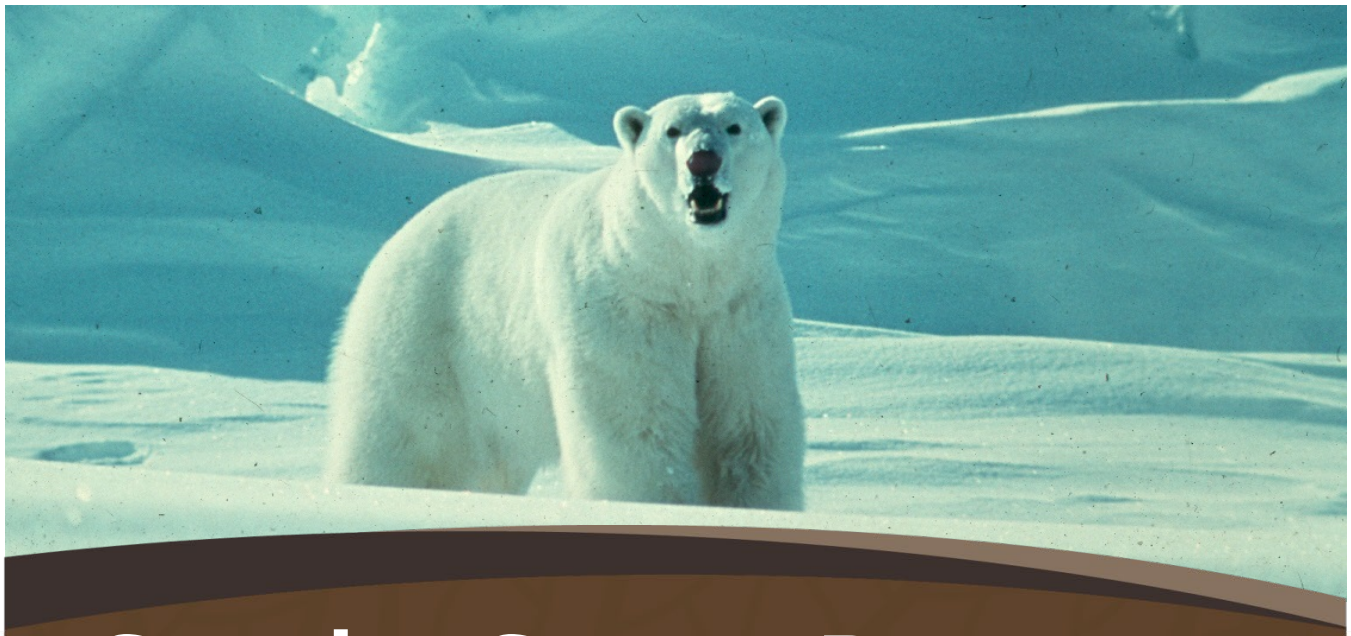

Species Status Report

Polar Bear

Ursus maritimus

Nanuq (Siglit/Uummarmiut)
Chehzhìi' (Teetł'it Gwich'in)
Chehzhyèe' (Gwichya Gwich'in)
Sahcho degoo (Tłı̨chǫ)

IN THE NORTHWEST TERRITORIES

NORTHWEST TERRITORIES SPECIES AT RISK COMMITTEE

RE-ASSESSMENT – SPECIAL CONCERN

April 2021

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 Indigenous 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 polar bear 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.

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

Cover illustration photo credit: ENR

RE-ASSESSMENT OF POLAR BEAR

The Northwest Territories Species at Risk met on April 15-16, 2021 and assessed the biological status of polar bear 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 based on Indigenous and Community Knowledge (ICK) and Scientific Knowledge (SK) and are available at: www.nwtspeciesatrisk.ca.

Assessment: Special Concern in the Northwest Territories

Special Concern – May become Threatened or Endangered in the Northwest Territories because of a combination of biological characteristics and identified threats.

Reasons for the assessment: Polar bear fit criterion ICK (a) and SK (b) for Special Concern.

Criterion	**Special Concern**
ICK(a)	Knowledge holders are observing changes in abundance, habitat quality/quantity, movements, or range, but these changes are not yet large enough to qualify the species for Threatened **AND** knowledge holders express concern that the species is being adversely impacted by one or more natural or human-caused threats.
SK(b)	The species may become Threatened if factors suspected of negatively influencing the persistence of the species are neither reversed nor managed with demonstrable effectiveness.

Main factors (ICK):

- Polar bears are solitary, live at very low densities, cover large ranges and constantly move to find ideal ice conditions and seals. Polar bear abundance changes from year to year and from region to region.
- Knowledge holders have observed that polar bears are not as big as they used to be, but there is not consensus on population-wide changes in body condition. Polar bears are observed to more often consuming the entire seal (as opposed to the blubber only), which suggests that these bears may be facing nutritional stress.
- Climate change has had an intensifying effect on polar bears and their habitat. There is broad concern that climatic conditions may alter denning habitat or render previously important habitats unsuitable, and influence polar bear condition, reproduction and prey availability.

- Knowledge holders suggest that polar bears may be adjusting their range further north and further out on the multi-year ice. Some polar bears have also recently been observed travelling further inland than in the past.
- Although ice conditions have always been highly variable (between and within seasons), knowledge holders have observed declines in multi-year ice and changes in sea ice from multi-year to annual ice pack. Annual pack ice may yield better ice conditions for polar bears.
- The combined effects of climate change with rapidly increasing development and activity, such as oil and gas exploration and marine traffic, in the Arctic are cause for high uncertainty and concern about cumulative impacts on polar bears and their habitat.
- Despite concern about the threats listed above, knowledge holders are not observing declines in polar bear populations at this time and they know polar bears are highly intelligent animals that can adapt to climate change.

Main factors (SK):

- NWT polar bears are from four subpopulations that are shared with Alaska, Yukon and Nunavut. Therefore, estimating the NWT-only polar bear population is challenging. The current best estimate is about 1,000 mature polar bears, but this leaves an unknown number of polar bears from the Arctic Basin subpopulation.
- The NWT population of polar bears is more likely to decline than to increase over the next three generations of polar bears.
- Scientific observations indicate a climate change-driven decline in summer extent of sea ice and ice thickness throughout much of the Arctic since 1970. Changes are ongoing, with winter Arctic sea ice extent continuing to decline. Most recent models predict that by 2050, the Arctic will be ice-free in September.
- Climate change related losses in sea ice in the range of the Southern Beaufort Sea subpopulation is of particular concern and has been associated with declines in survival and reproduction in the Alaskan portion of its range. Most research on links between climate change and polar bears has not specifically targeted NWT polar bears, however evidence suggests that declines in sea ice habitat are occurring in the NWT range, and this is likely having an impact on polar bears in the NWT.
- In some areas, changes in ice conditions are linked to declining body condition of seals, the main food source of polar bear. Recent data show that polar bear body condition changes in response to shifts in food resources, which are linked to seasonal changes in sea ice.

Additional factors:

- People in communities have expressed concerns about invasive research techniques impacting polar bear health. Harvesters and elders from numerous communities have discussed how chasing and immobilizing polar bears with helicopters so that they can be tagged can "spook" bears.
- Other threats to polar bear include pollution, potential offshore development of hydrocarbon reserves, increased ship traffic, transportation and service corridors, increase pathogens, changes in foraging ecology and other cumulative effects.

Positive influences to polar bear and their habitat:

- Inuvialuit have been managing their interactions with polar bears since time immemorial and have codes of conduct, traditional practices, and bylaws in place to ensure harvesting practices are sustainable. The precautionary principle is applied to quota decisions to ensure that wildlife populations will not be negatively affected by the harvest.
- Landmark agreements like the 1988 Inuvialuit-Inupiat Agreement and the 2006 Kitikmeot-Inuvialuit Polar Bear Management Agreement promote transboundary management and knowledge sharing.
- In 2017, the Inuvialuit Settlement Region Polar Bear Joint Management Plan was completed. This plan was developed to meet the requirements of a management plan under the territorial *Species at Risk (NWT) Act* and the Inuvialuit Settlement Region (Yukon and NWT) regional component of the national management plan under the federal *Species at Risk Act* while respecting the joint management process legislated by the Inuvialuit Final Agreement (IFA).
- Community conservation plans have been developed and recently updated for all six Inuvialuit Settlement Region communities. These plans identify critical habitat, community uses, and conservation objectives, to inform future decision making.
- In recent years in the NWT, researchers have been exploring less invasive research techniques, including biopsy mark-recapture methods which are currently underway in the NWT.

Recommendations:

- Encourage and support ongoing ICK research to provide critical long term on-the-ground observations that will help understand annual changes and be useful for species assessment.
- Continue to enhance on-the-ground community-based monitoring to systematically monitor and document change (consistent with the Inuvialuit Settlement Region Polar Bear Joint Management Plan).
- Work with partners to develop and implement protocols for industry and shipping traffic through the Northwest Passage to minimize disturbance to polar bears.
- Work with partners to effectively resource and implement tools to mitigate climate change impacts on polar bear and ensure that Canada and NWT uphold the international climate change agreements.
- Work with partners to ensure that the Canadian offshore oil and gas moratorium is reviewed on schedule and that polar bear and seal continue to be protected from negative effects of oil and gas offshore development.
- Complete and publish results of population surveys in a timely manner.
- Enhance research on complex systems associated with climate change and how polar bear respond to changes to sea ice.

Assessment History:

- The NWT Species at Risk Committee met in December 2012 and assessed Polar Bear as a species of Special Concern in the NWT because of concerns about the long-term impacts of climate change and other threats.
- In 2014, Polar Bears were listed as Special Concern in the NWT under the *Species at Risk (NWT) Act.*
- An Inuvialuit Settlement Region Polar Bear Joint Management Plan and Implementation Table for Actions on Management of Polar Bears in the Inuvialuit Settlement Region were completed in 2017.

