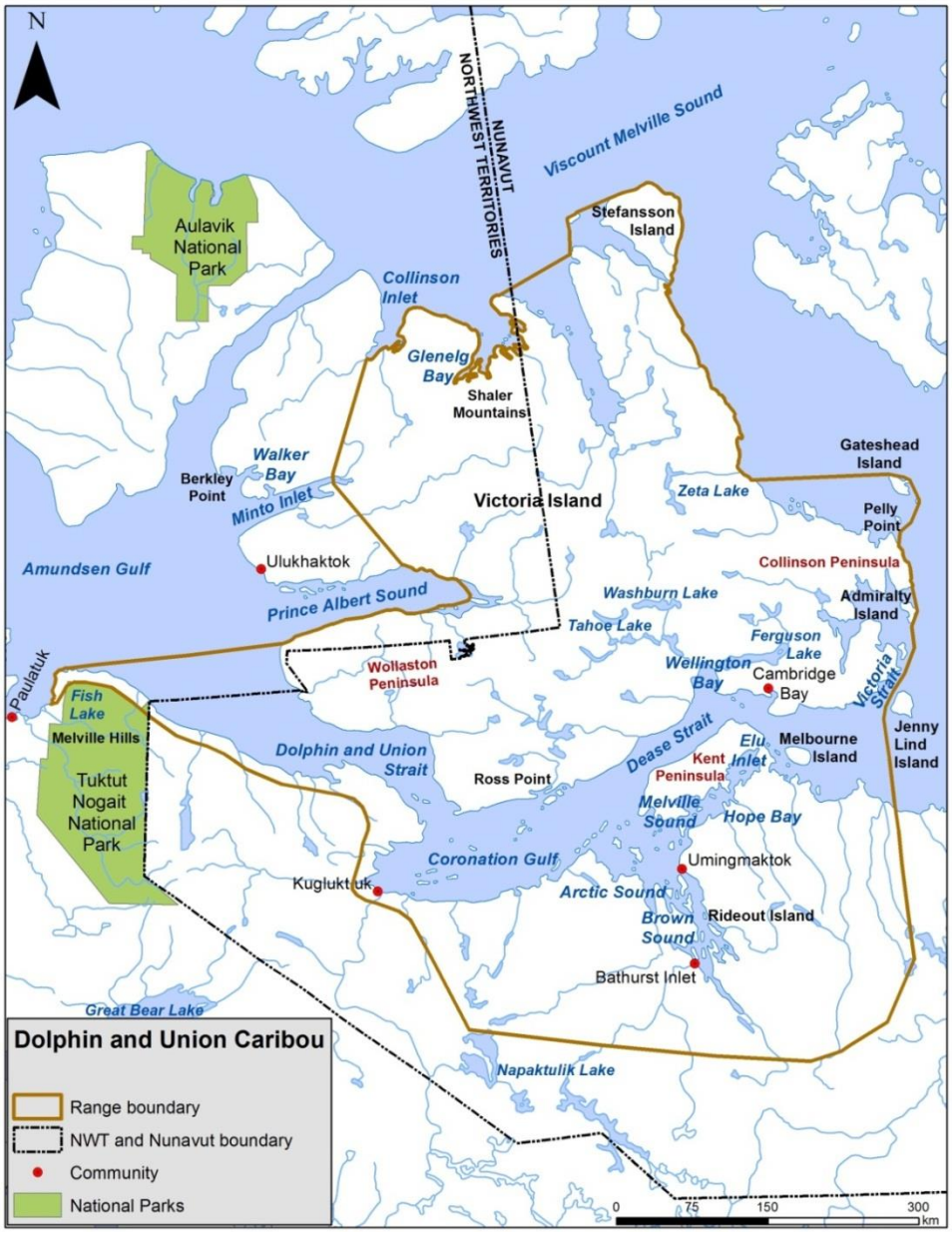

Figure 8. Continental distribution of Dolphin and Union caribou (Environment and Natural Resources, unpubl. data 2012).

NWT and Nunavut distribution

The distribution of Dolphin and Union caribou within the NWT and Nunavut is on Victoria Island (except for Prince Albert Peninsula to the northwest), the islands off the east coast (Stefansson, Gateshead and Admiralty), islands in Coronation Gulf and Dolphin and Union Strait, and the adjacent mainland coast (Fig. 8). Most of the annual range is within Nunavut. The distribution, habitat and abundance described in this report are based on the population as a whole.

The historic distribution (prior to commencement of aerial surveys in 1980) is summarised in Manning (1960). Archaeological evidence is fragmentary and indicates that Palaeoeskimo people reached Victoria Island ca. 4500 ybp (Savelle and Dyke 2002). Many of the hundreds of Palaeoeskimo sites are associated with caribou hunting. Those sites include caribou hunting sites on southern Victoria Island (Savelle and Dyke 2002; Brink 2005). Brink (2005) described stone hunting structures for caribou (cairns, shooting pits, and stone fences and funnels) near Wellington Bay. This site is where caribou currently cross in fall–early winter and then again in late winter–spring. At Lady Franklin Point, south-western Victoria Island, there is a Thule site with thousands of caribou bones (Taylor 1965 *in* Brink 2005). The archaeological sites suggest that caribou have likely been on the coast and crossing the sea-ice for hundreds or possibly even thousands of years.

The current distribution is naturally continuous (unfragmented) and there is a single geographical population. The Minto Inlet population of Peary caribou occurs on northwest Victoria Island and its range is adjacent to the summer range of Dolphin and Union caribou. The spatial separation of the Minto Inlet population from the Dolphin and Union population is based on the movements of satellite-collared cows during 1987-89 and 1996-2006 (Gunn and Fournier 2000; Gunn 2005; Nagy *et al.* 2009c; Poole *et al.* 2010; ENR Wildlife Management Information System (WMIS), unpubl. data 2011). The different origins and longer-term separation of Minto Inlet Peary caribou and Dolphin and Union caribou is based on nuclear DNA (Zittlau 2004; McFarlane *et al.* 2009).

Extant locations

The NWT Species at Risk Committee (SARC) considers location to be defined as a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the species present (SARC 2010 following the International Union for Conservation of Nature [IUCN]). Using this definition, Victoria Island (except the northwest peninsula) and the adjacent mainland coast is described as a single extant location based on the threats of climate warming and its effect on sea-ice formation, and hunting (described in *Threats and Limiting Factors*).

Extent of Occurrence

'Extent of occurrence' as defined by SARC is the area included in a polygon without concave angles that encompasses the geographic distribution of all known populations of a species (SARC 2010). The extent of occurrence for Dolphin and Union caribou was estimated based on the range shown in Figure 8 and was 499,449 km^2 for the entire geographical population and 116,841 km^2 for the NWT only. The range includes the areas where Dolphin and Union caribou have been recorded since 1980, corresponding with the commencement of aerial surveys in 1980. It encompasses all the known sites of use and includes the water bodies between islands and the mainland, as individuals are known to travel on sea-ice. On northwest Victoria Island the western boundary of the Dolphin and Union caribou relative to Peary caribou distribution was drawn from Richard Collinson Inlet to Minto Inlet, which encompassed the distribution of satellite-collared cows during 1987-89 and 1992-2006. The line is the same as the eastern boundary of the 1994 aerial survey for Stratum IV (Gunn and Fournier 2000; Nishi and Buckland 2000; Fig. 6 in Nagy *et al.* 2009c).

Area of Occupancy

'Area of occupancy' as defined by SARC is the area within the extent of occurrence that is occupied by a species, excluding cases of vagrancy. This measure reflects the fact that the extent of occurrence may contain unsuitable or unoccupied habitats. The area of occupancy is measured both as an estimate of the actual area occupied (the "biological occupancy") and as an index of area of occupancy (IAO) which uses a scale-correction factor to standardize this estimate across different spatial scales (SARC 2010). At the scale of available information it is only practical to map distribution rather than specific occupied habitats or potential or unoccupied habitats. The biological area of occupancy for Dolphin and Union caribou was calculated as the range of Dolphin and Union caribou and totalled 386,586 km^2 for the entire geographical population and 61,248 km^2 for the NWT only, including the sea ice. By excluding the sea ice, the biological area of occupancy becomes 300,401 km^2 for the entire geographical population and 53,211 km^2 for the NWT. The IAO was estimated as the surface area of 2 x 2 km grid cells that intersect the area of occupancy and totalled 391,292 km^2 for the entire geographical population and 64,168km^2 for the NWT, including sea ice. When sea ice is excluded, the IAO is 286,336 km^2 for the entire geographical population and 54,784 km^2 for the NWT.

Search effort

The qualitative effort to determine the species range in the NWT (on Victoria Island) uses data from systematic aerial caribou surveys that have taken place during 1980-2010, with transects that have covered most of the island (1980) or western or northwestern Victoria Island and the southern coast of the island (Table 4). The sheer size of Victoria Island (217,291 km^2) has imposed logistic restrictions and led to the emphasis on radio or satellite-collars rather than island-wide surveys (Gunn and Fournier 2000; Nishi 2000). The only systematic aerial survey

for almost the entire island (except Storkerson Peninsula and Stefansson Island) was flown in August 1980 using strip transects 1,000 m wide and flown at 120 m above ground level (agl), although the 4-6% coverage was low (Jakimchuk and Carruthers 1980). The three western strata of the 1980 survey held 92% of the caribou sightings.

The next and last extensive aerial survey covered western Victoria Island (about 63% of the total land mass) and was designed to map calving distribution (Nishi and Buckland 2000). Previous surveys to map calving distribution in 1987 and 1988 had not completely defined the calving distribution (inadequate coverage and poor weather; Gunn and Fournier 2000). The survey was flown in June 1994 at a uniform 10% coverage, 120 m agl flight height, and a 1,000 m strip width (Nishi and Buckland 2000). Subsequent aerial surveys were focused on north-west Victoria Island to track the abundance of the Minto Inlet population of Peary caribou (Nagy *et al.* 2009a, b, c; Davison *et al.* in prep.). Those aerial surveys (1998-2010) also included a portion of the northwestern summer ranges of the Dolphin and Union population based on satellite-collar locations for cows (Nagy *et al.* 2009a, b, c).

After 1994, the emphasis for aerial surveys shifted to measuring abundance during the fall staging along the south coast of Victoria Island and a survey in October 1997 (Nishi and Gunn 2004) was followed by one in October 2007 (Dumond and Lee 2013). During these surveys 10% (low density strata) to 20% (high density strata) coverage was completed using transect lines aligned perpendicular to the coast, using fixed wing aircraft flying at 100 m agl and 140-160 kph, with 500 m strip width on each side of the aircraft.

Other information on search effort to map distribution is based on unsystematic aerial and ground observations as well as the movements of radio and satellite-collared cows during 1987-89 (n = 9) and 1994-2006 (n = 60; Gunn and Fournier 2000; Nishi 2000; Poole *et al.* 2010, ENR WMIS unpubl. data 2011). The ground surveys included observations of caribou during late winter snowmachine surveys for polar bear dens on the islands off the east coast of Victoria Island in the mid-1980s (Gunn *et al.*1991a). Systematic aerial surveys were conducted near the proposed High Lake base metals mining development west of Bathurst Inlet during late winter and spring 2005-06, 2008, and 2012 (Wolfden Resources 2006; Poole unpubl. data 2012). These surveys documented Dolphin and Union caribou as far south as 20-25 km south of the James River in late March, closer to the coast in late April, and within 20 km of the coast and on coastal islands in late May.

A limited amount of information on the distribution of Dolphin and Union caribou was recorded during muskox (*Ovibos moschatus*) aerial surveys although typically they are flown at higher altitudes. Stefansson Island and Storkerson Peninsula were not surveyed during the first systematic survey for caribou in 1980 but were included in a systematic survey for muskoxen in August 1990 (Gunn and Lee 2000). The survey covered Storkerson Peninsula and the base of Hadley Bay. Four caribou were seen on the south end of Stefansson Island, as well as 13 caribou on the north end of Storkerson Peninsula and scattered southwest to Washburn Lake. An earlier

muskox survey of north-west Victoria Island east to Hadley Bay, in August 1983, does not mention caribou sightings (Jingfors 1985).

In the NWT, the systematic effort and extent of coverage make it unlikely that there are unexplored areas (at the scale of tens of km) that could harbour Dolphin and Union caribou. The negative data (areas searched and Dolphin and Union caribou not found) are available in the individual survey reports (see *Information Sources*). The scale of daily movements relative to the frequency of surveys makes it unlikely that any areas can be assumed not to be potential habitat.

Table 4. Years and coverage for Dolphin and Union caribou aerial surveys on Victoria Island, 1980-2010. Muskox surveys with caribou sightings recorded are also included.

Date	Survey coverage within study area (%)	Study area	Reference
1980	3-6	Entire island (except Storkerson Pen. and Stefansson Is.)	Jakimchuk and Carruthers 1980
Mar 1983	19.5	Southern Wollaston Pen. as far east as Richardson Is.	Poole 1985 (muskox survey)
Aug 1990	10	NE Victoria Is.	Gunn and Lee 2000 (muskox survey)
Jun 1994	10	Western Victoria Is.	Nishi and Buckland 2000
Oct 1997	10-20	South coast Victoria Is.	Nishi and Gunn 2004
Jul 1998	20	NW Victoria Is.	Nagy *et al.* 2009a
Jul 2001	20	NW Victoria Is.	Nagy *et al.* 2009b
Jul 2005	10-20	NW Victoria Is.	Nagy *et al.* 2009c
Oct 2007	11-20	South coast Victoria Is.	Dumond and Lee 2013
Jul–Aug 2010	20	NW Victoria Is.	Davison *et al.* in prep.

Distribution trends

Trends in Dolphin and Union caribou distribution as measured by aerial surveys are difficult to describe because the frequency of surveys is low since the first systematic survey in 1980 (Table 4), seasonal timing of surveys has changed from early or mid-summer to late fall, and the surveys do not cover the entire seasonal range. Measuring trends in distribution through the movements of satellite-collared caribou is limited by small samples and possible unrepresentative distribution of the collars. Trends in distribution, especially the extent of winter distribution, are expected as abundance has changed, and there is a likely relationship between abundance and distribution (based on barren-ground caribou where typically as abundance changes, distribution changes; Schmelzer and Otto 2003; Bergerud *et al.* 2008; Taillon *et al.* 2012).

Prior to the 1920s (summarized in Manning 1960), large numbers of caribou migrated in fall and early winter after rutting and staging along the south coast of Victoria Island, and crossed the sea-ice to the mainland. Some caribou remained and wintered on Victoria Island (the 'resident' population). As the migrants returned in spring to Victoria Island, they apparently rapidly migrated north and spread over the island.

The migration of Dolphin and Union caribou ended by the early 1920s, with an associated drop in abundance (Gunn 2008). Coinciding with that very marked change in abundance, there was a contraction in the winter range such that inter-island movements mostly ceased by the early 1920s as the caribou stopped crossing the sea-ice to the mainland coastal areas and wintered on Victoria Island (Manning 1960).

Although Figure 9 in Banfield (1950: 62) shows a small zone of fall migration crossing from the vicinity of Cambridge Bay to Kent Peninsula and the north coast of Elu Inlet, Manning (1960) suggests that those were barren-ground caribou, and that they were few in number and soon harvested. Banfield (1950) also maps a small patch of caribou summer range at the head of Prince Albert Sound and a narrow arrow representing spring migration from a winter range north of the Richardson Islands.

The abundance of Dolphin and Union caribou increased between the 1970s and 1997. A trend toward a southern extension of the winter range from central Victoria Island to the south coast (coinciding with an increase in abundance) and then the resumption of the sea-ice crossings and wintering on the mainland is recorded through observations by hunters in the mid-1970s and satellite-collared caribou (Gunn *et al.* 1997; Poole *et al.* 2010). In 1983, Poole (1985) reported relatively high numbers of caribou on the southwest coast of Victoria Island and estimated 1,290 ± 228 SD caribou. In 1987-88, the winter distribution of caribou included the length of the south coast (Gunn and Fournier 2000) based on unsystematic flights to find caribou for fitting satellite collars. By April 1994, caribou were still wintering on the coast south of Cambridge Bay but also on the mainland coast (Kent Peninsula and Melbourne Island) based on unsystematic flights to find caribou for fitting VHF collars (Nishi 2000).

Fall migration to the mainland by at least some Dolphin and Union caribou had resumed at least by 1976, with sightings on islands at the mouth of Bathurst Inlet (Gunn *et al.* 1997). In 1982, caribou were reported near Umingmaktok well into Bathurst Inlet and on islands within the Coronation Gulf (Gunn *et al.* 1997). In 1989, a satellite-collared cow crossed the sea-ice to the Jameson Islands at the opening of Bathurst Inlet (Poole *et al.* 2010). On, 2 June 1989, sightings on sea-ice during a single flight in this area revealed 46 caribou, mostly bulls and juveniles, and about 500 tracks (Gunn *et al.* 1997).

As winter distribution shifted further south to the mainland, the length of pre-calving migration became longer and more caribou were crossing the sea-ice. During a helicopter survey in May 1993, over 7,000 caribou had crossed or were crossing Coronation Gulf and Dease Strait (Gunn

et al. 1997). In 1993, caribou distribution ranged from Bernard Harbour on the mainland east to Cambridge Bay, and aerial systematic surveys estimated 2545 ± 142 SE caribou on Kent Peninsula in March 1993 and 719 ± 83 SE caribou on Melbourne Island in March 1994. Observations suggested that the pre-calving migration started in April and continued to early June. In May 1993, most of the caribou seen were cows, yearlings and a few young bulls. Observations in May 1994 also suggested that cows and yearlings preceded bulls in the spring migration. Those results fit with the historic observations reported by Manning (1960) before the migrations ceased in the 1920s.

Some Dolphin and Union caribou were recorded on the small islands in Victoria Strait in the 1980s, but there is insufficient information to determine if the use of the eastern islands was a shift in winter and summer distribution or whether it has persisted. The only information was based on polar bear denning surveys by snowmobile (Appendix B in Gunn *et al.* 1991a). In April 1984, 13 caribou were seen on Admiralty Island, apparently for the first time. In the following year, only tracks and feeding craters were seen. Inuit reported that caribou wintered on Jenny Lind Island at least during the 1980s. On Gateshead Island in April 1986, Gunn *et al.* (1991a) counted 85 caribou, which was considered to be an increase compared to previous years. They returned in July 1986, and counted 33 caribou including six calves and saw the shed antlers of bulls.

Radio-collar data demonstrate the changes in winter distribution (in Nunavut) between the late 1980s, when wintering was restricted to the southern portion of Victoria Island and a few islands near the mouth of Bathurst Inlet, and mid-1990s to mid-2000s, when wintering occurred only on the mainland (Fig. 9).

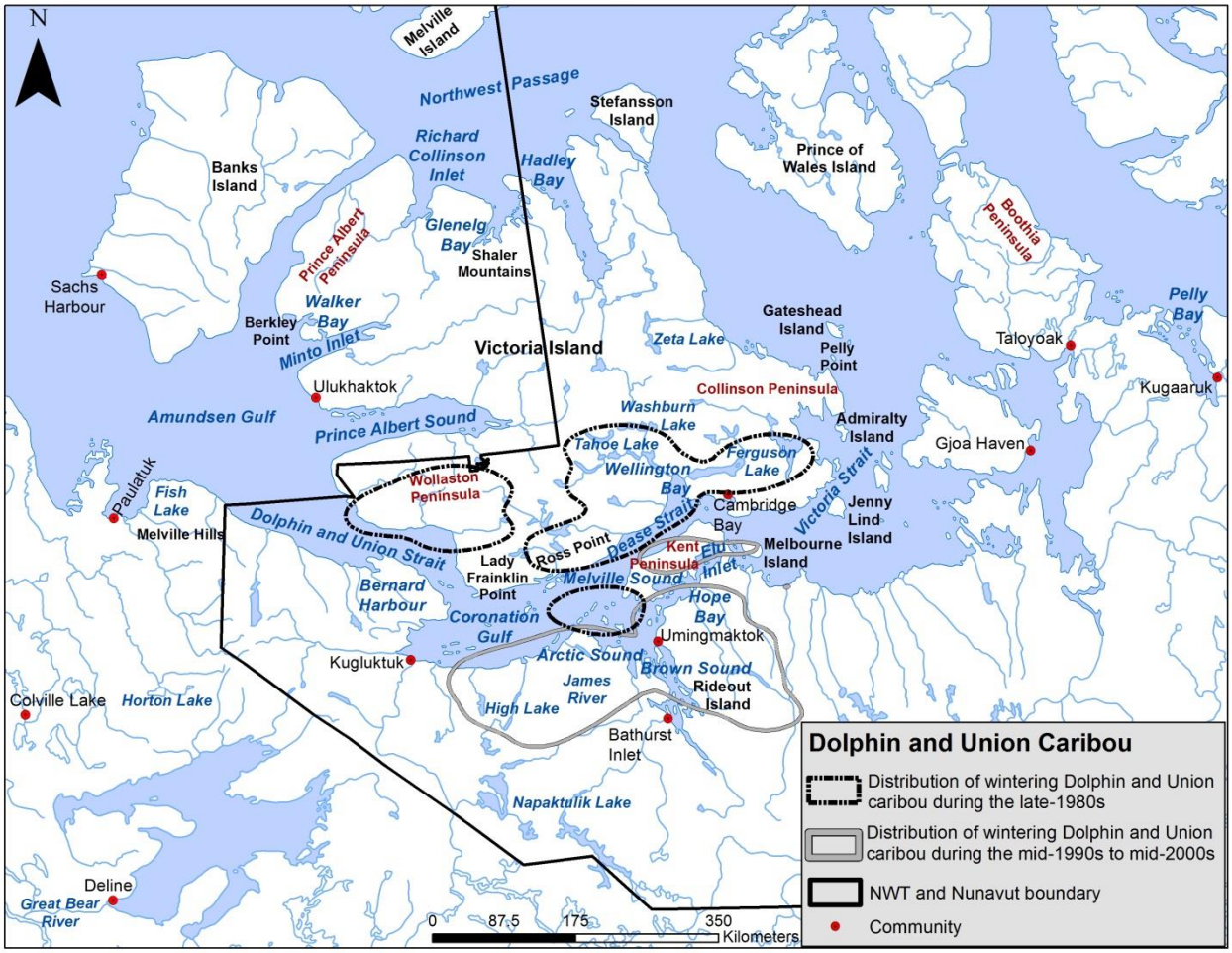

Figure 9. Distribution of wintering Dolphin and Union caribou during the late 1980s (dashed black line 90% fixed kernel polygons) and the mid-1990s to mid-2000s (dark grey polygon). Data from Poole *et al.* (2010).

Calving distribution also appears to have changed since the 1980s. In the late 1980s, satellite-collared caribou captured along the length of the southern coast migrated to a calving area on the Wollaston Peninsula (west central Victoria Island) with one cow calving on Collinson Peninsula (eastern Victoria Island) (Fig. 10), and either remaining on the Wollaston Peninsula or moving further north across central Victoria Island during the summer. By 1994-97, Nishi (2000) reported a more widespread calving distribution that overlapped slightly with the 1987-89 calving on Wollaston Peninsula and now was continuous across central Victoria Island including Collinson Peninsula and north to the Storkerson Peninsula (Fig. 10); these caribou had been captured in the Cambridge Bay and Kent Peninsula area. Collars deployed in 1996 and 2003 on northwest Victoria Island tended to calve further north on the island, while those captured in October 1999 along the south coast of Victoria Island calved across the island closer to the southern coast (Fig. 10). Thus, calving distribution appears to be affected to some degree by the areas sampled, rendering assessment of trends difficult.