Executive Summary

Indigenous and Community Knowledge	Scientific Knowledge
Description	
Nannut/nannuit/chehzhìi'/chehzhyèe' (polar bears) are large mammals that live on the sea ice and along the coastline throughout the circumpolar regions. They live mostly on the sea ice and in marine environments, but will den, travel, and occasionally feed on land. Inuit have been hunting *nannut/nannuit* (polar bear) in this region since time immemorial, giving them considerable knowledge of their regions' geography, fauna, weather, and ice conditions in relation to polar bears. Polar bears are greatly respected and are a culturally, spiritually, and economically important species to the Inuvialuit. Polar bears are considered the most intelligent animal in the Arctic, with Inuvialuit often referring to them reverentially as the 'Monarch of the Arctic'. As a result, the Inuvialuit have in-depth knowledge of polar bears and their habitat.	The polar bear (*Ursus maritimus* Phipps [1774]) is a large bear adapted to the unique niche of hunting marine mammals from a sea ice platform. Many of the physical traits of polar bears can be viewed as adaptations to hunting arctic seals. For management purposes, the polar bear is considered to be a terrestrial mammal in Canada.
Distribution	
The polar bears of the Northwest Territories (NWT) live mostly on the sea ice of the Arctic Ocean. Seasonally, they are found along the coastline of the NWT and Arctic islands and may occasionally be found inland on the Arctic islands and the Beaufort coast. Polar bears can cover a huge range in search of prey and mates and are known to be	Polar bears rely on sea ice as their primary habitat. They are distributed throughout the circumpolar Arctic where at least annual ice is known to occur. In the Northwest Territories (NWT), the species can be found throughout the Arctic Ocean and on all islands; however, the species' distribution on the NWT mainland is limited to a small strip

capable of swimming long distances in open water. Travel routes may vary depending on habitat conditions, but polar bears are capable of travelling across varied terrain, including very thin ice. If they need to, or if they smell food, bears can swim huge distances between ice and the shore. Wildlife management agencies recognize four subpopulations (or management units) of polar bears in the NWT: Northern Beaufort, Southern Beaufort, Viscount Melville, and Arctic Basin. However, there is consensus within all six Inuvialuit communities that the Northern and Southern Beaufort subpopulations are really one single subpopulation, as polar bears frequently move between both areas. Polar bears are mostly solitary and generally live at very low densities. Polar bears cover large ranges and are constantly moving in order to find ideal ice conditions and an abundance of seals. Where polar bears will be found is largely dependent on the ice conditions in the area. Polar bear habitat use/distribution is largely dependent on the ice conditions in the area. Ice type, thickness, and location will determine where bears are found. A decline in multi-year ice along the west coast of Banks Island may be contributing to changes in polar bear migration there. Inuvialuit believe that bears are adjusting their range further north and further out on the multi-year ice in response to changes in ice conditions and distribution of seals related to climate change. Some polar bears have also recently been observed travelling	of the Arctic Coastal Plain of only a few kilometres in width (excluding cases of vagrancy). The distribution of polar bears where they occur in the NWT is continuous and overlaps four recognized subpopulations that have historically also been treated as management units: Southern Beaufort Sea, Northern Beaufort Sea, Viscount Melville Sound, and the Arctic Basin. Overlap in movements and genetic interchange suggest subpopulations are not isolated from one another within the NWT, nor are they contained entirely within NWT borders. Polar bears of the Southern Beaufort Sea subpopulation are shared with Alaska and Yukon. Bears of the Northern Beaufort Sea and Viscount Melville Sound subpopulations are shared with Nunavut. Bears of the Arctic Basin are shared by the Range States (United States, Norway, Russia, Greenland, and Canada).

further inland than in the past. Inuvialuit understand that polar bear population size is cyclical over time and that populations across North America will naturally increase and decrease as the population changes or bears move from one area to another. Inuvialuit caution that polar bear distribution must be interpreted and analyzed in terms of an understanding of considerable seasonal/annual variation in sea ice conditions and polar bear movement patterns.	
Biology and Behaviour	
Polar bears depend on seals for their survival more than any other prey species. Polar bears' diet consists mainly of ringed (*natchiq*/*nattiq*) and bearded (*ugruk*/*ugyuk*) seals, which they hunt from their breathing holes, in their dens, and while hauled up on the ice. Seal health, distribution, and abundance are determined by sea ice and marine biological productivity. Polar bears are opportunistic predators and have been observed on occasion hunting other species, both on land and in the water, and will often scavenge on beached whales or other carcasses. The great respect that people hold for polar bears grows in part out of the species' ability to find clever ways of adapting and surviving amidst very difficult conditions. As polar bears live in such a specialized niche, they face little direct competition from other species. Arctic foxes, wolves, wolverines, ravens, ivory gulls, and potentially other species likely benefit from	Females reach sexual maturity at 4–6 years and usually have litters of no more than 1–2 cubs approximately every 3 years as cubs remain dependent on their mothers for two years. Most males generally breed for the first time at 8–10 years. Cubs-of-the-year and yearlings (age 1) exhibit survival rates that are lower than sub-adults (ages 2–4) and prime-age adults (ages 5–20). Senescent adults (21+ years) have lower survival rates than do prime adults. Few polar bears live longer than 25 years. The average age of parents of a cohort (i.e., newborn individuals in the population) is 11.5 years (95% CI: 9.8–13.6). Survival and reproduction are known to be influenced by ice conditions.

being able to scavenge polar bear seal kills. Polar bears generally have two cubs (twins) The maximum age of bears recalled in the sources ranged from 13-33 years old. Several hunters have observed that bears are not as big as they used to be, but there is not consensus on population-wide changes in body condition. However, hunters are finding that bears are more often consuming the entire seal (as opposed to the blubber only), which suggests that these bears may be facing nutritional stress. In general, knowledge holders reported that the physical condition of polar bears in their areas has remained stable over time, although there is considerable variation from one season to the next, and even within a given hunting season.	
Population	
Polar bear abundance changes from year to year and from region to region. Studies based on Inuvialuit knowledge suggest that, as of 2018, the Northern Beaufort, Southern Beaufort, and Viscount Melville subpopulations are stable, and that the Northern Beaufort and Viscount Melville subpopulations may even be increasing.	All science-based population size and vital rate estimates for NWT polar bears rely on data collected within its territorial boundaries from 2006, or earlier. More recent abundance estimates are known for the Southern Beaufort Sea subpopulation (to 2015), but only from Alaska, where 78% of the spatial extent of the unit occurs. The Southern Beaufort Sea subpopulation in Alaska is known to have declined from earlier abundance levels (prior to 2006) by 25–50%, to now average 565 bears from 2006–2015. As at 2015 numbers appeared stable but were not recovering. Assuming a similar decrease occurred in Canadian bears of the Southern Beaufort Sea subpopulation, which share similar ecological conditions including

	harvest pressure, we might now expect around 160 bears on average living in NWT territorial waters or on land in Yukon and NWT west of 133° longitude. All other estimates of subpopulation sizes are dated. However, if we assume no change in the population size of the Northern Beaufort Sea subpopulation since its last inventory (2006), and the Viscount Melville Sound subpopulation since its last published estimate (1992), while noting 30% of bears in the Viscount Melville Sound were captured in Nunavut when sampling occurred, we can compute what might be a current, approximate number of bears within the NWT: 1583 bears of all ages (range 1519–1685), or 989 mature bears (range 949–1053). Caution should be used if accepting this estimate, however, as we are assuming long-term stability for the majority of the NWT population when we know that the Southern Beaufort Sea subpopulation declined over the past three generations for polar bears. The estimate is also liberal in that it does not remove any Northern Beaufort Sea bears that should be assigned to Nunavut, rather than NWT (i.e., bears living in the southeast Amundsen Gulf or Dolphin and Union Strait). That said, the above also does not account for any Arctic Basin bears that may be resident within the territorial bounds of the NWT, at any point in time. Other formulations can be used to estimate the total size of the NWT population, using the same datasets and literature available, and same assumptions including no decline over the last three generations in

	subpopulations outside the Southern Beaufort Sea. Differences in estimates stem from how declines of the Southern Beaufort Sea subpopulation might be incorporated into extrapolations. These alternate, if more complicated, methods result in estimates of 992 mature bears (range 897–1085) for the NWT, with range depending on whether the last decline in the Southern Beaufort Sea was 50% or 25% of the total subpopulation, respectively; while another approach arrives at a more conservative estimate of 889 mature bears (point estimate only). Irrespective of how populations size for the NWT is computed, the balance of evidence, at writing, suggests that the NWT currently supports no more and likely less than 1000 mature polar bears within its territorial borders, at any given time. For polar bears of the Southern Beaufort Sea subpopulation, recent climate change-related losses in sea ice have been associated with declines in survival and reproduction, and it appears that polar bears of this region are responding to changes through diet shifts. No research on climate change and polar bears has been targeted specifically to NWT-only bears, as all subpopulations are shared and overlap other jurisdictions (bears captured in Alaska travel to and live in the NWT). Evidence suggests declines are likely to be occurring in the overall abundance of polar bears in the Southern Beaufort Sea based on trends in body condition and reproduction; with all other polar bear subpopulations ranging into the NWT being most recently classed as unknown for body

	condition and reproduction. Because no recent population estimates are available for NWT polar bears, and persistence modelling probabilities are influenced strongly by starting population size, no quantitative population projections are possible at this time. While sea ice projections are clear, indexing polar bear numbers to trends in ice is difficult (polar bears can and do persist in areas with ice-free summers). Nonetheless, monthly sea ice extent throughout the Arctic has now declined by almost 10% per decade since 1979 (with September 2020, being the second greatest monthly low since records have been kept). Further, there is strong evidence that ringed seals (*Pusa hispida*)—the critical food resource for polar bears of the Amundsen Gulf (Northern Beaufort Sea subopulation) – have experienced a sustained decline (from 1992–2019) in body condition (an approximate 30% decrease in depth of blubber fat for adult females) that has not reversed. Given the decline over at least the past two generations of polar bears that has occurred in the Southern Beaufort Sea subpopulation linked to changing ice conditions, and ongoing declines in the body condition of ringed seals of the Northern Beaufort Sea, it is precautionary to conclude that the overall NWT population of polar bears is more likely to decline and not increase over the next three generations of polar bears, i.e., to 2050. The magnitude of the potential decline, however, remains unknown.
Habitat	

Polar bears' key habitat requirement is sea ice from which they hunt ringed and bearded seals. Ice type, thickness, and location will influence where bears are found. Ideal habitat for hunting seals includes pressure ridges, open leads, and young or annual ice. If ice conditions are not suitable for hunting seals, polar bears will move to where they can find seals or other food. Until recently, and despite annual variation, many of these features have affected the location of polar bear and seal denning sites, and the distribution and movements of polar bears and seals. Variable sea ice conditions affect the seal population and distribution, and ultimately, the bears' behaviour, body condition, and distribution – although the relationships among these factors are complex. The dynamic sea ice is influenced by wind, currents and, over the last several decades, changes in the climate. Since the 1980s, Inuvialuit have increasingly observed the intensifying effects of climate change on the weather, sea state, sea ice, and snow. Numerous changes in the sea ice associated with climate change are being observed such as changes in the timing of freeze-up and melt, ice thickness and structure, and snow conditions. There is broad concern that climatic conditions (wave action, erosion, and a lack of snow accumulation due to open water) may alter denning habitat or render previously important habitats unsuitable. People have been noticing a decline in multi-year ice since the late 1980s and attribute it to climate change and increased activity in	Polar bear habitat is closely linked to the physical attributes of sea ice (type and distribution) and the density and distribution and productivity of ice-dependent seals, especially ringed seals and their pups. Polar bears of the NWT-Yukon-Alaska mainland coast of the Beaufort Sea live in what is called a divergent sea ice zone, where ice is generally carried by currents offshore (and melts away from shore during summer), versus the northern Beaufort Sea, which is convergent in nature, where ice motion promotes convergence and shoreward drift of ice westward year-round. Ice conditions in the Viscount Melville Sound display conditions particular to the northern Canadian Arctic Archipelago, including tracts of multi-year ice (ice that does not form anew each winter). Ice conditions in each of the subpopulations are different, which translates into varying predictions of effects of climate change on habitat trends for polar bears in each region. Scientific observations indicate a general decline in summer extent of sea ice and ice thickness throughout much of the Arctic since 1970, and this is related to climate change. Changes are ongoing, with winter Arctic sea ice extent continuing to decline, and the most recent models showing that by 2050, the Arctic is predicted to be mainly ice-free in September. Of particular importance for the status of polar bears in the NWT are reduced ice concentrations (measured as minimum ice concentrations in summer) in the Beaufort Sea (Southern Beaufort and Northern Beaufort Sea polar bear