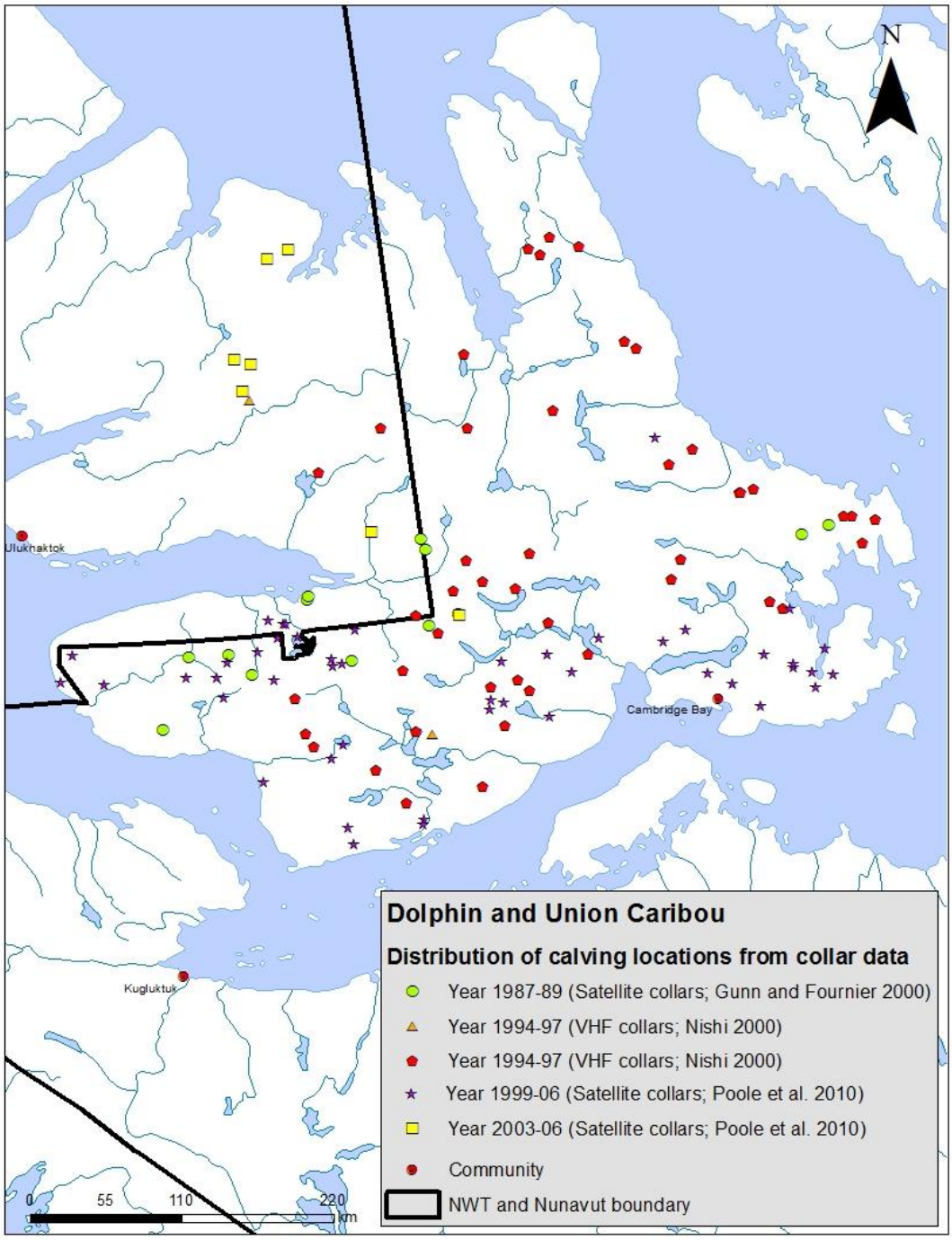

Figure 10. Distribution of calving locations from collar data from 1987-89 (green dots; satellite collars; Gunn and Fournier 2000), 1994-97 (orange triangles; VHF collars; Nishi 2000), 1994-97 (red octagons; VHF collars; Nishi 2000), 1999-2006 (purple stars; satellite collars; Poole *et al*. 2010) and 2003-06 (yellow squares; satellite collars; Poole *et al.* 2010).

The post-calving and summer distribution has also likely changed, at least between 1980 and 1994 in terms of the pattern of higher densities. In August 1980, caribou were concentrated at the

head of Prince Albert Sound and to a lesser extent around Richard Collinson Inlet on northwest Victoria Island (Jakimchuk and Carruthers 1980).This contrasted with the pattern of distribution in June 1994, which might have been partly an effect of the season as well as the reduction in the size of the Minto Inlet Peary caribou population at that time (Nishi and Buckland 2000). Densities were higher in the Shaler Mountains in June 1994. In July 1998 during aerial surveys of northwest Victoria Island, the numbers of caribou between Richard Collinson Inlet and Glenelg Bay (off Wynniatt Bay) were higher (433-583 non-calf caribou) (Nagy *et al.* 2009a) compared to the few caribou (only four in the entire known seasonal range of the Minto Inlet Peary caribou herd) observed in this area in June 1994 (Nishi and Buckland 2000).

Habitat

Habitat requirements

Dolphin and Union caribou habitat requirements are poorly understood and have not been fully assessed. As habitat is the sum of specific resources needed, it includes not just forage but habitat attributes related to reducing the risk of predation and parasitism (for example, habitat features to reduce exposure to oestrid fly harassment). Less is known about the predation and parasitism risks than how, for example, snow conditions affect forage availability for caribou in general. Information on vegetation types, cover and productivity from satellite imagery has been mapped at a regional scale for the Arctic including Victoria Island (Gould *et al.* 2003, Raynolds *et al.* 2012). Hughes (2006) found using NDVI satellite imagery that the summer productivity of vegetation for southern Victoria Island was annually variable and consistently less than for the mainland coastal winter ranges.

At the ecoregion scale, generalized descriptions of vegetation and terrain are available (Environment Canada 2012). The annual range of Dolphin and Union caribou is within the Northern Arctic Ecozone. The calving, summer and fall ranges on the northern two-thirds of Victoria Island fall within the Victoria Island Lowlands ecoregion. The upland vegetative cover is discontinuous, varies between 5-80% coverage and is dominated by prostrate dwarf shrubs including purple saxifrage (*Saxifraga oppositifolia*), *Dryas* spp., and arctic willow, along with alpine foxtail, wood rush, and other saxifrages. Poorly drained areas have a more continuous cover of sedge, cottongrass, saxifrage, and moss. The terrain is undulating lowlands (<200 m elevation) underlain by carbonate rocks. Along the east coast are more extensive wetlands dominated by sedge-moss tundra with higher average biomass than most of Victoria Island (Gould *et al.* 2003). Dolphin and Union caribou also use as post-calving and summer range the Shaler Mountains ecoregion, which has relatively rugged, steep-sided flat-topped hills reaching over 750 m elevation.

Typically, the approach to assessing forage habitat requirements is dependent on describing diet,

distribution of forage by vegetation types and the distribution of caribou feeding sites relative to plant phenology or snow conditions. This information is largely missing for Dolphin and Union caribou. The limited information available includes data on late winter diet based on collections of adult cows in late winters 1987-91 and fall 1992. The diet was mostly evergreen shrub leaves (*Dryas, Ledum*), sedges (*Carex* spp.) and willow (*Salix* spp.) typically of upland plant communities (Gunn unpubl. data 1992). In November 1992, the only year when early winter diet was sampled, caribou were feeding more on sedges but dwarf shrubs still dominated their diet with forbs, lichen and moss forming only a small fraction of the diet. The use of upland communities was also described by Schaefer *et al.* (1996) and Hughes (2006) based on the distribution of fecal pellets among vegetation classes on southeastern Victoria Island. In April – May 2004, Hughes (2006) compared the late winter diet of Dolphin and Union caribou on Victoria Island and on the mainland. Caribou on the island had higher proportions of *Dryas* spp, grasses and sedges compared to arctic heather (*Cassiope tetragonia*), lichen, shrub and twigs in their mainland diet. Dolphin and Union caribou have larger hind guts and stomachs than Norwegian reindeer which indicates an ability to digest coarse forage, but they are less adapted to coarse forage than muskoxen (Stalaand *et al.* 1997).

The fall range along the south coast of Victoria Island is within the Amundsen Gulf Lowlands ecoregion. The dwarf tundra vegetation tends to be more continuous cover than central and northern Victoria Island with erect shrub vegetation, dwarf birch, willow, northern Labrador tea, *Dryas* spp., and *Vaccinium* spp. with willow and sedges dominating moist sites.

A Resource Selection Function analysis was conducted in conjunction with the proposed High Lake mineral development assessment process using data from collared female Dolphin and Union caribou from 1999-2004 (Wolfden Resources 2006). This assessment was restricted to winter distribution on the mainland, and used the Ecological Land Classification (ELC) developed for much of the Slave Geological Province (SGP) (Matthews *et al.* 2001). The following cover classes were rated as high suitability for Dolphin and Union caribou: non-tussock sedge, tussock sedge, riparian tall shrub, and low shrub. Heath bedrock/boulders and lichen veener were rated as moderate suitability, and heath tundra and bedrock/boulders were rated as low suitability.

Some parallels for habitat requirements for Dolphin and Union caribou can be drawn from Peary caribou such as on Banks Island (Larter and Nagy 2001a, b, c). There, habitat requirements during the snow-free season appear to be tied to how terrain and snow melt conditions allow caribou to select for flower and leaf buds and newly emerged leaves and flowers (Larter and Nagy 2001b). Peary caribou select leaves and flowers such as purple saxifrage and arctic poppy (*Papaver radicatum*) to maximize protein intake. Terrain (slope and aspect) affect the snow conditions and timing of snow melt, which consequently affect the availability of forage and the energetic costs of the caribou foraging through the snow (Larter and Nagy 2001a). Consequently, a key habitat requirement is terrain and vegetation features that offer choices as caribou adjust

their foraging to changing snow conditions.

Maxwell (1980, 1981) has described the climate at a broad scale, based on two coastal weather stations and knowledge of the large-scale circulation patterns. Maxwell (1981) reported that three climate regions cover Victoria Island. Northern Victoria Island is within the influence of the Arctic Ocean but modified by the effect of multi-year ice to be cold with a relatively short season of annual plant growing degree days (Table 5). Central and eastern Victoria Island has a continental climate similar to the adjacent mainland and is relatively dry and has highly variable seasonal temperatures. Maritime air masses from the northern Pacific and southern Beaufort Sea modify the climate in western Victoria Island, which receives more precipitation and cloudiness.

Table 5. General climatic characteristics of Victoria Island (Nishi and Buckland 2000), based on Maxwell 1980, 1981.

Region	Winter (B: Begins, E: Ends)[a]	Mean annual thawing degree-days [b]	Mean annual growing degree-days [c]
Northwestern – Western Parry Channel	B: Aug 20-25 E: June 10-25	400-600	50-100
South-central – Victoria Island-Boothia Pen.	B: Aug 25- Sep 15 E: June 5-15	500-600	100-200
Western	B: Aug 30- Sept 5 E: May25	500-600	100-200

[a] Winter defined as time when mean daily temperature <0°C.
[b] Mean annual totals of degree-days >0°C based on the period 1941-70.
[c] Mean annual totals of degree-days >5°C based on the period 1941-70 (an indicator of total heat available for plants during the growing season).

Habitat availability

Habitat availability is usually assessed as resource abundance, although the term relates more to the accessibility of those resources (Krausman 1999). For Dolphin and Union caribou, there has been no assessment of either habitat requirements or availability. The question of whether there are areas of the NWT that appear to have available habitat but are not occupied by the species is covered in the section on *Distribution trends*. The influence of caribou themselves or muskox numbers on the availability of habitat is covered in the section on *Interactions*.

Habitat fragmentation

On Victoria Island, there are no obvious sources of human activity likely to have imposed habitat fragmentation at a scale that alters dispersal or movements. Two major mining exploration projects are located in core Dolphin and Union caribou winter range on either side of Bathurst Inlet and, should they move forward, could result in impacts to habitat, including fragmentation. As of late 2012, the development in the Hope Bay area has been on extended shut-down, but new management in 2013, TMAC Resources, is now pushing for production. The exploration in the High Lake area west of Bathurst Inlet currently has little temporal overlap with Dolphin and Union winter range (restricted to activities in April and May). Thus mineral developments on the mainland winter range could lead to fragmentation, or at least effects on movements, but currently these impacts are likely low. However, these projects and others could lead to the potential for fragmentation once fully engaged. Data are currently lacking to assess impacts, and monitoring often is inadequate to measure demographic effects.

In terms of natural habitat fragmentation such as plant succession or natural disturbances that change the patterns of habitat, there are almost no descriptions or studies available on the spatial variability of forage for Victoria Island. An exception is Schaefer and Messier (1995) who examined the relationship between snow and the underlying vegetation, concluding that correlation coefficients between single species coverage and thickness of snow-cover generally increased with increasing scale (size of sampling units) from 1-1,000 meters.

An important potential type of habitat fragmentation is the effect of ship traffic on the sea-ice crossed during fall migration. These points are covered in the section on *Threats and Limiting Factors*.

Habitat trends

Changes in habitat (including changes in vegetation community composition and the amount and timing of plant growth) are likely as the effects of climate change are pronounced in the Arctic (IPCC 2007). There is evidence for warming temperatures in the range of the Dolphin and Union caribou. Summer temperatures on northwestern Victoria Island have been warmer over the last several decades (Peros and Gajewski 2008), and warming fall temperatures (and associated delays in sea-ice formation) have been recorded at Cambridge Bay and Lady Franklin Point (Poole *et al.* 2010). However, there is almost no assessment of trends in caribou habitat. In the western continental Arctic, as summer temperatures have increased plant productivity has also increased (Callaghan *et al.* 2005; Hudson and Henry 2009).

Between 1948 and 2008, mean fall temperatures along the south coast of Victoria Island have increased (Poole *et al.* 2010). This has occurred at the same time as a trend between 1982 and 2008 for sea-ice to form an average 10 days later (Poole *et al.* 2010). This trend toward later sea-ice formation not only affects the sea-ice habitat for fall migration but may have implications for

a longer duration of staging along the south coast as the caribou wait for sea-ice to form (Poole *et al.* 2010). Any local trends in forage availability as a result of longer staging are unmeasured.

Other habitat trends related to changes in caribou abundance or other herbivores and human activity are described in *Threats and Limiting Factors*.

Biology

Life cycle and reproduction

Dolphin and Union caribou life-history strategies are likely similar to barren-ground caribou in the sense that accessibility of forage affects a caribou cow's body condition which, in turn, determines the age of first pregnancy and the annual likelihood that a cow will conceive (Thomas 1982; Gerhart *et al.* 1997). Barren-ground caribou usually calve at 3 years of age, although under high forage availability and a corresponding high rate of body growth, cows can calve at 2 years of age (Thomas 1982). The reproductive lifespan is likely about 12 years as caribou are relatively long-lived. Hughes (2006) reported that harvested Dolphin and Union caribou cows were 1.8 years to 13.8 years with a mean age of 6.5 years. The average number of offspring per female has not been measured. Under high forage availability, cows can have a single calf every year. They can cope with occasional years of restricted forage access either by not becoming pregnant, or by weaning a calf prematurely, as lactation uses the cow's protein reserves. Annual variation between condition of individual cows and productivity may be high (Moyes *et al.* 2011).

Adult survival for ungulates, especially females, is relatively high (Gaillard *et al.* 2000) unless predation or harvest rates are high. The trend in population size is especially sensitive to even small changes in adult female survival (Boulanger *et al.* 2011). The few data for Dolphin and Union caribou are described in the section on *Structure and Rates*.

Annual movement patterns for Dolphin and Union caribou are broadly similar to barren-ground caribou in that there are pre-calving and fall migrations between seasonal ranges. However, there are two differences that likely reflect both snow conditions and forage availability. Although pre-calving migration is relatively gregarious (groups of dozens of cows), calving is dispersed over much of central Victoria Island east to the eastern coast. This is based on satellite-telemetry (during 1987-89 and 1992-2006), radio-collars tracked by aircraft during calving (1994-96) and an aerial survey (1994) (Gunn and Fournier 2000; Nishi 2000; Nishi and Buckland 2000). At a finer geographic scale, if Dolphin and Union caribou are similar to Peary caribou, calving sites likely provide snow-free or shallow snow-covered sites, at least shortly before and during calving each year (Urquhart 1973; Miller *et al.* 1977). Annual fidelity for calving sites by individuals in successive years appeared to be at the scale of 10 to hundreds of kilometres (Nishi

2000).

Based on information from satellite-collared caribou and aerial surveys (Nishi and Gunn 2004; Poole *et al.* 2010; Dumond and Lee 2013), Dolphin and Union caribou reach the south coast of Victoria Island in the fall and stage there waiting for freeze-up. The duration of staging is shorter when the caribou have travelled further from their summer ranges on northern Victoria Island (Poole *et al.* 2010). The timing of fall migration and staging in mid-October suggests the rut occurs during either migration or staging. It is uncertain whether annual variations in the timing of calving from early to mid-June (Gunn and Fournier 2000, Nishi 2000) reflect the annual variation in the timing of the rut and/or the condition of the cows during pregnancy.

The breeding strategies of Dolphin and Union caribou are unknown other than the fact that it is typical for a caribou bull to mate with more than one cow (Mysterud *et al.* 2003).

Physiology and adaptability

The physiology and adaptability of Dolphin and Union caribou has not been specifically studied. Although they are adapted to extreme cold, their tolerance of heat is unknown. Like all caribou, Dolphin and Union caribou have relatively broad hooves for their body mass (Manning 1960), which is likely an adaptation to their forage being covered in snow for 8-9 months a year. Their molariform tooth row is relatively long for their skull size (Manning 1960), which may be an adaptation for relatively sparse vegetation and possibly higher levels of natural wind-blown dust on the forage.

Dolphin and Union caribou likely adapt to varying forage availability through their foraging strategies, which include local or long-distance movements and migrations when winter snow and ice conditions are exceptionally restrictive. Those movements include crossing the sea-ice to reach mainland winter ranges characterised by a higher amount of vegetation (Hughes 2006) and more varied terrain and snow conditions.

Interactions

Interactions with other herbivores

Dolphin and Union caribou share their ranges with muskoxen as well as four types of smaller-bodied herbivores: Arctic hare (*Lepus arcticus*), ptarmigan (*Lagopus* spp.), and lemming (*Dicrostonyx groenlandicus*, *Lemmus trimucronatus*). Numbers of these smaller herbivores fluctuate on the Arctic Islands. At least on southeast Victoria Island during winter in the mid-1990s, hares, ptarmigan and muskoxen tended to have patterns of habitat use distinct from caribou using the uplands (Schaefer *et al.* 1996). However, it is uncertain how or under what conditions the smaller-bodied herbivores affect caribou foraging or, as alternative prey, sustain

predation on caribou.

Across the Arctic, interactions between caribou and muskoxen are a controversial topic and opinions differ whether and under what conditions caribou and muskoxen compete for space and/or forage, or influence each other's parasite and predator relationships (summarised in Larter *et al.* 2002; Gunn and Adamczewski 2003). Muskox abundance has increased on Victoria Island during the 1980s and 1990s. On southeastern Victoria Island, numbers increased from 3,300 ± 345 SE in 1983 to 18,290 ± 1,100 muskoxen in 1999 (Gunn and Patterson 2012).

Muskox use of plant communities during the period of increasing abundance appears to have changed on southern Victoria Island. In the mid-1990s, Schaefer and Messier (1994, 1995) reported muskoxen foraged more in the lower-lying sedge and willow communities and, during snow-melt, in the upland drier communities. By 2003, muskoxen appeared to be feeding in all communities (Hughes 2006), including feeding on sedges, which are also used by caribou. Overlap in diet and habitat use is not evidence for a competitive relationship, although overlap increases the possibility. Dolphin and Union caribou and muskoxen share several species of gastro-intestinal nematode worms, which suggests a potential for cross-transmission between the two (Hughes *et al.* 2009).

Predation

Wolves (*Canis lupus*) are the primary predators of Dolphin and Union caribou, although grizzly bears (*Ursus arctos*) likely also take some caribou. There is no direct information on predation rates. The only information to index predation is sightings of wolves during aerial surveys for caribou and muskoxen (Table 6), and the wolf sightings from ground-based field researchers. Aerial survey sightings suggest wolf numbers have increased since the mid-1990s. Miller and Reintjes (1995) compiled wolf sightings from field researchers from across the Arctic. For Victoria Island, wolves were only seen during 5 of 101 weeks of fieldwork during 1987-90. This was lower than for Banks Island, where wolves were observed during 50 of 189 weeks of field work from 1974-90.

The seasonal survival of adult Dolphin and Union caribou cows that had been fitted with satellite collars during 1999-2006 (Poole *et al.* 2010) indicated a lower survival rate during mid-to late winter on the mainland coast, which was likely associated with predation (Patterson unpubl. data 2002).

Table 6. Summary of wolf observations during aerial surveys for caribou and muskoxen, Victoria Island, 1959-2010.

Date	Location	Observation	Reference
1959	Tahoe Lake 9930 km^2 surveyed	Wolf heard howling No wolves sighted	Macpherson 1961
Jun 1987, 1988	Western and central Victoria Is.	No wolves sighted	Gunn and Fournier 2000
Jun 1994	Western Victoria Is.	No wolves sighted	Nishi and Buckland 2000
Jun 1994-97, Oct 1994, 1997	Southern and central Victoria Is.	No wolves sighted	Nishi 2000
17-22 Oct 1997	Southern Victoria Is.	No wolves sighted	Nishi and Gunn 2004; Nishi pers. comm. 2012
15 Jul-15 Aug 1998	Northwest Victoria Is. (range of Minto Inlet Peary caribou)	1 pack of 5 wolves	Nagy *et al.* 2009a
16-21 Jul 2001	Northwest Victoria Is. (range of Minto Inlet Peary caribou)	11 wolves	Nagy *et al.* 2009b
6-8 Jul 2005	Northwest Victoria Is. (range of Minto Inlet Peary caribou)	12 wolves (10 on Peary caribou range)	Nagy *et al.* 2009c
24-30 Oct 2007	Southern Victoria Is.	11 wolves in 2 packs	Dumond pers. comm. 2012b
28 Jul-15 Aug 2010	Northwest Victoria Is. (range of Minto Inlet Peary caribou)	18 wolves (13 on Peary caribou range)	Davison *et al.* in prep.

Parasites and disease

Trends and current conditions of parasites and diseases are largely unknown, although they may cause individual effects or sub-clinical effects. Effects at the population level may have been mostly under-estimated in wildlife ecology (Gunn and Irvine 2003). Elsewhere for caribou and specifically for caribou on Arctic islands, there is increasing recognition that parasites can influence host body condition and fat reserves and pregnancy rates (Albon *et al.* 2002; Hughes *et al.* 2009). For example, high levels of gastro-intestinal round worms depress pregnancy rates in Svalbard reindeer (Langvatn *et al.* 1999), probably through a combination of effects including reduced forage intake.

Only a few instances of parasites – *Besnoitia* and cystocercus (tissue infection after exposure to eggs of *Taenia* spp) – were detected during examination for parasites from 62 caribou collected during 1987-90 on southern Victoria Island (Gunn *et al.* 1991b). Kutz *et al.* (2012) updated the identification of gastro-intestinal nematodes and the continued presence of *Besnoitia*.

In 79 Dolphin and Union caribou cows sampled during 1987-90, the number of warbles varied among years (Fig. 11) and for March-April averaged 33 per cow (range 0-215) (Gunn et al. 1991b), which was markedly lower than the average numbers seen in barren-ground caribou

(Thomas and Kiliaan 1990). Depth of back fat also differed widely between 1987 and 1988-90 (Fig. 11) (Gunn et al. 1991b). In a separate study, Hughes (2006) examined 72 Dolphin and Union cows collected on the mainland winter range east of Kugluktuk during April 2001-03, and found higher numbers of warbles compared with the late 1980s, and variable back fat depths (Fig. 11).

There have also been three fall collections of Dolphin and Union caribou. In November 1992, eight adult cows had 22 mm average back fat (no warbles recorded; CARMA 2012) in contrast to November 1993, when back fat of 11 adults averaged 2.6 mm and warbles averaged 56 (range 0-140) (CARMA 2012). Nishi (2000) reported that the number of warbles in eight cows collected October 1997 averaged 197 (range 48-450) and back fat averaged 22.7 mm.

Hughes (2006) suggested that as warble numbers increased, the depth of back fat decreased and high burdens of warble larvae significantly reduced the probability of being pregnant. However, based on review of the two spring studies (Gunn et al. 1991b; Hughes 2006) (Fig. 11) and the three fall studies (CARMA 2012; Nishi 2000), it is not possible to determine whether this suggestion holds any weight.