Arctic waters. As ice is disappearing, polar bears are adjusting their range and movements due to more open water. Annual ice forms in the winter months, and some solid (multi-year) ice remains in the high Arctic. Knowledge holders confirm that sea ice is changing but emphasize that ice conditions have always been highly variable and that the conditions of annual ice will have the most influence on polar bear conditions, reproduction, and prey availability. Generally, polar bears prefer to stay on the sea ice instead of on land, but will return to shore to den. Pregnant females (and occasionally non-pregnant females and males) will look for deep snow to make dens along the banks of the coastline, inland in ravines or depressions, and occasionally on the sea ice, and will spend the winter in these dens.	subpopulations), which, for the first time during the observational record, was ice free (<15% coverage) in mid-September 2012 south and east of Cape Prince Alfred, Banks Island. This phenomenon largely repeated itself in 2016, 2019, and 2020. Changes are also occurring in the Viscount Melville Sound and the Arctic Basin; however, changes to preferred polar bear habitat are less pronounced in these waters compared to what is happening in the Southern and Northern Beaufort Sea polar bear subpopulations.
Threats and Limiting Factors	
Climate change is causing or compounding all major threats to polar bears and their habitat in the NWT, including changes in sea ice habitat, potential offshore oil and gas exploration and development, and increased marine traffic. The combined effects of climate change with rapidly increasing development and activity in the Arctic are cause for high uncertainty and concern about cumulative impacts on polar bears and their habitat. Since the 1980s, Inuvialuit have increasingly observed the intensifying effects of climate change on the weather, sea state, sea ice,	Climate change is likely to influence all the threats and limiting factors listed below, either directly or indirectly. Polar bears are apex marine predators adapted to a carnivorous diet, foraging on a sea ice platform and highly dependent on the marine food web, especially ice-dwelling seals and their pups. The main limiting factor affecting polar bear distribution and numbers in the NWT is likely to be availability of, access to, and abundance of ringed seals and other marine mammals. Direct human-caused mortality (almost exclusively from hunting) is also a limiting

and snow. The ice is disappearing a lot earlier and freezing later and there is no more multi-year ice anywhere in the southern Beaufort Sea along the coast of the Yukon and NWT, nor in the Amundsen Gulf off the coast of Ulukhaktok. Other changes include warmer winter temperatures, fewer icebergs, thinner winter sea ice, increasingly frequent and severe fall storms, more hot weather during the summer, low summer water levels, unprecedented summer thunderstorms, melting permafrost, mudslides, and soil erosion. Some hunters have observed a change in direction of prevailing winds, which impacts ice conditions (impact can be positive or negative). Thinner ice and increased ice movement has resulted in a decline in the number and size of pressure ridges – a key ice feature from which bears hunt seals.

These environmental changes may affect polar bear health (inaccessibility of food), change their range and migrations, and stress their adaptive capabilities. While polar bears are adept at hunting and scavenging on land, there would likely be a decline in population before sufficient adaptation to new ranges could be made.

Seals, the primary prey species for polar bears, are also being impacted by climate change, impacting habitat availability and food availability. Impacts to seals are likely to be felt by polar bears. If polar bears cannot hunt seals due to changes in sea ice, it may be difficult for them to adapt to hunt different prey.

The potential for offshore oil and gas

factor; however, harvest and kills in defense of life and property are not heavy and have consistently been below allowable quota for the past 30 years in all NWT subpopulations. Reproduction is limited by body condition, which in turn is related to food availability (particularly that of key prey species like ringed seals) and hence, sea ice conditions. Recent data clearly shows that polar bear body condition (lipid content of adipose tissue) changes in response to shifts in food resources linked to seasonal changes in sea ice, especially onset of break-up. However, variation in stable isotope ratios, diets, and niche widths suggest that polar bears can forage adaptively in response to resource availability, accessibility, and distribution.

While threats to polar bears of the NWT from changing availability of food resources remain largely unknown, the greatest risks appear to exist for polar bears of the Beaufort Sea, where, further to known changes in ice conditions, body condition of ringed seals has been shown to be in a sustained decline (Amundsen Gulf).

Additional threats to polar bears, of unknown magnitude, also include pollution, and increased ship traffic and associated sea ice break-up from ship traffic, energy production (e.g. oil and gas drilling, mining and quarrying), transportation and service corridors, increasing pathogen prevalence and changes in foraging ecology influencing contaminant exposure, and the accumulation of environmental contaminants (mainly organochlorines) in tissues of polar bears. A possible future

exploration and development brings with it the risk of water pollution and disturbance. The consequences from a spill or blowout are thought to be potentially catastrophic to Arctic life. Disturbance to seals and polar bears can also result from seismic blasting and industrial activity near the shoreline, which could impact their movements and migrations. The opening of the Northwest Passage to marine traffic is seen as having the potential to be one of the most serious threats to polar bear habitat, preventing open leads from re-freezing properly and contributing to the decline in multi-year ice. Noise from ships could affect polar bear and seal communication and social functions, including migrations and movements. Other threats include invasive research techniques and behavioural changes caused by disturbances or nutritional stress. Pollution and contamination are being more frequently observed, especially in the form of marine plastics.	threat comes from potential offshore development of hydrocarbon reserves.
Positive Influences	
Inuvialuit have been managing polar bears for generations and have codes of conduct, traditional practices, and bylaws in place to ensure harvesting practices are sustainable. The precautionary principle is applied to quota decisions to ensure that wildlife populations will not be negatively affected by the harvest. The *Inuvialuit Final Agreement* introduced a wildlife management regime that	Positive influences on polar bear numbers in recent years stem largely from coordinated management of shared populations with adjacent jurisdictions. User-to-user agreements have been signed between the Inuvialuit (who have exclusive rights to harvest polar bears in the NWT), the Inupiat in Alaska, and the Inuit in Nunavut. Current harvest levels are lower than allowed by quota, which is likely to reduce the effects of harvest on polar bear productivity. The

established the paramountcy of conservation and preservation of wildlife in the Inuvialuit Settlement Region, and made the Inuvialuit partners in all matters related to the management of wildlife in the Western Arctic. Collaborative management is undertaken through hunters and trappers' committees, and with management authorities, other Indigenous groups, and biologists. Landmark agreements like the 1988 Inuvialuit-Inupiat Agreement and the 2006 Kitikmeot-Inuvialuit Polar Bear Management Agreement promote transboundary management and knowledge sharing. In 2017, the Inuvialuit Settlement Region Polar Bear Joint Management Plan was completed. This plan was developed to meet the requirements of a management plan under the territorial *Species at Risk (NWT) Act* and the Inuvialuit Settlement Region (Yukon and NWT) regional component of the national management plan under the federal *Species at Risk Act* while respecting the joint management process legislated by the Inuvialuit Final Agreement (IFA). Community conservation plans have been developed and recently updated for all six Inuvialuit Settlement Region communities. These plans identify critical habitat, community uses, and conservation objectives, to inform future decision making. Across the NWT and NU there are a number of protected areas (terrestrial and marine) and conservation areas within the range of polar bears. In 2016, Fisheries and Oceans	*Inuvialuit Final Agreement* provides a legal structure for conservation and management of the polar bear population in the NWT. As an internationally recognized sentinel species, agreements to secure the conservation of polar bears exist at several scales, from the regional to international level. Additionally, polar bears are listed under species at risk legislation in the neighbouring United States and at the national level in Canada and the NWT, and conservation actions are required for the species.

Canada designated the *Anguniaqvia niqiqyuam* Marine Protected Area in Darnley Bay. This area has been identified as a highly productive area for a variety of species, including Arctic char, beluga whales, polar bears, ringed seals, and a variety of birds. Some Inuvialuit believe that changes in the sea ice (from multi-year to annual pack ice) may yield better ice conditions for hunting seals and therefore benefit polar bears. Others have noticed that later freeze-up and earlier melt in sea ice have also resulted in decreased harvesting pressure as unsafe and impassable ice conditions restrict the range of hunters.	

Technical Summary – Indigenous and Community Knowledge Component

Question	Indigenous and Community Knowledge
About the Species	
For example: whether cultural relationships have been impacted by declines/changes in the species; whether the species is sensitive to natural/human-caused disturbances; the reproductive capacity of the species; the dispersal capacity of the species; whether the species has critical/important/sensitive habitat components.	Polar bears generally have two cubs (twins), with annual or local variation in the number of cubs related to the relative prevalence of seals the previous spring, when females were mating. The maximum age of polar bears ranges from 13-33 years. Polar bears can cover a huge range in search of prey and mates, including moving between countries (Canada and Russia), and are known to be capable of swimming long distances in open water. They are considered a highly intelligent species, with excellent senses and highly adaptable. Out of all the food they eat, polar bears depend on seals for their survival more than any other species, with seal blubber being a key physiological requirement for polar bears. Ice type, thickness, and location determine where bears are found as ice is the primary platform from which polar bears hunt ringed and bearded seals. Until recently, and despite annual variation, many ice features were found with some certainty in the same locations year after year. Changes in the occurrence and location of multi-year and annual sea ice, pressure ridges, floe edges, and polynyas have affected the location of polar bear and seal denning sites, and the distribution and movements of polar bears and seals and have altered the location of historic Inuvialuit hunting areas and travel routes. These changes are affecting Inuvialuit knowledge. Since the mid-1980s, no one has been able to travel and hunt polar bears as far offshore as they had previously. Warmer temperatures and poor ice conditions disrupt Inuvialuit observations and harvesting that previously extended further into the season.