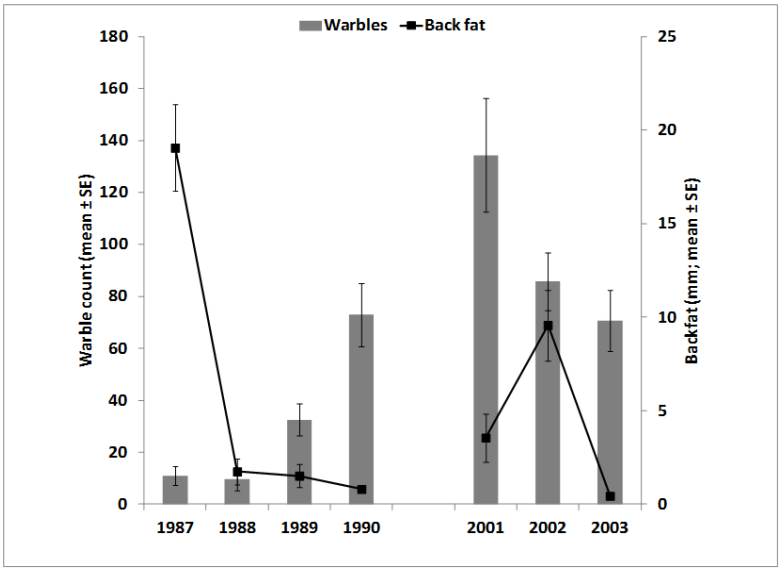

Figure 11. Warble counts and back fat depth ($\overline{x}$ ± SE) from April collections of Dolphin and Union cows (1987-90: Gunn *et al.* 1991b; 2001-03: Hughes 2006).

Increasing nematode burden did correlate with a significant decrease in Dolphin and Union caribou body weight (Hughes 2006). Hughes (2006) described a weaker relationship between body mass and worm burden in pregnant cows and suggested that there may be trade-offs as some cows with a high parasite burden become pregnant while those maintaining a lower parasite burden were unable to reproduce, suggesting some cost to the expulsion of parasites.

To determine changes in insect harassment with climate change over time, trends in warble

indices were derived from MERRA (Modern Era Retrospective-Analysis for Research and Applications) weather data and calculated for the summer range of Dolphin and Union caribou (CARMA 2012). Oestrid indices were calculated from temperature and wind algorithms after Russell *et al.* (1993). Maximum warble index and length of warble season (from first onset of oestrid index based on weather parameters to the first 3 days of negative minimum temperatures in last summer and early fall – the point when warble harassment was assumed to have been diminished) were plotted. Although data were annually variable and linear regressions produced weak correlations with year ($r^2 < 0.02$), cumulative warble index and length of warble season increased on average 7% and 2% per decade, respectively, between 1979 and 2009 (Fig. 12). In recent years peak values in warble index occurred in the last half of the 1990s and in 2006-07.

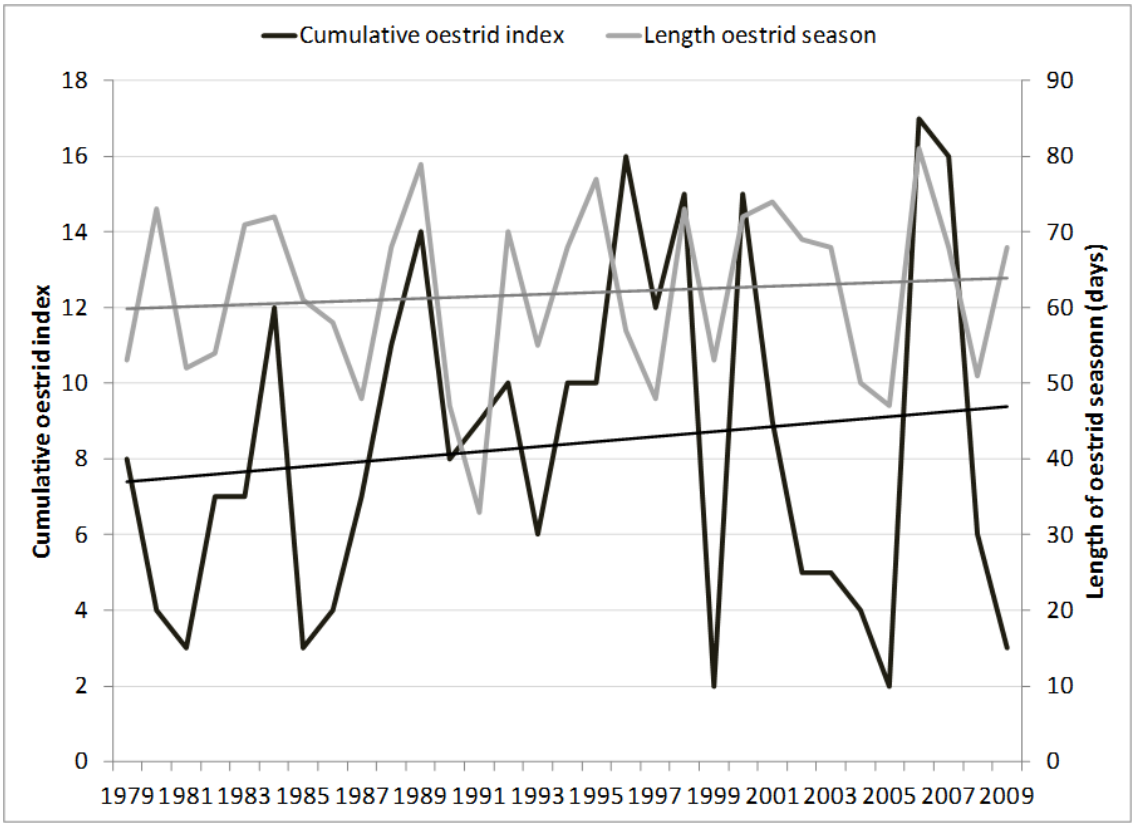

Figure 12. Cumulative oestrid index and length of oestrid season calculated from MERRA weather data (CARMA 2012). Linear trends are provided although regressions produced weak correlations with year ($r^2 < 0.02$).

There is limited evidence for Dolphin and Union caribou being exposed to brucellosis although the bacterial disease was found in two individual muskoxen on western Victoria Island in 1996 (near Minto Inlet) and 1998 (near the Ekalluk River) (Elkin pers. comm. 2011). A few unconfirmed reports (visual symptoms only) are available for brucellosis in Dolphin and Union caribou (Dumond, pers. comm. 2012b).

Population

Structure and rates

Generation time is estimated to be seven-nine years (COSEWIC 2004; Boulanger pers. comm. 2011). COSEWIC (2004) assumed a generation time for Peary caribou of seven years (thus three generations is approximately 21 years), but the basis for this was not provided. Boulanger (pers. comm. 2011) assumed a generation time of eight-nine years for Bathurst caribou based on adult survival and fecundity. Calculation of generation time involves several steps (Hernandez-Suarez 2011), and depends on the age structure and average age of the population.

In other long-lived mammals, the importance of age structure is well recognized (Festa-Bianchet *et al.* 2003; Coulson *et al.* 2004). The existence of variability in age classes (cohorts – animals born in a given year [Caughley 1977]) for Dolphin and Union caribou is likely because of the annual variations in productivity (Hughes 2006; CARMA 2012). Age structure influences rate of change in caribou populations and the probability of persistence, but there are few data or population models to assess the age structure for Dolphin and Union caribou as it depends on age-specific rates of survival and productivity, which are mostly lacking. In other caribou populations, shifts in age structure can accelerate rates of decline and influence recovery (Eberhardt and Pitcher 1992; Tyler *et al.* 2008).

The maximum rate of increase for Dolphin and Union caribou is likely similar to other caribou and could allow their numbers to double every 3 years under conditions of maximum productivity and survival (Heard 1990). Rate of change for a population is the outcome between recruitment into the breeding population and mortality (assuming emigration and immigration are minimal). Recruitment to breeding age is indexed by productivity, which is the sum of pregnancy rate and calf survival. Calf survival depends partially on the calf's body size, which reflects the cow's condition during pregnancy and lactation.

Pregnancy rates for Dolphin and Union caribou were measured from adult cows collected annually or observed and assessed for pregnancy status by seeing hard antlers or a calf at heel during calving surveys (Figure 13). Pregnancy rates in 2001-03 (56%; n = 82) appear to be lower than rates in the 1980s and 1900s (84%; n = 110). Annual variation is high and between 1987 and 1997 pregnancy rate appears to vary between higher and lower in alternate years (Figure 13).

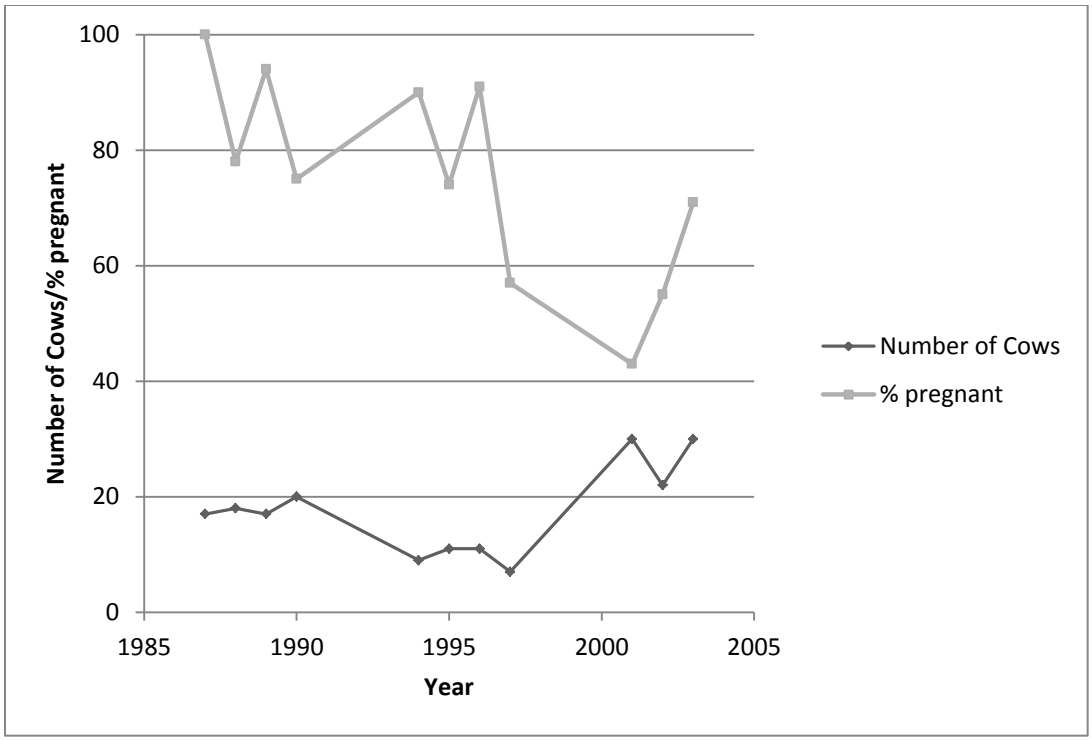

Figure 13. Pregnancy rates based on adult cows collected 1987-90 (CARMA 2012) and 2001-03 (Hughes 2006) and observed 1994-97 (Nishi 2000).

Calf survival rates are mostly unknown or based on small and infrequent samples. Nishi (2000) reported that of the five collared cows with calves in June 1997, three still had their calves in October 1997. Reports on sex ratios were not available.

Mortality is difficult to measure unless a large sample of individuals is marked and their fate determined; this information is available for two periods on Victoria Island. Nishi (2000) deployed 20 VHF radio-collars in April 1994 and searched for them in June and October 1994-97. The radio-tracking was across large areas of Victoria Island and so would not have detected mortalities on the mainland winter ranges. Nishi (2000) found that mortality among the 20 VHF collared caribou varied among the 4 years (0%; 33%, 0% and 20%). The fates were unknown except one cow was harvested. From 25 cows fitted with satellite collars in 1999 and 2001, the overall survival rates were relatively low as the annual survival for the adult cows was 76% (1999 – 2006) (generally, anything lower than 90% survival is considered low (Larter pers. comm. 2013)) and was lowest during fall migration and mid- to late winter (Poole *et al.* 2010). The annual details indicated that no caribou died during fall 1999 and pre-calving migrations 2000, but five caribou died during the 1999-2000 winter: one was harvested and four were possible wolf predation. In fall 2000, one collared cow may have died breaking through the ice and in fall 2001, five collared cows died while crossing the newly formed sea-ice (Patterson unpubl. data 2002). Details on mortalities in subsequent years are not available.

Another cause of death is malnutrition, which claimed two of ten collared cows that died during February 1988, which was also the same winter when Cambridge Bay hunters reported freezing rain in early winter and caribou dying along the coast. Gunn and Fournier (2000) followed up on the reports in August 1988 and found 28 caribou carcasses west of Cambridge Bay judged to be from the preceding winter, 23 of which appeared to have been malnourished.