Place	
For example: amount and quality of habitat available to the species compared to the past; changes in range use by the species; whether knowledge holders feel there will be changes in habitat quantity/quality; whether the species has shifted its distribution/range, and if so, how.	Although there can be considerable seasonal/annual variation in sea ice conditions and polar bear movement patterns, in recent years, changes in polar bear migration patterns have been observed. A decline in multi-year ice along the west coast of Banks Island may be contributing to these changing patterns. Since the 1980s, Inuvialuit have increasingly observed the intensifying effects of climate change on the weather, sea state, sea ice, and snow. However, hunters caution that the ultimate impact of ice loss on polar bears is not yet fully clear and the sea ice habitat in the Beaufort where polar bears live is extremely complex. Ice conditions matter, and ice type, thickness, and location will determine where bears are found. Multi-year ice is disappearing, but annual sea ice will still be available for polar bears. Numerous hunters believe that bears will be more successful in annual ice, and others believe bears will move north as annual ice replaces multi-year ice.
Population (e.g., local, regional)	
For example: how often the species is observed compared to the past (less, more, same) and, if possible, the degree of change in observed abundance; whether the species is now unavailable, or less available, in areas where it was historically abundant; whether these changes are seen as normal or not for the species; if knowledge holders are expressing concern about the species' future, whether they express these concerns in	Polar bear abundance changes from year to year and from region and region. Polar bear population size is cyclical over time and populations across North America naturally increase and decrease as the population changes or as bears move from one area to another. However, overall, studies based on Inuvialuit knowledge suggest that, as of 2018, the Northern Beaufort, Southern Beaufort, and Viscount Melville subpopulations are stable, and the Northern Beaufort and Viscount Melville subpopulations may in fact be increasing. Some knowledge holders have observed that the distribution and local abundance of polar bears have changed over time, though different communities report different patterns, such as polar bears arriving from the north later in fall than previously. In general, knowledge holders have reported that the

the short-, medium-, or long-term.	physical condition of polar bears has remained stable over time, although there is considerable variation from one season to the next, and even within a given hunting season. Similarly, polar bear distribution must be interpreted and analyzed in terms of an understanding of considerable seasonal/annual variation in sea ice conditions and polar bear movement patterns It is important for hunters to avoid speculating about the future. The future is unknown, and because of this, it is believed that one should be humble about one's abilities to predict what will happen, and not expect any one particular outcome over another.
Threats and Limiting Factors	
For example: how knowledge holders characterize the degree of disturbance the species and/or its habitat are facing, through human-caused or natural sources.	Climate change is causing or compounding all major threats to polar bears and their habitat in the NWT, including changes in sea ice habitat, offshore oil and gas exploration and development, and increased marine traffic. The combined effects of climate change with rapidly increasing development and activity in the Arctic are cause for high uncertainty and concern about cumulative impacts on polar bears and their habitat. Since the 1980s, Inuvialuit have increasingly observed the intensifying effects of climate change on the weather, sea state, sea ice, and snow. These changes may affect polar bear health (inaccessibility of food), change their range and migrations, and stress their adaptive capabilities. Seals, the primary prey species for polar bears, are also being impacted by climate change, impacting habitat availability and food availability. Impacts to seals are likely to be felt by polar bears. Offshore oil and gas exploration and development brings with it the risk of water pollution and disturbance. The consequences from a spill or blowout are thought to be potentially catastrophic to Arctic life. Disturbance to seals and polar bears can also result from seismic blasting and

	industrial activity near the shoreline, which could impact their movements and migrations. The opening of the Northwest Passage to marine traffic is seen as having the potential to be one of the most serious threats to polar bear habitat, preventing open leads from re-freezing properly and contributing to the decline in multi-year ice. Noise from ships could affect polar bear and seal communication and social functions, including migrations and movements. Other threats include invasive research techniques and behavioural changes caused by disturbances or nutritional stress. Pollution and contamination are being more frequently observed, especially in the form of marine plastics.
Positive Influences	
For example: factors that are or are likely to have a positive influence on the status of the species in the NWT, including habitat protection, community conservation initiatives, etc.	Inuvialuit have been managing polar bears for generations and have codes of conduct, traditional practices, and bylaws in place to ensure harvesting practices are sustainable. The precautionary principle is applied to quota decisions to ensure that wildlife populations will not be negatively affected by the harvest. The *Inuvialuit Final Agreement* introduced a wildlife management regime that established the paramountcy of conservation and preservation of wildlife in the Inuvialuit Settlement Region, and made the Inuvialuit partners in all matters related to the management of wildlife in the Western Arctic. Collaborative management is undertaken through hunters and trappers' committees, and with management authorities, other Indigenous groups, and biologists. Landmark agreements like the 1988 Inuvialuit-Inupiat Agreement and the 2006 Kitikmeot-Inuvialuit Polar Bear Management Agreement promote transboundary management and knowledge sharing. In 2017, the Inuvialuit Settlement Region Polar Bear Joint

	Management Plan was completed. This plan was developed to meet the requirements of a management plan under the territorial *Species at Risk (NWT) Act* and the Inuvialuit Settlement Region (Yukon and NWT) regional component of the national management plan under the federal *Species at Risk Act* while respecting the joint management process legislated by the Inuvialuit Final Agreement (IFA). Across the NWT and NU there are a number of protected areas (terrestrial and marine) and conservation areas within the range of polar bears. Community conservation plans have been developed and recently updated for all six Inuvialuit Settlement Region communities. These plans identify critical habitat, community uses, and conservation objectives, to inform future decision making. In 2016, Fisheries and Oceans Canada designated the *Anguniaqvia niqiqyuam* Marine Protected Area in Darnley Bay. This area has been identified as a highly productive area for a variety of species, including Arctic char, beluga whales, polar bears, ringed seals, and a variety of birds.

Technical Summary – Scientific Knowledge Component

Question	Scientific Knowledge
Population Trends	
Generation time (average age of parents in the population) (indicate years, months, days, etc.).	11.5 years (95% CI: 9.8–13.6 years).
Number of mature individuals in the NWT (or give a range of estimates).	Likely ≲ 1,000 mature bears living within NWT borders, at any time during the year.
Percent change in total number of mature individuals over the **last** 10 years or 3 generations, whichever is longer.	Likely decline in the Southern Beaufort Sea subpopulation over the past three generations. Data are deficient to conclude declines in other subpopulations shared within the borders of the NWT.
Percent change in total number of mature individuals over the **next** 10 years or 3 generations, whichever is longer.	No formal simulations available. The best available scientific evidence suggests that around 2006 the Southern Beaufort Sea subpopulation declined by 25–50%, linked to declining sea-ice habitat. The Southern Beaufort Sea subpopulation has neither continued to decline, at writing, nor recovered. Sustained declines in body condition of ringed seals of the Northern Beaufort Sea subpopulation have also recently been a cause of concern, but due to lack of data there exists no quantitative projection of decline for polar bears considering all NWT bears together. Notwithstanding the lack of data to quantitatively project the population forward, the best available evidence suggests that the NWT polar bear population is more likely to decline than increase over the next three generations, i.e., to 2050. The magnitude of potential change is not possible to project.
Percent change in total number of mature	The balance of scientific evidence suggests the collective population inhabiting the NWT is more likely to be declining

individuals over any 10 year or 3 generation period that includes **both the past and the future**.	than increasing, and has very likely declined over the past two generations for NWT polar bears of the Southern Beaufort Sea (as demonstrated on the Alaska side of the border).
If there is a decline in the number of mature individuals, is the decline likely to continue if nothing is done?	Yes
If there is a decline, are the causes of the decline reversible?	No. Any future decline would be very difficult to reverse, as it is most likely related to nutritional stress resulting from climate-related changes to sea ice.
If there is a decline, are the causes of decline clearly understood?	No. The relationship between climate change and subsequent impacts on sea ice habitat in the NWT, the distribution and abundance of polar bear food resources (especially ringed seals), and demography and abundance of polar bears is complicated and not clearly understood.
If there is a decline, have the causes of the decline been removed?	No
If there are fluctuations or declines, are they within, or outside of, natural cycles?	Polar bears are not known to cycle. Any fluctuations or declines would be outside of natural cycles.
Are there 'extreme fluctuations' (>1 order of magnitude) in the number of mature individuals?	No
Distribution	
Estimated extent of occurrence in the NWT (in km^2).	1,467,985 km^2

Index of area of occupancy (IAO) in the NWT (in km²; based on 2 x 2 grid).	1,454,148 km² Note: IAO is slightly smaller than extent of occurrence because of the inclusion of some inland areas within a minimum convex polygon required to estimate the latter. These areas were deleted from IAO as unsuitable habitat.
Number of extant locations in the NWT.	There are four recognized subpopulations in one continuous population sharing coastal and offshore areas of the NWT with other adjacent jurisdictions. The number of extant locations is unknown.
Is there a **continuing decline** in area, extent, and/or quality of habitat?	Yes, for quality of habitat, especially in the Beaufort Sea.
Is there a **continuing decline** in number of locations, number of populations, extent of occupancy, and/or IAO?	No
Are there 'extreme fluctuations' (>1 order of magnitude) in number of locations, extent of occupancy, and/or IAO?	No
Is the total population 'severely fragmented' (most individuals found within small and isolated populations)?	No
Immigration from Populations Elsewhere	
Does the species exist elsewhere?	Yes
Status of the outside	The species in Canada is listed as Special Concern on

population(s)?	Schedule 1 of the federal *Species at Risk Act*, and was last re-assessed as such by the Committee on the Status of Endangered Wildlife in Canada in 2018 (COSEWIC 2018). The Southern Beaufort Sea subpopulation (and the species in general) is listed as Threatened on the Alaska side of the Canada/United States border (United States *Endangered Species Act*) and has experienced declines there. Polar bear has no status in Yukon or Nunavut where there is no stand-alone species at risk legislation in place. Polar bear is listed as Threatened in Manitoba (2008) and Ontario (2009), and is Vulnerable in Quebec (2009) and Newfoundland and Labrador (2008). The Arctic Basin subpopulation outside Canada is of unknown status. The IUCN status is vulnerable.
Is immigration known or possible?	Yes
Would immigrants be adapted to survive and reproduce in the NWT?	Yes
Is there enough good habitat for immigrants in the NWT?	Yes, however, future expected changes to sea ice in the southern latitudes of the Beaufort Sea will result in reduced amounts of sea ice habitat for potential immigrants from the United States. Over the longer term, reduced habitat for immigrants is also expected in the higher latitudes of the Beaufort Sea. Trends of available habitat for immigrant polar bears in the Viscount Melville Sound have not been assessed.
Is the NWT population self-sustaining or does it depend on immigration for long-term survival?	The NWT population is self-sustaining (although no subpopulation is identified as occurring solely within NWT borders).
Threats and Limiting Factors	
Briefly summarize negative influences and indicate the	Climate change is the ultimate limiting factor affecting polar bear distribution and numbers in the NWT, with the

magnitude and imminence for each.	main threat being loss of habitat (sea ice) leading to changes in availability of food (access to and abundance of seals, especially ringed seals). Direct human-caused mortality is also a limiting factor; however, harvest and kills in defense of life or property have not been heavy in the NWT and are rigorously managed. Survival and reproduction are limited by ice conditions and thus food availability. Declines in survival and reproduction have been noted for the Southern Beaufort Sea subpopulation in connection with climate change-related losses in sea ice. A ~10% decadal decline in summer extent of sea ice for the Arctic, with 2012, 2016, 2019, and 2020 being particularly warm years leading to the lowest autumn extent of sea ice on record for places like the Beaufort Sea, suggests polar bear habitat in the NWT is shifting rapidly. Ongoing declines in body condition of ringed seals of the Northern Beaufort Sea (Amundsen Gulf), which appear to be related to climate change in a complicated manner, have not reversed. However, polar bears are adaptive to changing habitat conditions, and can and do shift diets from species like ringed seals and dietary niche based on changing food availabilities. Over the long term, it is speculated that due to climate change, habitat for polar bears will be reduced throughout polar bear range in the NWT.
Positive Influences	
Briefly summarize positive influences and indicate the magnitude and imminence for each.	Positive influences on polar bear numbers in recent years stem largely from coordinated management of shared populations with adjacent jurisdictions. Current harvest is below the allowable quota and favours males. This sex ratio in harvest may benefit polar bear productivity.

Glossary

Term	Dialect	Translation	Source
Aglu		Breathing holes	Lowe 2001
Aiviq		Walrus	Hart *et al*. 2004
Angutiryuaq	S	Shovel bears	JS 2015
Arviq		Bowhead whale	Hart *et al.* 2004
Aulagun quglygniq	K	Pressure ridges	Lowe 1984, 2001
Avalliq/avallialuk		Pullen Island	Cockney 1997; Richardson in SARC 2012: 12, 63
Hiku	U, K	Sea ice	Lowe 1984, 2001
Hikualuk	U	Old ice	Lowe 1984, 2001
Hikuliaq	U	Annual ice/ new ice/ young ice	Lowe 1984, 2001
Hikulihaaq	K	Annual ice/ new ice/ young ice	Lowe 1984, 2001
Hikulluak	K	Land-fast ice	Lowe 1984, 2001
Hikulluaq	S	Land-fast ice	Lowe 1984, 2001
Hiku nuulailaq	U	Multi-year ice	
Hikupiaq	U	Land-fast ice	Lowe 1984, 2001
Hikuqpai	U	Icebergs	Lowe 1984, 2001
Hikut ahiqqut	K	Rubble ice	Lowe 1984, 2001
Hikuyuittuq	K	Floe edges and polynyas	Lowe 1984, 2001
Hitilik		Mercy Bay, Banks Island	Haogak *in* SARC 2012
Igluligyuaq		Pelly Island	Richardson in SARC 2012: 12, 63
Ikaahuk		Sachs Harbour/ Banksland	Usher 1970b; Slavik *et al.* 2009
Ikaahukmiut		Sachs Harbour residents	
Ikiqtunaayuk		Johnson Point, Banks Island	
Ikkuq		Gore Islands, Banks Island	Haogak *in* SARC 2012
Imnaqpaluk		Big Bluff, Banks Island	
Imnaqyuak	S[1], U[2]	Nelson Head, Banks Island	Farquharson 1976
Ivunrit	S	Ice pileups	Lowe 1984, 2001
Ivunrit	U	Pressure ridges	Lowe 1984, 2001
Ivvuit	S	Rough ice	Lowe 1984, 2001
Ivvuq	S	Rubble ice	Lowe 1984, 2001
Kamikgik		Hooper Island	Richardson in SARC 2012: 12, 63
Kangikyuatihuk		Minto Inlet	S. Tiktalik *in* Nagy 1999
Kangiqhualuk		De Salis Bay, Banks Island	Nagy 1999
Kangiqluk		Old Horton River	Slavik *et al*. 2009
Kangiryuarmiut		Copper Eskimo	Stefansson 1913
Katyaaq	U	Hungry bears/ starving bears	Haogak *in* SARC 2012

[1] Siglitun (S)
[2] Uummarmiutun (U).

Kayaaniq	S	Starving polar bear/ spooked bear	JS 2015; Hart *et al.* 2004
Kayanaluit	S	Starving bears	
Kayangnituk		Hungry bears	S. Lucas *in* Slavik 2013
Kogluk		Jumpy bear	Hart *et al*. 2004
Kuglunik	S	Pressure ridges	Lowe 1984, 2001
Kugmallit		Shallow Bay	J. Sittchinli *in* Berger 1976b
Kuuk		Horton River	J. Pokiak *in* Slavik *et al*. 2009
Kuukayuk		North Star Harbour	
Kuuruq		Whale Bluffs	Hart *et al.* 2004
Manilaq	K	Rough ice	Lowe 1984, 2001
Murarat	U	Rubble ice	Lowe 1984, 2001
Nannuit	U	Polar bears (plural)	MPEG 2006
Nannut	S	Polar bears (plural)	MPEG 2006
Nannuktauguktualuit		Monster bear (huge paws, fearless)	MPEG 2006
Nanuq[3]		Polar bear (singular)	Lowe 2001; MPEG 2006; JS 2015
Nanurluit		Extremely large polar bears in the Chuckchi Sea area	Voorhees *et al.* 2014
Natchiq/natchiit	U, S	Ringed seal (singular/plural)	Lowe 1984, 2001
Nattiq	K[4]	Ringed seal	Lowe 1984, 2001
Nunavialuk		Maitland Point	
Nuvuk		Cape Kellett/ Cape Dalhousie/ Observation Point	Haogak *in* SARC 2012
Nuvuraq		Atkinson Point	Richardson in SARC 2012: 12, 63
Paatchaluk	S	Starving bears	
Piilauyuq tariuq		When the ocean ice has no openings	J. Nasogaluak *in* Hart *et al.* 2004
Piqaluyak	K	Icebergs	Lowe 1984, 2001
Piqaluyaq	S	Multi-year ice/ icebergs	Lowe 1984, 2001
Pualrisiktualuit		Monster bears (huge paws, fearless)/ shovel bears	MPEG 2006
Qairilaq hiku	U	Rough ice	Lowe 1984, 2001
Qaliriik hiku	K	Ice pileups	Lowe 1984, 2001
Qangangnittaq hiku	K	Multi-year ice	
Qaugaq		Eider ducks	Hart *et al.* 2004
Qikitaruk		Herschel Island	Richardson in SARC 2012: 12, 63
Qilalugaq		Beluga	Hart *et al.* 2004
Quglugniq		Pressure ridges	Lowe 2001
Sarvaq		Currents	Lowe 2001

[3] The Inuvialuit people are made up of three subgroups – the Uummarmiut, Siglit, and Kangiryuarmiut – each with a distinctive dialect of the Inuvialuktun language (Joint Secretariat 2015).
[4] Kangiryuarmiutun (K).

Sikiituq		Snowmobiles	Lowe 2001
Siku	S	Sea ice	Lowe 1984, 2001
Sikuliaq	S	Annual ice/ new ice/ young ice	Lowe 1984, 2001
Silu		Beached whale	Hart *et al.* 2004
Tigiaqpak	K	Weasel bear (polar bear that looks and runs like a weasel)	Slavik 2013
Tiriaranaq		Weasel bear (polar bear that looks and runs like a weasel)	MPEG 2006
Tiriarnaq	S	Weasel bear (polar bear that looks and runs like a weasel)	Slavik 2013
Tuktu		Caribou	Lowe 2001
Tuktuuyaqtuuq		Tuktoyaktuk	
Tuvaq	S	Land-fast ice	Lowe 2001
Tuvvaq	K	Land-fast ice	JS 2015
Ualligyuaq		Garry Island	Richardson in SARC 2012: 12, 63
Ugruk/ugruit	U	Bearded seal (singular/plural)	Lowe 1984, 2001
Ugyuk/ugyuit	K, S	Bearded seal (singular/plural	Lowe 1984, 2001
Uiniq	S	Floe edges and polynyas	Lowe 1984, 2001
Uiniq		Open leads	Lowe 2001
Ukivik		Kendall Island	Slavik *et al*. 2009
Umingmak		Muskox	Lowe 2001
Umingmalik		Melville Island	
Ungalaq		West wind(s)	Lowe 2001; Hart *et al*. 2004
Uqsuq		Seal blubber	Lowe 2001
Utqaluk		Baillie Islands	Richardson in SARC 2012: 12, 63
Utuqaq hiku	K	Old ice	Lowe 1984, 2001
Utuqqaq	S	Old ice	Lowe 1984, 2001
Vunrit	U	Ice pileups	Lowe 1984, 2001

Table of Contents

Table of Figures

INDIGENOUS AND COMMUNITY KNOWLEDGE COMPONENT

Preface

"You can't really teach someone on a piece of paper, like theoretical. For that, you have to be more practical; you have to go out there and show them. They have to physically see what you are talking about, compared to reading it from a piece of paper. That's the teaching that I do. I bring them out there., I let them feel the ice. They can see the... different ice colours. Which is safe, which is good to go on, which is not safe, [where] it could be unstable. So, there are all these things about the ice. And you've got the currents, you've got the moon, you've got the wind direction. You can't teach a person in one week about all these changes that are happening, that you're aware of, that you could see, you could hear and feel. But giving that knowledge takes time; say, two, three years just to absorb this information and keep seeing." (PIN 158 [Paulatuk] in Joint Secretariat 2015)

The consideration of Indigenous peoples' cultural histories, identities, languages, social organizations, and interactions with their environment is of vital importance for the accurate assessment of species. While all reasonably available Indigenous and community knowledge was solicited for inclusion in this status report, limitations are acknowledged. First, in the completion of these reports, the Species at Risk Committee (SARC) is not able to conduct any primary research or information gathering activities (e.g., interviews). The transcription and verification of Indigenous and community knowledge is often complex and resource-intensive, not to mention sometimes controversial (Bayha 2012). It is often the case that only a small portion of the Indigenous and community knowledge that exists in recorded interviews has actually been transcribed. This limits the completeness, and perhaps also accuracy, of a status report. Second, it is important for us to recognize that the recorded Indigenous knowledge that has been transcribed and was available for inclusion in this status report, is, in many respects, removed from the cultural, spiritual, linguistic, and ecological context in which it was intended to be heard (Berkes *et al*. 2000; Thorpe 2004; SENES Consultants Ltd. 2010; Tłı̨chǫ Research and Training Institute [TRTI] 2016). Translation, in particular, can result in generalizations and the loss of sometimes subtle descriptions of inter- and intra-specific variation, interactions, and patterns (TRTI 2016; Polfus *et al.* 2017). As noted by Polfus *et al*. (2017: 17), "*words are used in context and convey different meaning depending on who is speaking, what dialect is being used, what questions are being addressed, where on the land the speaker is located, and the dialect or background of the audience*." Although Indigenous knowledge and its transmission is ultimately grounded in practice, language is integral to its interpretation (Bayha 2012; Polfus *et al.* 2016). Ultimately, understanding the environment

(animals, plants, land, water, air, etc.); that is, practicing one's culture, is essential to understanding the stories and legends.

Preamble

Regional/Cultural Background

The Inuit occupy the largest area of any Indigenous peoples, extending from Siberia, across the coastal areas of Alaska and Canada, to the east coast of Greenland (Freeman 1976; Damas 1984; Riewe 1991). The Inuvialuit in the Mackenzie Delta-Beaufort region of Canada's Western Arctic originate from at least three regionally and culturally distinct Inuit ancestors – the Mackenzie Inuit, the Iñupiat, and the Copper Inuit (Ayles and Snow 2002). The Inuvialuit number approximately 5,000 people and are made up of three subgroups – the *Uummarmiut*, *Siglit*, and *Kangiryuarmiut* – each with a distinctive dialect of the Inuvialuktun language (Joint Secretariat [JS] 2015).

Inuvialuit have been hunting polar bears (*nanuq*) in their traditional territories in the Western Arctic since time immemorial (JS 2015). Harvesting polar bears and other animals has always been an integral part of the Inuvialuit identity, values, livelihoods, and culture: "In addition to nourishing their imaginations, spirituality and creative arts, these animals and the harvesting of them have until relatively recent times been the foundation of their economy" (JS 2015: 1).