During the late October 2007 systematic aerial survey on the south coast of Victoria Island, surveyors observed three drowned caribou, 15 kill sites and two caribou dead from unknown causes (Dumond pers. comm. 2012a). No dead caribou were documented during the October 1997 survey (Nishi and Gunn 2004).

Movements

The relationship between abundance and the extent of migration is a significant gap in current understanding of Dolphin and Union caribou ecology. Migration is the regular, usually seasonal, movement of all or part of an animal population to and from a given area. For Dolphin and Union caribou, the length of pre-calving and fall migration has changed during the 20th century. This is also typical for barren-ground caribou, despite the energetic costs of moving a greater distance (Bergerud et al. 2008; Couturier et al. 2009). Reasons for migration between spatially distinct seasonal ranges are complex and likely involve access to higher abundance or quality of forage (McCullough 1985; Hughes 2006), or to reduced risk of predation (Fryxell and Sinclair 1988) or parasitism (Folstad *et al.* 1991; Hughes 2006). Interaction between those general causes is also a possibility, such as trade-offs between predation risk, parasitism risks and forage availability. Hughes (2006) documented that fall migration to the mainland winter ranges was to areas with higher plant biomass. Those areas also likely have quite different forage availability due to snow conditions than on Victoria Island, as the climate as measured at Kugluktuk and Cambridge Bay differs. Cambridge Bay tends to be windier (mean average wind 21.2 kph versus 16.1 kph), drier (mean annual precipitation 138.8 mm versus 249.3 mm) and colder (mean annual temperature –14.4°C versus –10.6°C) than Kugluktuk (Environment Canada 2011).

However, unlike most barren-ground caribou, calving is less gregarious and the cows disperse over a relatively large area to calve (Nishi 2000). This may be related to a relatively low density of predators and a low vegetation biomass. The biomass range for central Victoria Island is 100-500 g m^{-2} (above ground) compared to 1,000-4,000 g m^{-2} for the range of the larger barren-ground populations (Gould *et al.* 2003).

Dolphin and Union caribou could potentially disperse to neighbouring islands (Banks, Melville or Prince of Wales islands), which are currently the range of Peary caribou. This dispersal is possible because sea-ice connects the islands for most of the year. However, almost nothing is known about dispersal in Dolphin and Union caribou. Dispersal is usually classified as innate or environmentally forced, directional movement (as opposed to migration). Environmentally-

forced dispersal could relate to forage inaccessibility due to high densities or imposed by icing and snow conditions. There is an indication of environmentally-forced dispersal during severe winters for Dolphin and Union caribou, such as the 1984 shift from eastern areas including Collinson Peninsula to central wintering areas (Gunn *et al.* 1991a).

Neither immigration nor emigration rates are currently known. The Dolphin and Union population is likely self-sustaining in the sense that it does not depend on immigration and it is a separate ecotype from neighbouring Peary and barren-ground caribou. The geographically nearest source of colonists would be the Minto Inlet population of Peary caribou on northwest Victoria Island, which is currently at low numbers (Davison *et al.* in prep.).

To the south on the mainland, barren-ground caribou occasionally overlap on the winter range with Dolphin and Union caribou (Gunn, unpubl. data 1985; Calef and Hubert 2002). Some barren-ground caribou may move with the Dolphin and Union caribou to the summer range on Victoria Island. One satellite-collared caribou, a presumed Dolphin and Union caribou, caught 100 km east of Kugluktuk in March 2001 and on the western portion of the Dolphin and Union mainland winter range, subsequently travelled within the range of the Bluenose East population for the next 3 years, including movements near Horton Lake and along the Great Bear River west of Délı̨nę. During a helicopter survey in May 2003 on the mainland coast between Kugluktuk and east of Hope Bay, three mainland-looking cows were observed among 620 classified Dolphin and Union caribou cows (approx. 0.5%) (Dumond, unpubl. data 2012).

Abundance

The first estimates of abundance for Dolphin and Union caribou were suggestions for the numbers of caribou crossing the Dolphin and Union Strait early in the 20th century, and ranged between 100,000 and 200,000 (Anderson 1922; Manning 1960). Given the large area of Victoria Island (217,291 km^2), and halving the overall density reported for barren-ground caribou, Manning (1960) proposed one caribou per square mile (0.40 caribou/km^2) as not unreasonable and extrapolated to 100,000 animals in the early 20th century (Fig. 14). However, given that this estimate included caribou that wintered on Victoria Island that were not thought to be numerous, as well as the migrant caribou, the estimate of 100,000 animals is likely unrealistically high.

By the early 1920s, numbers declined and migration across the Dolphin and Union Strait ceased. The causes were possibly a combination of icing storms and the introduction of rifles (Manning 1960; Gunn 1990). Banfield (1950) gives a population estimate of 1,000 for a ‘Victoria Island herd’, with the summer distribution shown around Prince Albert Sound, which indicates that this number would largely have consisted of Dolphin and Union caribou (Fig. 14). Macpherson (1961) compiled sightings by geologists during unsystematic flights on Victoria Island in 1958 and 1959 and estimated 671 caribou based on observed densities during 18,500 km of transects (Fig. 14). These animals were considered part of the relict migratory herd identified by Manning

(1960) as Dolphin and Union caribou.

The subsequent estimates of abundance for Dolphin and Union caribou were based on caribou counted on strip transects during systematic aerial surveys. In 1980, most of the island was surveyed (Jakimchuk and Carruthers 1980) and 7,936 ± 1,118 caribou were estimated (estimate likely included calves). This includes northwest Victoria Island, which is the seasonal range of the Minto Inlet population of Peary caribou. The estimate for northwest Victoria Island in 1980 was 4,512 ± 988 non-calf caribou and that estimate likely includes mostly Minto Inlet caribou based on caribou distribution. Removing the estimate of Peary caribou from the total estimate of caribou numbers on Victoria Island would leave just under 3,500 Dolphin and Union caribou on Victoria Island in 1980 (Fig. 14).

The next systematic survey covered western and central Victoria Island in July 1994 (Nishi and Buckland 2000) and the estimate was 14,500 ± 1,015 (SE) non-calf caribou. The stratum boundary (Stratum IV) for northwest Victoria Island was further west than in 1980 and likely was more representative of the range of the Minto Inlet Peary caribou population based on satellite telemetry. Only four caribou (likely Minto Inlet Peary caribou) were observed on-transect in Stratum IV and the estimate was 39 ± 28. The total estimate for the remaining area was an under-estimate as the survey area, for logistical reasons, did not include eastern Victoria Island where six of the 20 radio-collared cows were found immediately after the survey (Nishi and Buckland 2000; Nishi 2000). Assuming a simple correction for collars located outside of the census zone (14,500 x (20/14) = 20,714), the resulting Dolphin and Union population estimate would be roughly 20,700 non-calf caribou (Fig. 14).

A series of systematic aerial surveys in 1998, 2001, 2005 and 2010 covered northwest Victoria Island and led to estimates for portions of the Dolphin and Union population based on the satellite collar locations (Nagy *et al.* 2009a, b, c; Davison *et al.* in prep.). Although the mean estimates for 1998–2010 varied between 400 and 1,000 caribou and declined from 2001, it is uncertain if this indicates annual variation in summer distribution or a trend in reduced abundance.

The realization by the late 1990s that a large proportion of the Dolphin and Union population were staging along the south coast of Victoria Island in October led to timing an aerial survey during that time, as the survey area would be relatively small compared to the size of Victoria Island (Nishi and Gunn 2004). In October 1997 there were estimated to be 27,948 ± 3,367 (SE) caribou within the census zone based on an aerial survey along the south coast while the caribou were staging in preparation for crossing to the mainland (Nishi and Gunn 2004) (Fig. 14). The survey area likely included most caribou as immediately prior to the survey, nine of the 12 VHF radio-collars were located. The three collars whose radio signals were not heard also had not been heard in late June 1997 (Nishi and Gunn 2004), which means it is uncertain whether they were alive and available for monitoring. The mainland winter ranges had not been covered during the radio-tracking so winter mortality of the radio-collared caribou would not have been

detected.

In a similarly designed survey in October 2007, Dumond and Lee (2013) estimated 21,753 ± 2,343 (SE) caribou within the census zone along the south coast of Victoria Island (Fig. 14). Dumond and Lee (2013) assumed that not all caribou had migrated to the coast and consequently they derived a correction factor for their estimated population size. Dumond and Lee (2013) used the distribution of satellite-collared cows during late October 2000-02 to derive a probability for caribou to be within the 2007 survey area. This probability (0.81) was used to correct the 2007 survey estimate and increase it to 27,787 ± 3,613 (SE). Dumond and Lee (2013) also applied a similar correction based on the 2000-02 satellite collars to the 1997 estimate to account for caribou assumed to be outside of the census zone, and estimated 34,558 ± 4,283 (SE). Dumond and Lee (2013) concluded the population trend between 1997 and 2007 was "at best stable" as no statistically significant decline was detected (two-tailed z = 1.51, *P* =0.13).

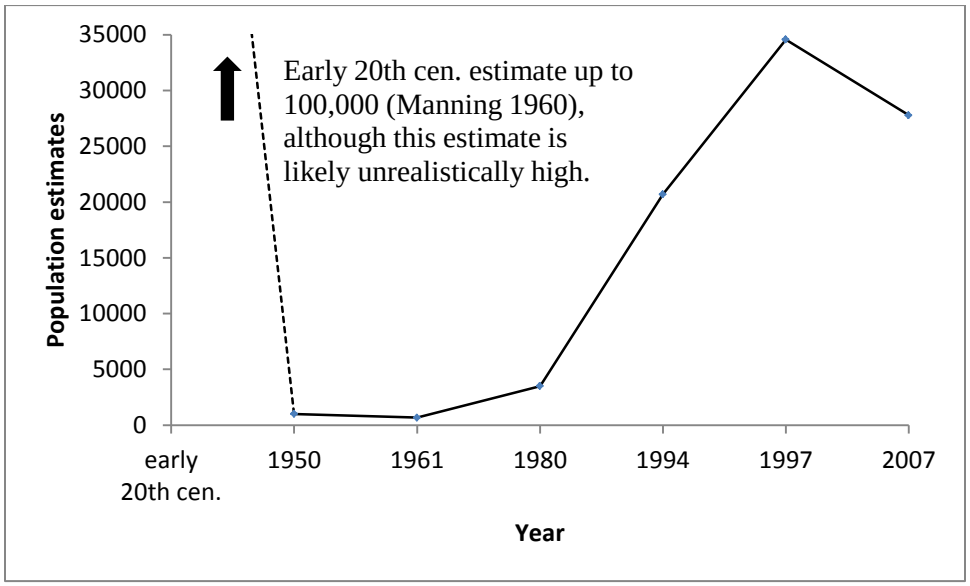

Figure 14. Depiction of approximate population estimates between the early 20th century and 2007 (Anderson 1922, Manning 1960, Banfield 1950, MacPherson 1961, Jackimchuk and Carruthers 1980, Nishi and Buckland 2000, Nishi and Gunn 2004, Dumond and Lee 2013).

Corrections applied to the 1997 and 2007 survey results (Dumond and Lee 2013) add uncertainty to the herd estimates. Use of satellite collar data from 5-7 years earlier to correct for animals outside of the coastal census zone is questionable, given among-year differences in arrival times and movement rates. A stable trend between 1997 and 2007 is inconsistent with information gathered by local hunters and Conservation Officers, the unknown but likely higher recent harvest levels, likely increased predation, possibly increased fall mortality because of later ice formation, recent reports of poor body condition, and the uncertainty associated with trying to

determine a trend from two data points.

Dolphin and Union caribou are seasonally present within the NWT portion of Victoria Island, with very few to no caribou there for most of the winter. Based on the distribution of observations during the 1994 survey of western Victoria Island (Nishi and Buckland 2000), distribution of observations during the 1994-97 VHF telemetry study (Nishi 2000), and collar distribution since the late 1990s (Poole *et al.* 2010), approximately 15% of the population occurs within the NWT during summer. Therefore, assuming an October 2007 estimate of roughly 27,800 caribou (all ages), the summer estimate for the NWT is about 4,200 caribou. There is insufficient information to determine the number of non-calf caribou. Thus, the NWT could be considered to hold about 15% of the global population, albeit on a seasonal basis.