Polar bears were one of the main subsistence species for the *Kangiryuarmiut* – Copper Inuit from the Walker Bay and Minto Inlet region of Victoria Island (Usher 1971; Nagy 1999). Stefansson (1913) observed this group was unique in their strong tradition and practice of polar bear hunting:

"[The Kangiryuarmiut] live on a diet differing from that of any other Eskimo tribe known to us; for more than three-fourths of their food consists of polar bears, which they hunt with dogs, knives, and bows and arrows on the ice off Nelson head, where the strong currents keep the lanes of water open all winter." (p. 453)

The *Kangiryuarmiut* hunted polar bears on foot on the ice off the southeast coast of Banks Island between Nelson Head (*Imnaqyuak*), DeSalis Bay (*Kangiqhualuk*), the Horizon Islands, and Cape Baring on the southwestern point of Victoria Island (Stefansson 1913, 1919; Farquarson 1976). Stefansson (1919) wrote:

"Nelson Head is rich in bears, and they form the chief article of food in winter for the larger portion of the Kangiryuarmiut. Even for fuel, bear grease here largely replaces seal oil, though occasionally the bear hunters near Nelson Head trade bear meat or fat for seal blubber to their neighbors towards DeSalis Bay, for these do not depend exclusively on bears." (p. 49-50)

Historically, polar bear was harvested more for the meat than for the hides, although the hides had many purposes as well before becoming a tradeable commodity. Both polar bear meat and seal meat were essential to sustaining dog teams, and most of the hunting of these species was for dog feed – the equivalent of fuel, to work on the trap lines in the winter months (Slavik 2013). In the 1960s, Usher (1970b) estimated that 75% of all country food obtained at Sachs Harbour was used to feed dogs.

During the early years of trapping on Banks Island from 1928-1948, polar bear harvest levels were low (relative to later peaks) because bears were used primarily for meat and clothing (Usher 1970a). There was little economic incentive to hunt bears exclusively for their fur as trappers were making a very good income from trapping. As Joseph Carpenter from Sachs Harbour explained, "*if you've got a lot of foxes you don't depend on polar bear for income*" (Slavik 2013: 155). Polar bears were hunted any time of the year, especially by trappers whose lines followed the coast (Usher 1970a). Before the value of bear hides rose, most people would not go out exclusively for bears. Instead they would hunt polar bears opportunistically, and the harvest pressure on the bears was generally low (Barr 1996). In the past, smaller bears may have been preferred because some harvesters believed their hides were easier to work on, their fur was ideal for clothing such as wind pants, and their meat was preferred (Nagy 1999). Inuvialuit harvest of polar bears traditionally focused on females and their cubs in and near maternity dens; however, this practice was banned by the Government of the Northwest Territories (GNWT) by the mid-1960s (JS 2015, 2017).

As much as the polar bear hunt is dictated by ice conditions, seasonality, availability, harvesting pressure, and management decisions, it is also influenced by the ebb and flow of economic and global policy. This includes gas prices, the cost and demand for guided hunts, and the price for bear hides on the global market. Together these factors influenced the commoditization of polar bears through sale and sports hunting. The economics of polar bear harvesting varied from one community to the next, reflecting historical and regional differences in fur prices, as well as access to the DEW (Distant Early Warning) Line and sport hunting markets (JS 2015). For example, one Paulatuk hunter said that prior to DEW Line construction near the community in the 1950s, polar bear pelts were used mostly for clothing. Once the DEW Line arrived, employees were a new market for the meat and pelts and were willing to pay good money for them, which caused the economics of polar bear hunting to change overnight (JS 2015). A Tuktoyaktuk elder said that DEW Line personnel purchased polar bear hides at a time when the pelts sold for far less than those of white foxes (JS 2015).

The 1970s saw significant changes in the economics of hunting polar bears as the price of furs increased considerably and Inuvialuit began guided sport hunting (JS 2015). To address the increasing harvests due to high demand and high prices for polar bear hides, the GNWT introduced guided sport hunting for polar bears, in order to allow for a new economic

opportunity for realizing an increased income from the smaller number of animals allowed under the new quota system (Stirling 2002; JS 2017). In 1973, the International Agreement on the Conservation of Polar Bears was signed in Oslo, Norway, which among other things, prohibited all taking (including hunting, killing, and capturing) of polar bears except for specific exceptions, such as traditional hunting, defence, and research (Stirling 2002). Canada was the only nation to allow an exception for sports hunting, with the stipulation that the hunter must be guided by an Inuit outfitter and travel must use traditional methods (i.e., dog teams). Guiding provided income to Inuvialuit hunters and "an economic rationale for the continuation of the polar bear hunting tradition" (JS 2015: xiv).

Over the last 30 years, guided polar bear sport hunts have become economically important to Inuit and Inuvialuit communities as a means of earning culturally appropriate income (Wenzel 2005; Freeman and Wenzel 2006). In the Western Arctic, sport hunts at times accounted for roughly half of the total polar bear harvest and brought in approximately $400,000 annually to local hunters in Sachs Harbour, Ulukhaktok, Paulatuk, and Tuktoyaktuk (Usher 2002). When sport hunts began, the tags were split 50:50 between subsistence and guided hunts. This split allocation of bears between sport hunts and subsistence hunts is because the maintenance, transmission, and celebration of the polar bear hunting culture was highly valued by the Inuit and Inuvialuit (Freeman 2001). Sport hunting also encouraged continuation of traditional lifestyles through the maintenance of hunting-dog teams, providing young people with on-the-ice experience, and generating the necessary income to support subsistence harvesting activities – which increase yearly due to increases in the cost of gas and other operating expenses (Slavik 2013). In fact, as observed in *Inuvialuit and Nanuq: A Polar Bear Traditional Knowledge Study* (JS 2015):

"…the high cost of living in the Western Arctic, including the price of gas, oil and food, has deterred many younger people from travelling great distances in pursuit of polar bears, particularly where Inuvialuit based in Inuvik and Aklavik are concerned. Wage labour in the towns provides more income than what they can earn from harvesting polar bears." (p. 202)

The Joint Secretariat study (2015) gathered biological and ecological information from Traditional Knowledge Holders to inform management. In the study, several Indigenous knowledge holders spoke of the factors responsible for a decrease in traditional harvesting activities and the knowledge transmission associated with them. This includes: an increased dependence on community life; formal schooling (including residential schools); wage employment; the increasing cost of travel and harvesting (e.g., gas, snowmobile purchases); and the immersion in a global culture of television, internet, and computer games (JS 2015). Younger generations are not spending as much time on the ice, water, and land, and therefore have fewer opportunities to learn from elders (JS 2015).

Polar bear pelts provided clothing, mattresses, and tools for maintaining sled runners. Hides, teeth, claws, bones, and skulls from harvested bears were used for traditional purposes (e.g., clothing, household items, tools, and medicine), sold locally as artifacts and crafts, or entered the commercial fur trade (Keith 2005; Peacock *et al.* 2011; Kakekaspan *et al.* 2013; Kendrick 2013; JS 2015; Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2018). Polar bear fur continues to be used to make handicrafts and traditional clothing such as wind pants (Slavik 2013; JS 2015).

Polar bear meat is still consumed in many Inuit communities (Keith 2005; Inuvik Community Corporation [ICC] *et al*. 2006; Slavik *et al*. 2009; Wenzel 2011; Zotor *et al*. 2012; Kolahdooz *et al*. 2014). In the past, the intestines, meat, and heart were eaten, while the bladder, bowels, liver, lungs, kidney, and genitalia were not (Kasam 2009). Polar bear fat was commonly consumed, and the paws were considered a delicacy - "a tradition that remains, with hunters offering polar bear paws to the elders" (Slavik 2013: 154). In Alaska, Voorhees *et. al.* (2014) also found that polar bear meat is a delicacy for elders, but many of the younger generation avoid it because of its intense flavor and the risk of *trichinosis*.

Due to the close interaction with, and continued reliance on, land and marine animals for subsistence and economic purposes, Inuvialuit have considerable knowledge of their regions' geography, fauna, weather, and ice conditions. Their reliance on the land and ice for income and subsistence has emphasized the importance of monitoring and learning from their environment (Slavik 2013; JS 2017). Since the 1980s, Inuvialuit have increasingly observed the intensifying effects of climate change on the weather, sea state, sea ice, and snow. Inuvialuit hunters have experienced directly, and learned from one another, how polar bears, seals, and other wildlife have responded to these changes, just as Inuvialuit hunters themselves have responded to these changes (JS 2015).

Inuvialuit come by their knowledge of polar bears primarily through "intergenerational knowledge transmission, direct experience, daily social interaction, and use of modern mass media and technologies" (JS 2015: 211). As expressed by one knowledge holder from Tuktoyaktuk, "all this knowledge never really clicks until you're actually experiencing it" (JS 2015: 211).

The Joint Secretariat study (2015) summarizes how the Inuvialuit understand the species within their culture and worldview:

"The most important aspects of Inuvialuit knowledge concerning polar bears are intergenerational knowledge (acquired from parents, grandparents and other elders) combined with direct experience. In general, this is what Inuvialuit mean by Traditional Knowledge (TK): personal knowledge acquired by travelling across ice, hunting seals and polar bears, running dog teams, reading wind directions, snow and cloud patterns, geographic features, currents and stars, and by intergenerational transmission." (p. 9)

Spiritual/Cultural Importance

Published in the Joint Secretariat study (2015), an elder from Ulukhaktok shared a story about a female polar bear that became a human while her cub became a dog. The story is an origin myth that explains why polar bears resemble humans in certain ways and illustrates a key aspect of the Inuvialuit worldview: there is little differentiation between humans and animals, and they can transform back and forth.

"The stories our ancestors have used…. This guy go out hunting to the hunting grounds, the caribou hunting grounds that his father and his grandfather had gone to before. On his return trip, he could see a plume of smoke coming out of his tent. He never worried about it. He seen it a few times happening. When he's going back home, he sees a plume of smoke. After a while, he wanted to find out what was actually happening. He went to find out what or who was making meals for him. When he gets home, there was food prepared already — tea, everything all ready, all set to eat when he gets back to his tent. But there's nobody around, no one around to see.

One day, he decided he would pretend to go out hunting to his usual hunting grounds, but stay a little bit distant and watch his tent. He went in the direction of where he usually goes hunting, and then he made a turn and went to an area where he could hide, but keep an eye on his tent. He really wanted to find out exactly what was happening, why food is prepared for him, and stuff like that when he got home.

While he was hiding, watching his tent, a couple of bears went over to his tent. The bears went and got up to his tent and removed their skin. And by that, they put their snout out onto the ground, and their skins peeled off of them. The female took her skin off and became a human being and got all dressed in caribou skin clothing, and all that, and then started preparing food for the occupant of the tent.

He got out of his hiding spot and went over to his tent and confronted the bears, but out of the female bear, he cut up the skin of that female bear, the bear that had become a person. He had cut up the skin of that female bear, so there was no way for that female to turn back into a bear…. The other bear that went to the tent with the female became a dog, his pet of some sort, like some animals seem to do.

When he had cut up the skin of that female, that bear couldn't turn back into a bear; let's put it that way. So, he wanted her to become his wife. That cub became his dog and the female became his wife, because that male could provide very well, could provide food. I guess that female wanted to stay with him…. The female was much stronger than the male. So, she would carry more when they're moving from camp to camp; carry more of the provisions, the stuff they need for the camp.

When they got inside of his parents' camp, his parents had seen that he's coming home with a female. So, they figure that he's got a wife now. The mother was running over to them, really

happy and everything. "I've got a granddaughter!" When they got to camp, they greeted everybody, and when they were leaving again, that female bear could pack a lot more than the male. Anyways, they would use the fat of caribou or something for straps and for covering their provisions, their camping gear or any stuff like that, their sewing stuff, and pack them. Anyways, the one who was a bear who had turned into a human put that on.

The mother wanted to help them when they were leaving, help them to another camp. The one who was a polar bear, that female, gave her pack for the mother-in-law to carry. She just handed it to her like it was nothing. That woman was going to put it on her back, and the mother-in-law just collapsed. She fell right to the ground because it was too heavy for her. She couldn't pack that packsack, so the male packed it for her instead. When they moved to the camp, that's where they lived as a couple for the rest of their lives. That female bear never changed back into a bear. She just stayed as a human being.

Because of that story, he figures that…. the bear meat or bear fat has got the same texture as human flesh. That's where that story probably comes from maybe. That's his last words there."[5] (JS 2015: 205-206)

When compared to other animals hunted by the Inuit and Inuvialuit, the relationship between people and polar bears is unique due to the esteemed position polar bears occupy in their beliefs and culture (Wenzel 1983; Keith *et al.* 2005; Dowsley and Wenzel 2008). In general, Inuvialuit have a relationship of respect and mutuality with the animals that share their Arctic environment, based on the understanding that as long as the animals are treated with respect, animals will thrive and freely offer themselves to hunters (Freeman 2001). Polar bears are placed in a special symbolic category not shared by other animals or other bears; some Inuvialuit have referred to *nanuq* reverentially as the "Monarch of the Arctic" (Slavik 2013: 151).

Apart from their economic contribution, polar bears continue to nourish the Inuvialuit imagination. They feature prominently in Inuvialuit mythology, spirituality, storytelling, art, song, and other forms of cultural expression (JS 2015). A key feature of the Inuvialuit worldview — which is shared with their Inuit, Inupiat, and Yup'ik neighbours elsewhere in the Arctic — is that animals are ensouled (animism) and have the same status as human beings[6] (JS 2015). This shared animism allows animals to understand human speech, and for them and humans to communicate with one another (JS 2015).

Humans and other animals have relationships based on the concept of reciprocity. In return for being shown respect, animals offer themselves to human hunters. However, if they are not

[5] The translator of this story said, upon completion of the telling by the elder, that "ancestors have told us to pass these stories on for many, many generations, that originated tens of thousands of years ago or just 500 years ago. That's been passed down for years and years and years, those stories." (JS 2015: 205)
[6] "In the past, special powers were afforded to Inuvialuit shamans who could transform themselves into any number of animals, with the polar bear being one of the most powerful." (Alunik *et al.* 2003: 24)

respected, they will go elsewhere or not present themselves to hunters, with great hardship or even starvation the result for their human neighbours (Alunik *et al.* 2003). Polar bears will avoid hunters if the latter speak inappropriately about them: "bragging, making fun of polar bears or otherwise speaking disrespectfully about them can have serious consequences, including death" (JS 2015: 277). Respect takes various forms, including not speaking badly about the animal, not chewing or consuming certain body parts, not playing with the animal, and taking its life when it presents itself to the hunter rather than refusing the gift of its life (Slavik 2013; JS 2015). Breaking taboos while cooking, sewing, eating, and hunting could lead the animals to not return to hunters, and people were told to say "nothing bad about the animals or they would have a hard time getting them and might even become scarce" (Nagy 1999: 10).

Polar bear hunts were a reason for community celebration, gathering, storytelling, and food sharing. It was a chance for bonding, for teaching, and a reason for companionship between young men and families throughout the community as sharing the meat and other products of the hunt integrates a hunter socially into his or her community (Slavik 2013; JS 2015). There is excitement in taking a young person on their first bear hunt - something the community and family is proud about, as "hunting polar bears in those days took great courage as well as skill in order to grapple with them in their ice environment" (JS 2015: 198). Inuvialuit never forget their first polar bear hunt and it could be considered a rite of passage to becoming a capable hunter and an important coming-of-age ritual for young men (and sometimes women) (Slavik 2013; JS 2015). Today, the customary hunting of polar bear is recognized for its value in preserving Inuvialuit connection to the environment and their cultural identity.

Another way of respecting *nanuq* that is particularly relevant to this species status determination is the worldview of Inuvialuit as it relates to managing wildlife and projecting future population impacts. Voorhees *et al*. (2014) note:

"In Iñupiaq and Siberian Yupik culture, it is important for hunters to avoid speculating about the future. The future is unknown, and because of this, it is believed that one should be humble about one's abilities to predict what will happen, and not expect any one particular outcome over another. Following these cultural norms, hunters caution that the ultimate impact of ice loss on polar bears is not yet fully clear. The great respect that people hold for polar bears grows in part out of the species' ability to find clever ways of adapting and surviving amidst very difficult conditions. It is this respect for polar bears that leaves hunters with a degree of optimism about the polar bears' future." (p. 533)

Inuvialuit are critical of the idea that humans can "manage" highly mobile or migratory wild animals such as polar bears, caribou, seals, fish, and waterfowl. In reality, humans "manage" only a tiny fraction of the Earth's animals in cases where they control their distribution, reproduction, and genetic makeup (Feit 1988). Thus, humans do not "manage" polar bears - "they manage their relations with one another with respect to harvesting polar bears and

through the management of resource extraction and other human activities that have an effect on their abundance, distribution and condition" (JS 2015: 276).

Source Summary and Gaps/Omissions

Stirling (2002) noted that the subsistence hunting of polar bears in the Canadian Beaufort Sea area is not well documented prior to about 30 years ago, leaving a knowledge gap about the traditional use and harvesting practices of polar bears in the academic literature. However, just because this knowledge hasn't been documented, does not mean that it does not exist in the living memory, traditions, and oral history of Inuvialuit and their ancestors. Over the last 25 years there have been numerous oral history projects and Indigenous knowledge studies, culminating in *Inuvialuit and Nanuq: A Polar Bear Traditional Knowledge Study* (JS 2015), which is the most extensive and current study of polar bear Indigenous knowledge available[7]. Over this time, the shift from Indigenous knowledge being supplementary and incidental to academic studies, to being the focus of studies itself is clearly evident (JS 2015). One benefit of this multitude of studies over the last 25 years is the opportunity to use validation, verification, and cross-referencing to strengthen the conclusions and observations held by many individual hunters and elders[8].

Indigenous knowledge research requires training and the application of robust methods and best practices in social sciences as well as interdisciplinary environmental science, so it inherently becomes a multidisciplinary undertaking (Huntington 2000). However, there is not a single, established methodology for Indigenous knowledge research (Riedlinger 2001) and there are contrasting opinions on the most appropriate methods to conduct knowledge studies across circumpolar regions. Some researchers advocate for a standardized methodology in documentation (Fehr and Hurst 1996; Gilchrist *et al*. 2005), which would allow for comparable analysis in communities with large species subpopulation management boundaries, such as among polar bear subpopulations across the Arctic. Others advocate for Indigenous knowledge studies involving creative methodologies to match the conditions and context of

[7] The 2015 Joint Secretariat study had a rigorous interdisciplinary methodology in the design of the survey instrument, interview techniques, analysis, and verification. A total of 72 people were interviewed from the six Inuvialuit communities during 66 interviews, including 11 women. The youngest person interviewed was born in 1982; the oldest was born in 1915. The average birth year of the interviewees was 1948, meaning that their average age was 62 years. One valuable method used to develop conclusions from the study was the community confirmation workshops in 2012, and a Polar Bear Environmental Change workshop. The Polar Bear Environmental Change workshop was held in Inuvik in 2013 and involved 12 Inuvialuit participants, all of whom had been interviewed as part of the 2010 study fieldwork.

[8] For example, in the Aulavik Oral History Project (Nagy 1999), ten of the 49 participants were also interviewed for the 2015 Joint Secretariat study (Nagy 1999). Likewise, community researchers working on a 2008 research project that focused on polar bear denning and post-denning behaviour (Richardson *et al.* 2008) interviewed many of the same people from Aklavik, Inuvik, and Tuktoyaktuk who were interviewed for the 2015 Joint Secretariat study.

where the study takes place (Riedlinger 2001; WMAC [North Slope] 2018). These methodologies must strive to preserve the inherent accuracy and precision of observations by individual informants, while gathering knowledge that has depth of focus and a scope that covers an appropriate spatial and temporal range (Arima 1976; Freeman 1993; Ferguson and Messier 1997).

Rigorous research methodologies must be employed from the start, and field researchers must be trained in both the nuances of Indigenous knowledge research, the geography in which the research takes place, and in the subtleties of the language and worldview of the region's communities and cultures. For example, Ferguson and Messier (1997: 18) caution that "understanding Inuit knowledge is dependent on the investigative techniques used to record it, the researcher's assumptions about the cultural basis for that knowledge, and the researcher's conscious and unconscious assumptions derived from his or her own culture."

Social science methods employed through more recent efforts at information collection include participant observation; semi-directed, in-depth interviews; group workshops; mapping exercises; qualitative analysis; and verification exercises. Participatory mapping was frequently employed, but presents several methodological challenges due to the nature of mapping a continuously evolving sea ice environment[9].

This update to the *Species Status Report for Polar Bear (Ursus maritimus) in the Northwest Territories* (SARC 2012), Indigenous and community knowledge component, includes the following new resources:

- 2016 updates to the community conservation plans (CCPs) of all six Inuvialuit communities (Community of Aklavik *et al.* 2016; Community of Inuvik *et al*. 2016; Community of Paulatuk *et al*. 2016; Community of Sachs Harbour *et al.* 2016; Community of Tuktoyaktuk *et al*. 2016; Community of Ulukhaktok *et al*. 2016).
- Committee on the Status of Endangered Wildlife in Canada [COSEWIC]. 2018. COSEWIC Assessment and Status Report on the Polar Bear *Ursus maritimus* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. xv + 113 pp.
- Joint Secretariat. 2015. Inuvialuit and Nanuq: A Polar Bear Traditional Knowledge Study. Joint Secretariat, Inuvik, NT. xx + 304 pp.

[9] Furthermore, Dowsley and Wenzel (2008: 182-186) caution that "traditional knowledge is almost always derived from local-level observations and may not always translate well into discussions of wildlife populations at the larger geographic scale." Therefore, wildlife managers must be cautious in generalizing spatially-specific Indigenous knowledge throughout the entire range of the species (Slavik 2013).