Fluctuations and trends

The NWT Species at Risk Committee's criteria for considering population declines in the assessment of status follow the recommendation of the International Union for the Conservation of Nature and Natural Resources (IUCN) to consider declines over 10 years or three generations (21-27 years for Dolphin and Union caribou), whichever is longer (IUCN 2001; SARC 2010). Relatively robust trend data are only available for less than 15 years. However, while the aerial survey methods in 1994, 1997 and 2007 were relatively well-standardized, season and survey area differed, which limits determining trends in abundance. The June 1994 estimate was an under-estimate as it did not include eastern Victoria Island, and it is uncertain whether all caribou had moved to the south coast and were within the census zone in 1997 and 2007.

The three surveys suggest, with a high degree of uncertainty, an increase between 1994 and 1997 (exponential rate of change 0.100) then a possible decline between 1997 and 2007 (exponential rate of change –0.025). The 1999-2006 adult survival rates were low (Poole *et al.* 2010) which together with environmental trends (climate change), the unknown but likely relatively high harvest (around 7-10%; discussed further in *Threats and Limiting Factors*), population and health indications from local knowledge (caribou deaths during fall-early winter migration when ice isn't yet strong enough to support their weight, possible increase in diseased animals), and a possible (though non-significant) decline in population estimate between 1997 and 2007, together suggest the likelihood of a declining trend in abundance.

Available data do not allow us to determine whether the documented high numbers in the early 1900s, followed by about 50-60 years of low numbers then an increase for about 20 years are part of regular fluctuations.

Threats and limiting factors

There is uncertainty about which limiting factors are responsible for a likely declining population trend for the Dolphin and Union population since the late 1990s. Measures of abundance are infrequent as there have been four estimates since 1980. Although productivity has been annually variable, it has not been consistently measured and trends are not well documented. There are only a few years with measures of adult survival and none since 2006.

The most important threats to Dolphin and Union caribou may be hunting, predation, changes in sea-ice formation, and other effects of climate change on vegetation and parasite loads. Warmer temperatures are already manifested as trends in the mean fall temperatures which delay fall sea-ice crossings (Poole *et al*. 2010; see *Distribution*). Other potential threats include competition for forage and industrial development on the winter range, which could also increase access for hunting. Contaminants do not appear to be current threats.

Recent reliable harvest data are unavailable for the NWT and Nunavut. In the NWT, no systematic harvest information has been collected since January 2010. The development of a community-based monitoring program is hoped to change this in the future (Carpenter pers. comm. 2013). In Nunavut, voluntary reporting has been initiated and the Nunavut Wildlife Management Board is working on updating their harvest study (Dumond pers. comm. 2012a). It is also uncertain how limiting factors interact. For example, mortality as a consequence of wolf predation and hunting acts on populations against the background of annual variation in environmental conditions (timing of sea-ice formation, as well as effects of weather on forage availability and plant growth) and also interacts with parasite effects. Harvesting may become an increasingly important threat, especially if mortality rates from predation or drowning increase.

Hunting

Hunting is part of Aboriginal culture and Aboriginal people can be considered as a part of wildlife ecology. Hunting can be a benefit to conservation as it provides information about distribution, health and condition (Gunn 2001). Without data to inform management decisions about the effects of hunting, it can also serve as a threat. The return of the migration of the Dolphin and Union caribou to the mainland after an absence for most of the 20th century meant that Inuit from the mainland communities were able to re-establish hunting patterns that had largely been absent for generations (Gunn *et al.* 1997). When barren-ground caribou are available to mainland communities, Cambridge Bay is the main harvester of the Dolphin and Union caribou in Nunavut. Hunters from Ulukhaktok and Cambridge Bay also hunt Dolphin and Union caribou during their migrations nearer to these communities.

Trends in harvesting of Dolphin and Union caribou are difficult to describe because efforts to collect information have varied over time. A key message is that harvest levels of Dolphin and Union caribou appear to be related to trends in the abundance and distribution of neighbouring

populations of Peary caribou and barren-ground caribou. For example, in the early 1990s, there was a decline in the Minto Inlet population of Peary caribou. In 1993, the Olokhaktomiut Hunters and Trappers Committee passed a zero-harvest by-law to stop Peary caribou hunting for Northwestern Victoria Island; the by-law is enforced by Government of the Northwest Territories (GNWT) legislation. The reduction raised a concern about whether the harvest of Dolphin and Union caribou would increase (management history is summarised in Nishi and Buckland 2000). Based on information from the Inuvialuit Harvest Study, Dolphin and Union caribou harvest by people from Ulukhaktok in Prince Albert Sound varied between 41 and 381 per year between 1987 and 1996 (Nagy unpubl. data 1998). Harvest data were then collected for the Prince Albert Sound area from 1990-91 to 2010-11 (Fig. 13).

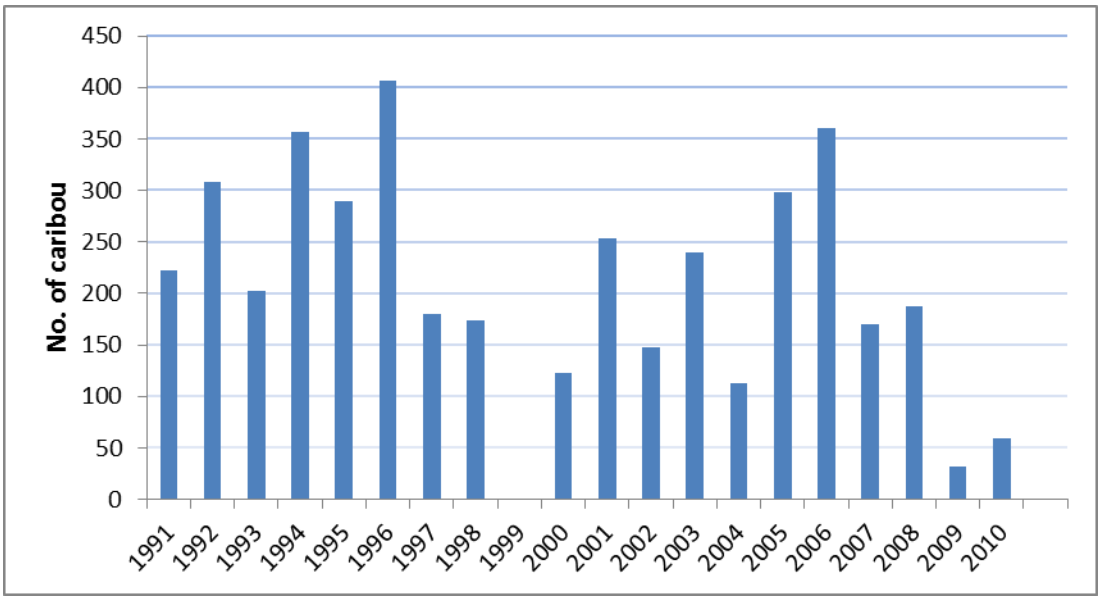

Figure 15. Harvest of caribou (listed as Dolphin and Union caribou) for Prince Albert Sound (Unit I/BC/04), Victoria Island based on the Kitikmeot Harvest Study (J. Nagy unpubl. data 1998) and the Summary of harvest data for species under quota in the Inuvialuit Settlement Region: July 2006-June 2011 (ENR 2011).

By 2006, declines were being reported for the Bluenose-East, Bluenose-West and Bathurst barren-ground caribou populations (Adamczewski *et al.* 2009). Additionally, Dumond (2007) commented that the winter distribution of barren-ground caribou changed and access to them within the Kugluktuk hunting range was limited from fall 2006 to April 2007. Dumond (2007) reported that numbers of caribou (all subspecies) harvested by Kugluktuk hunters was similar between periods 1997-2001 and 2004-07; roughly 1,000-2,000 animals. However, the proportion of the harvest that was Dolphin and Union caribou increased from about 20–30% during 1997-2001 to about 75% in 2006-07.

Prior to the start of the Nunavut Wildlife Harvest Study in June 1996 (Priest and Usher 2004), there were two smaller scale studies designed to estimate the harvest of Dolphin and Union

caribou. The first study was done by the Kitikmeot Hunters' and Trappers' Association (KHTA) and ran from January 1994 to May 1995. Then the GNWT Department of Resources, Wildlife and Economic Development resumed the harvest study from October 1995 to June 1996.

Average annual harvest of caribou from June 1996 to May 2001 were Kugluktuk (1,575), Umingmaktok (176), Bathurst Inlet (93), and Cambridge Bay (811) (Priest and Usher 2004). These harvests came from a combination of populations including the Dolphin and Union population. For example, a portion of the Bathurst Inlet and Umingmaktok harvest occurred during summer when Dolphin and Union caribou were not near these communities. Most of the Kugluktuk harvest occurred in areas typically inhabited by Bluenose-East caribou (Priest and Usher 2004).

In addition to the subsistence harvest described above, Dolphin and Union caribou presently support a sports harvest quota of about 40 tags in Cambridge Bay, with roughly 20-30 caribou harvested annually. No commercial harvest is currently in place on Victoria Island (Dumond pers. comm. 2012a).

Thus, the harvest reported by ENR (2011) in 1991-2010 suggests a drop in harvest during 2009 and 2010 on western Victoria Island (Fig. 13). However, reliable recent total harvest levels for Dolphin and Union caribou are unavailable so overall trends are uncertain. COSEWIC (2004) suggested a harvest of 2,000 to 3,000 Dolphin and Union caribou per year may be likely, based on the reported caribou harvest from the Kitikmeot Harvest Study and the proportion of arctic island caribou reported in recent harvest studies. While the numbers of Dolphin and Union caribou harvested for subsistence by communities are not known, the annual harvest rate is believed to be between 2,000 and 3,000 animals from Nunavut communities and less than 200 from the NWT, 7–11% of the 2007 population estimate (corrected) of roughly 27,800 caribou (Governments of Northwest Territories and Nunavut 2011; Dumond and Lee 2013). Unless the herd is increasing rapidly and has strong calf recruitment, a 7-11% harvest rate is unsustainable (Adamczewski pers. comm. 2013)

Predation

The impact of wolf predation on Dolphin and Union caribou numbers cannot be quantified. However, reported wolf sightings on Victoria Island appear to have increased over the past two decades (Table 6) and an increase in wolf numbers was also reported in Dumond (2007) by Colin Adjun, a conservation officer with the Government of Nunavut at the time, but are likely still at low overall densities compared with predators sighted during aerial surveys of the mainland populations (Poole *et al.* 2011). Numbers of muskoxen have also increased on Victoria Island (Gunn and Patterson 2012) and this increased muskox abundance may have supported more wolves, meaning that muskoxen could be indirectly supporting increased predation rates on Dolphin and Union caribou.

No studies specifically focusing on grizzly bear surveys in Dolphin and Union caribou range were available for this report; however, based on a number of anecdotal reports, grizzly bear numbers within the range of Dolphin and Union caribou appear to have increased. Dumond (2007) reported comments from two Kugluktuk residents noting that grizzly bear numbers were increasing. Likewise, N. Nasogaluak and P. Ekpakohak noted, in Slavik *et al.* (2009) and Slavik (2011), that more grizzly bears have been observed on Banks and Victoria islands than in the past. During extensive fieldwork (both ground based and with 5 days of helicopter surveys for raptors) in the Hope Bay area in 1984-86, averaging 3-3.5 months per summer, only one bear was observed annually (Poole, unpubl. data 1986). In 2009, seven individual bears were observed within 50 km of the Doris North mine site at Hope Bay during 2 days of helicopter surveys for raptors (Poole unpubl. data 2009). The apparent increase, at least in Nunavut, may be related to fewer bears being shot for food in recent years (Dumond 2007). Additional factors may be related to changes in abundance of large prey populations (muskoxen and caribou), or the progression of greater plant productivity northward as a result of climate change, resulting in higher quality forage and possibly increased small mammal populations (Dumond pers. comm. 2012b). Grizzly bears likely have their greatest impact on newborn caribou, but with relatively few bears on Victoria Island and dispersed caribou calving (Nishi 2000), their impact on Dolphin and Union caribou is likely limited.

Climate change and forage availability

Changing climate patterns have resulted in warming trends in Arctic regions at higher rates than other global ecosystems (Hinzman *et al.* 2005; Parmesan 2006; Barber *et al.* 2008). An increase in plant productivity (NDVI) is measurable across the western Arctic Islands, especially the interior of Banks Island (Walker *et al.* 2011). Examination of changes in pollen profiles suggests a strong warming trend (~1°C) on northwest Victoria Island over the last 100 years (Peros and Gajewski 2008). Since 1948, average October and November temperatures at Cambridge Bay have increased 0.35 to 0.39°C per decade, with a greater rate of increase since 1980 (Poole *et al.* 2010). Similarly, at Lady Franklin Point between 1958 and 1992 mean October and November temperatures rose by 4.5 and 4.0°C, respectively (Poole *et al.* 2010).

Summer weather affects the timing and amount of plant growth and, in turn, the amount of forage influences body mass and pregnancy rates as well as caribou winter survival. However, experience elsewhere reveals that the relationships between summer conditions, body mass and reproduction are complex (Ozgul *et al.* 2009). The warmer and longer summer weather also would increase the amount of harassment by oestrid flies; these trends might be already happening on Victoria Island (Fig. 7). It is unknown how the strongly regional effects of a warmer climate on plant growth (Elmendorf *et al.* 2001) could offset the greater ecological costs of parasites including gastro-intestinal nematodes. The trend toward warmer summers will modify conditions for parasites and diseases although the effects will be complex (Kutz *et al.*

2009) and are currently unknown.

The annual variation and trends in the timing and amount of plant growth relative to weather are unknown for Victoria Island. Likewise the effects of the timing and type of snow cover on foraging are unmeasured. Tyler (1987) reported for Svalbard reindeer that summer moisture can limit plant growth for the dry communities used in winter, which may reduce caribou forage. This is likely also the case for Victoria Island as a large part of the Dolphin and Union seasonal ranges has a continental climate (Maxwell 1981), which means it is relatively dry.

Contemporary research on relationships between forage availability and weather (often termed density-independent) acknowledges that weather-forage availability is also related to the density of the animals. The relative strength of the effects of weather and density on forage availability varies in strength over time (for example, Ozgul *et al.* 2009).

Changes in sea-ice formation

Over the short-term (decades), Dolphin and Union caribou may be especially vulnerable to the effects of a warmer climate if the current trend toward later formation of sea-ice continues and leads to increased risk of drowning deaths (Poole *et al.* 2010; Howell *et al*. 2010). Additionally, if the caribou continue to stage along the coast and the duration of staging increases, effects of increased foraging on the coastal plant communities are likely.

Most shipping through the Northwest Passage takes the southern route, which includes the Coronation Gulf and Dolphin and Union Strait. Reductions in perennial ice (Overland and Wang 2005; Serreze *et al.* 2007; Barber *et al.* 2008) as well as increased industrial development are likely to lead to increased shipping through the Northwest Passage as the sea-ice season is reduced and the ice thins. How a longer shipping season and more frequent ship passages will affect fall migration will depend on the timing of the passages. Dolphin and Union caribou migration movements were delayed as a result of the artificial maintenance of an open water channel in the sea-ice near Cambridge Bay (Dumond *et al.* 2013). The draft West Kitikmeot Regional Land Use Plan voiced residents' concern about the effects of shipping on wildlife and supports shipping only during the normal open water season, from 1 July to 15 October, or to 30 October if the shipping does not break ice (Nunavut Planning Commission 2004).

Shipping through the Northwest Passage has increased since the 1990s, reaching an annual peak by 2010 of 22 vessels (ENR 2012). However, Canadian Ice Service (Wilson *et al.* 2004) noted uncertainty in predicting a rapid increase in shipping in the Northwest Passage due to the variability of sea-ice conditions.

Intra- and inter-specific forage competition

Intra-specific competition has not been examined in detail for Dolphin and Union caribou. The shift to wintering on the mainland has been suggested as evidence for competition among

Dolphin and Union caribou (Hughes 2006).

Although it is not direct evidence for intra-specific competition, the dispersed distribution during calving may be a consequence of the relative low plant coverage and biomass on Victoria Island (Gould *et al.* 2003). Along the south coast, plant coverage and biomass are higher than inland (Gould *et al.* 2003). Alternatively, dispersion of females during calving season may be a predator-avoidance strategy (e.g., being spaced out rather than grouped together) (Larter, pers. comm. 2013). If the trend is for the Dolphin and Union caribou to stage for a longer time while waiting for the sea-ice to freeze, then intra-specific competition becomes more likely.

A second potential aspect of intra-specific competition is the seasonal overlap of the Dolphin and Union winter range on the mainland with the seasonal summer ranges of barren-ground caribou. However, this aspect has not been assessed. Hughes (2006) noted that the summer ranges of some barren-ground caribou populations overlapped with the Dolphin and Union winter range. There is overlap between the Ahiak/Beverly population of barren-ground caribou and Dolphin and Union caribou on the eastern winter range at least in some winters (Calef and Hubert 2002), and occasional overlap in late winter and spring east of Kugluktuk between primarily male Bluenose-East caribou and wintering Dolphin and Union caribou (Dumond pers. comm. 2012b), but the degree of overlap and relative densities among populations have not been assessed.

There is also uncertainty about the existence and extent of inter-specific forage competition between caribou and other herbivores (arctic hare, ptarmigan, lemmings, and muskoxen). Both Schaefer *et al.* (1996) and Hughes (2006) examined distribution of herbivores relative to plant communities. While Schaefer *et al.* (1996) did not find overlap, Hughes (2006) reported that muskoxen were foraging on the upland ridges where typically caribou feed (at least at one site in 2004-05). This led Hughes (2006) to suggest that inter-specific competition between Dolphin and Union caribou and muskoxen was a factor in caribou fall migration to the mainland. However, it may be more complicated as the migration began while caribou and muskox abundance were still relatively low (Gunn *et al.* 1997, Gunn and Patterson 2012). At least at one site on southern coastal Victoria Island there is some evidence for overlap in diet between Dolphin and Union caribou and muskoxen (Hughes 2006), but the spatial extent and consequences of that overlap are unknown. Hughes (2006) suggested that shared species of gastro-intestinal nematodes between caribou and muskoxen may also be a factor in the caribou migration to the mainland, if the caribou try to avoid the infested ranges.

Disturbances from human activity

The magnitude and immediacy of human activities as a measurable threat to Dolphin and Union caribou are likely low at this time, although data are lacking to assess impacts. Based on experience elsewhere, disturbances such as low level aircraft flights, people on foot and vehicles have been documented to increase caribou energetic costs if those human activities interrupt

caribou foraging or cause the caribou to move away in response (Weladji and Forbes 2002). Development which includes roads, seasonal or year-round, is a greater concern because roads increase access for hunting and tend to facilitate more development. At present and as discussed below, human disturbance is primarily the result of activities associated with mineral development, military sites and campgrounds.

Mineral exploration occurred in the Shaler Mountains of northwest Victoria Island in the 1990s (CEAA 2010) but so far the exploration has not led to development. The Aboriginal Affairs and Northern Development Canada Spatially Integrated Dataset (SID; http://ism-sid.inac.gc.ca/website/sidvh1/viewer.htm) was searched for active mineral claims and leases, and land use permits. Relatively few permits occurred on Victoria Island, with about 14 land use permits scattered along the south coast (mostly related to military sites and campgrounds). A scattering of active mineral leases and mining-related land use permits are present about 50 km east of the head of Prince Albert Sound, and active mineral leases (no land use permits) occur near the head of and east of Minto Inlet.

On the Dolphin and Union mainland winter range, land use permits and active mineral leases are clustered along the greenstone belt south of Hope Bay, south of the head of Elu Inlet, and greenstone formations in the High Lake and southwest of High Lake areas. A gold mine east of Bathurst Inlet on Melville Sound at Hope Bay was slated for start of production in 2012, but as of February 2012 was placed in care and maintenance indefinitely. Associated with this development are a series of exploration sites that run down the greenstone belt 60 km to the south. West of Bathurst Inlet, a proposed copper-zinc mine at High Lake, south of Grays Bay, has gone through the preliminary approval process, and is now combined with the larger Izok Corridor project. The proposed High Lake mine is an underground mine with a 45 km road to a shipping port for the ore. Both these projects have increased human activity and potential disturbance to caribou winter range associated with them.

Contaminants

In Dolphin and Union caribou collected from the Kent Peninsula in November 1993, researchers found relatively low levels of organochlorine, heavy metal and radio nuclide contaminants resulting from long-distant atmospheric transportation (Macdonald *et al.* 1996). Heavy metal concentrations from sampling in fall and early winter 2006 were also low and showed no trend over time (Gamberg 2008). Evidence based on sampling in the 1990s and 2006 suggest that contaminants do not appear to be current threats to Dolphin and Union caribou health. Likewise, contaminants in muskoxen on southern Victoria Island were low except for a finding of elevated hexachlorobenzene levels in muskox calves (Salisbury *et al.* 1992). Despite these findings, contaminants were included among potential threats because over time the types of contaminants change as new chemicals come into common use. For example, use of brominated flame

retardants and fluorinated surfactants have increased since the 1980s (Stow *et al.* 2004).

Positive influences

Community meetings in Nunavut about the decline of Peary caribou on northwest Victoria Island in the early 1990s included concerns for Dolphin and Union caribou because of increased harvesting and risks from crossing the sea-ice (summarised in Nishi and Buckland 2000 and Dumond 2007). The community meetings led to the aerial surveys in 1994, 1997 and 2007, which have reported on the status of Dolphin and Union caribou. Community meetings are a positive influence as they increase understanding of the status and threats. Nishi and Buckland (2000) also describe reductions to commercial use of Dolphin and Union caribou in the late 1990s.

COSEWIC (2004) assessed the status of Dolphin and Union caribou in Canada and rated them as Special Concern. They were added to Schedule 1 in February 2011 as Special Concern under the federal *Species at Risk Act* (http://www.sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=822). The listing requires a management plan within three years for which consultations should start soon (Bigelow pers. comm. 2012). The consultations and collaboration required for the management plan will themselves be a positive influence through the sharing of information about Dolphin and Union caribou. The Wildlife Management Advisory Council (WMAC) NWT has initiated discussions with the Nunavut Wildlife Management Board and the Kitikmeot Regional Wildlife Board regarding possible management or conservation actions that could be collaboratively implemented for Dolphin and Union caribou (Gau pers. comm. 2012). This was precipitated by the recent joint submission to the USFWS and the harvest levels that became apparent (Governments of Northwest Territories and Nunavut 2011).

There are no Protected Areas on the annual ranges; however, maps for the Nunavut Planning Commission's draft Nunavut Land Use Plan reference sea-ice crossing areas (but not calving areas) (http://www.nunavut.ca). These maps form the basis for discussions on how the Land Use Plan may direct and guide development once it is finalized and approved. In the NWT, conservation priorities for the area have been formalized in the Inuvialuit Community Conservation Plans (CCPs). The Olokhaktomiut CCP identifies a calving area for Dolphin and Union caribou in the Colville Mountains as a Wildlife Area of Special Interest. The Colville Mountains Wildlife Area of Special Interest, as well as a number of other areas important to Dolphin and Union caribou are discussed in more detail in the Traditional and Community Knowledge component of this report, under *Habitat Requirements*.

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STATUS AND RANKS

Region	Coarse filter (Ranks) To prioritize	Fine filter (Status) To provide advice	Legal listings (Status) To protect under species at risk legislation
Global	G5TNR - Species secure, subspecies not yet assessed (NatureServe)	TNR - Not Yet Ranked	
Canada	N2N3 – Imperiled or vulnerable (NatureServe Canada 2012)	Special Concern (COSEWIC – 2004)	Special Concern (SARA 2011)
Northwest Territories	**Sensitive** (NWT General Status Ranking Program 2011)	**To be determined**	**To be determined**
Adjacent Jurisdictions			
Nunavut	SNR – Species Not Ranked		

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Kaomayok, D

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Anonymous
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Kamoayok, Lena
Kaniak, Mary
Kapolak, Allen
Keyok, Charlie
Klengenbery, Clarence
Koihok, Moses
Kudlak, Luke
Kuptana, Noah
Niptanatiak, Joseph
Novilogak, Luke

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Aloakyuk, Nickolas
Banksland, Alex
Egotak, Harry
Goose, Agnes
Kagyut, William
Kudlak, Jimmy
Kuptana, Frank
Memogana, Jimmy
Nigiyok, Morris
Oliktoak, Sam

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Kuneyuna, John
Kuptana, David
Joss, Allen
Inuktalik, Roy
Banksland, Alex
Okheena, George
Ekpakohak, Patsy
Alikamik, John

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Akoluk, Martha
Algona, Bobby
Algona, May
Alonak, Jack
Analok, Frank
Angulalik, Bessie
Angulalik, Mabel
Hagialok,Jessie
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