- Joint Secretariat. 2017. Inuvialuit Settlement Region Polar Bear Joint Management Plan. Joint Secretariat, Inuvik, NT. vii + 66 pp.
- Slavik, D. 2013. Knowing Nanuut: Bankslanders Knowledge and Indicators of Polar Bear Population Health. Master of Science in Rural Sociology Thesis, University of Alberta, Edmonton, AB.
- Wildlife Management Advisory Council [WMAC] (North Slope) and Aklavik Hunters and Trappers Committee [HTC]. 2018. Inuvialuit Traditional Knowledge of Wildlife Habitat, Yukon North Slope. Wildlife Management Advisory Council (North Slope), Whitehorse, YT. vi + 74 pp.

Species Overview

Names and Classification

Inuvialuktun[10]

Nanuq (S, U)	A (one) polar bear	(Lowe 2001; Mackenzie Project Environmental Group [MPEG] 2006; JS 2015)
Nannuk (S, U)	Two polar bears	(MPEG 2006)
Nannut (S), *nannuit* (U)	Three or more polar bears	(MPEG 2006)
Nurraiyaat (U), *nanuaqqat anilramiit* (S)	Newborn cubs in the den	(JS 2015)
Nanuaraaluk	Polar bear cub	(Lowe 2001)
Atauhimik ukiulik (U), *nanuq atautchimik ukiulik* (S)	One-year old cub	(JS 2015)
Nanuaq	Young polar bear	(Lowe 2001)
Anguhaluq (U), *angusalluq inirniq* (S)	Full grown male	(JS 2015)
Arnahaluq narranilu (S), *qitunrailaq* (S)	Adult female without cubs	(JS 2015)

Gwich'in[11]

Chehzhìi' (TG)		(Gwich'in Social and Cultural Institute [GSCI] 2012)
Chehzhyèe' (GG)		(GSCI 2012)

Tłı̨chǫ

Sahcho degoo	Big white bear	(Rabesca pers. comm. 2021; Dogrib Divisional Board of Education 1996)

[10] Three dialects are spoken in the Inuvialuit Settlement Region. Siglit (S) is spoken in the coastal communities of Tuktoyaktuk, Paulatuk, and Sachs Harbour. Uummarmiut (U) is spoken in the Delta communities of Aklavik and Inuvik. Kangiryuarmiut (K), or Inuinnaqtun (I), is spoken in the community of Ulukhaktok (Holman) on Victoria Island.

[11] Two dialects are spoken in the Gwich'in Settlement Area. Teetł'it Gwich'in (TG) is spoken by Gwich'in speakers originating from the community of Fort McPherson. Gwichya Gwich'in (GG) is spoken by Gwich'in speakers originating from the community of Tsiigehtchic.

Description

Polar bears (*nannut* (S), *nannuit* (U)) are large mammals that live on the sea ice and along the coastline throughout circumpolar regions. They live mostly on the sea ice and in marine environments, but will den, travel, and occasionally feed on land. Polar bears are opportunistic predators and their diet consists mainly of ringed (*natchiq* (U, S) *nattiq* (K)) and bearded (*ugruk* (U), *ugyuk* (K, S)) seals[12]. As the largest member of the bear family (Ursidae), polar bears can grow up to 14-16 feet tall according to oral history and hunters' records (Slavik *et al.* 2009). Polar bears are greatly respected by Inuvialuit hunters as the most intelligent animal in the Arctic (Canadian Wildlife Service [CWS] 2010)[13]. They are a culturally, spiritually, and economically important species to the Inuvialuit. As a result, the Inuvialuit have an in-depth knowledge of polar bears and their habitat (Fig. 1).

Figure 1. An Inuvialuit hunter observes a polar bear on land. Photo R. Hamberg, GNWT.

[12] See Glossary for full list of Inuvialuit terms, translations, and references used in this text.
[13] "The polar bear is the most intelligent animal in the wild that I have ever encountered." (R. Kuptana [Sachs Harbour] *in* CWS 2010: 14)

Distribution

The main range and habitat of polar bears in the Northwest Territories (NWT) is in the Inuvialuit Settlement Region (ISR). The ISR includes the coastal regions of mainland NWT and the Yukon North Slope, as well as the Arctic islands of the NWT. Information on the geographic range of polar bears in this area and changes in their range and distribution is informed by generations of Inuvialuit knowledge regarding the best areas to hunt for bears, and countless sightings of bears in their habitat (Fig. 2).

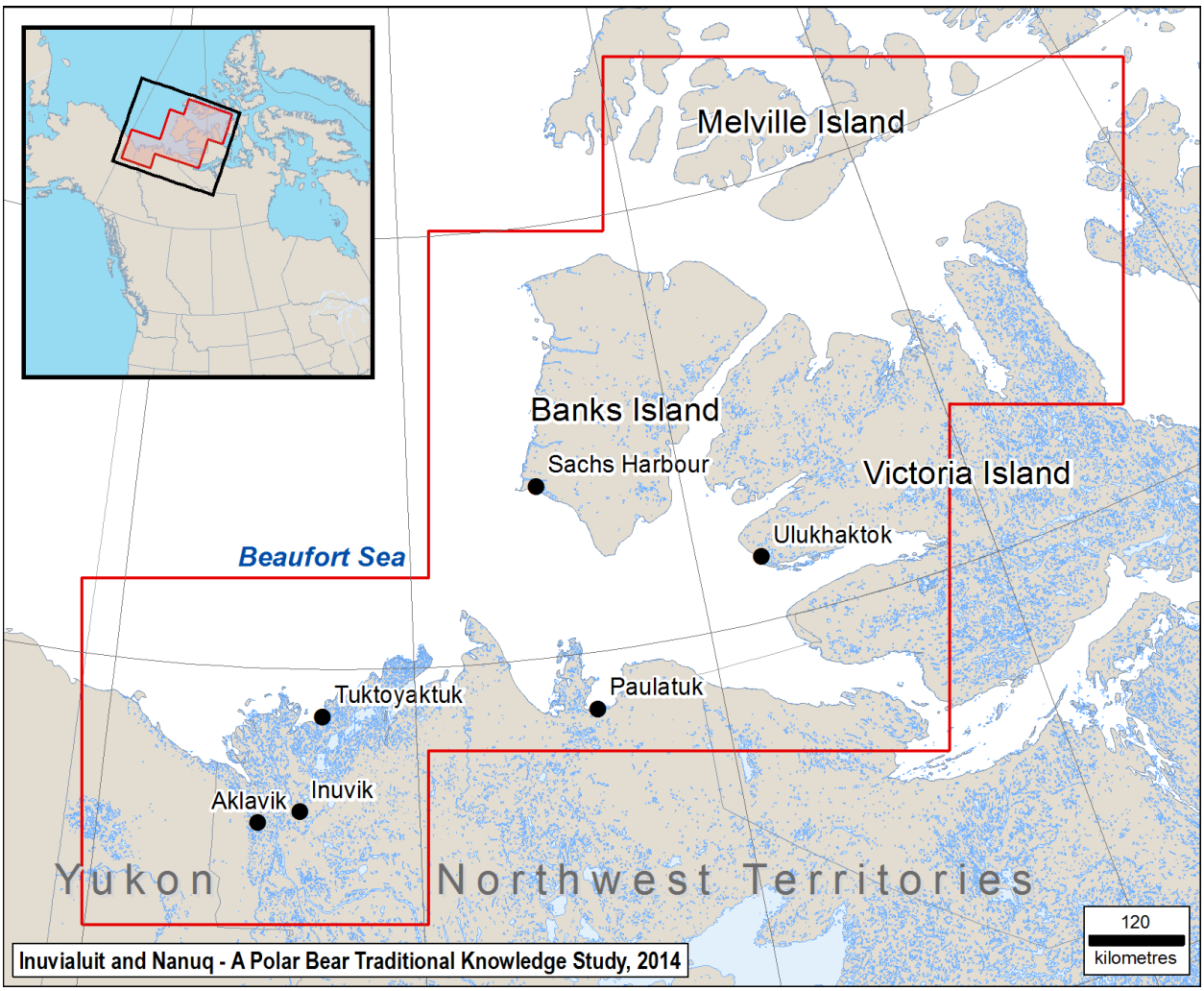

Figure 2. Study area for Inuvialuit and Nanuq: A Polar Bear Traditional Knowledge Study. Reproduced from Joint Secretariat (2015: 4) with permission.

NWT Distribution

Polar bears in the NWT live mostly on the sea ice (*hiku* (U, K), *siku* (S)) of the Arctic Ocean and Beaufort Sea. Seasonally, bears are found along the coastline of the NWT and Arctic islands and may occasionally be found inland on the Arctic islands and up to 400 kilometers (km)

inland from the Beaufort coast (CBC 2008; Frost 2011). In 2008, two observations were reported of polar bears 320 km inland from the Beaufort Sea (COSEWIC 2018).

Polar bears can cover a huge range in search of prey and mates and are known to be capable of swimming long distances in open water (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009)[14]. As solitary animals, polar bears generally live at very low densities but are known to congregate occasionally when feeding or mating:

"When you take off from my home, you could meet the polar bears out there on the ice. Sometimes … different parts of ice there's no bears and it's like an island of bears in another place." (P. Ekpakohak [Ulukhaktok] in Slavik et al. 2009: unpubl. transcript)

Where polar bears will be is largely dependent on the ice conditions in the area:

"The ice conditions has a lot to do with where the bears are. If it's really rough they move elsewhere where there's better hunting. They don't follow a GPS. Where the ice is good for hunting is where you'll find them. They're out there but they're not in the same spot. If it's rough out around Pierce Point, they might move towards Pin-One or Baillie Island where there's better hunting. Cause some years there's not [many] around Pierce Point cause the rough ice - huge, huge blocks of ice so they can't hunt - so they go east or go towards Baillie Island or straight out to Cape Perry or Nelson Head. That's where they do their hunting. Ice has a lot to do with where you see them." (M. Kudlak [Paulatuk] in Slavik et al. 2009: 46)

The central finding of the Joint Secretariat study (2015) is that "ice conditions matter", and ice type, thickness, and location will determine where bears are found (JS 2015: 22; JS 2017). The sea ice habitat in the Beaufort region where polar bears live is extremely complex. This complexity cannot be ignored when considering trends in polar bear abundance, distribution, and condition, or the effects of climate change on polar bears. Polar bear distribution must be interpreted and analyzed in terms of an understanding of considerable seasonal/annual variation in sea ice conditions and polar bear movement patterns (JS 2015).

To categorically examine community knowledge of NWT polar bear distribution, information and observations are grouped into five geographic regions: North Beaufort, Amundsen Gulf, Viscount Melville, Cape Bathurst, and South Beaufort. The regional boundaries used in these descriptions do not correspond to polar bear subpopulation boundaries used for management (Fig. 3). More detailed information on seasonal ranges is also provided where available.

[14] "Polar bear could swim for hundreds of miles without ice, but it's got to hunt in the ice floes." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al*. 2009: 40)

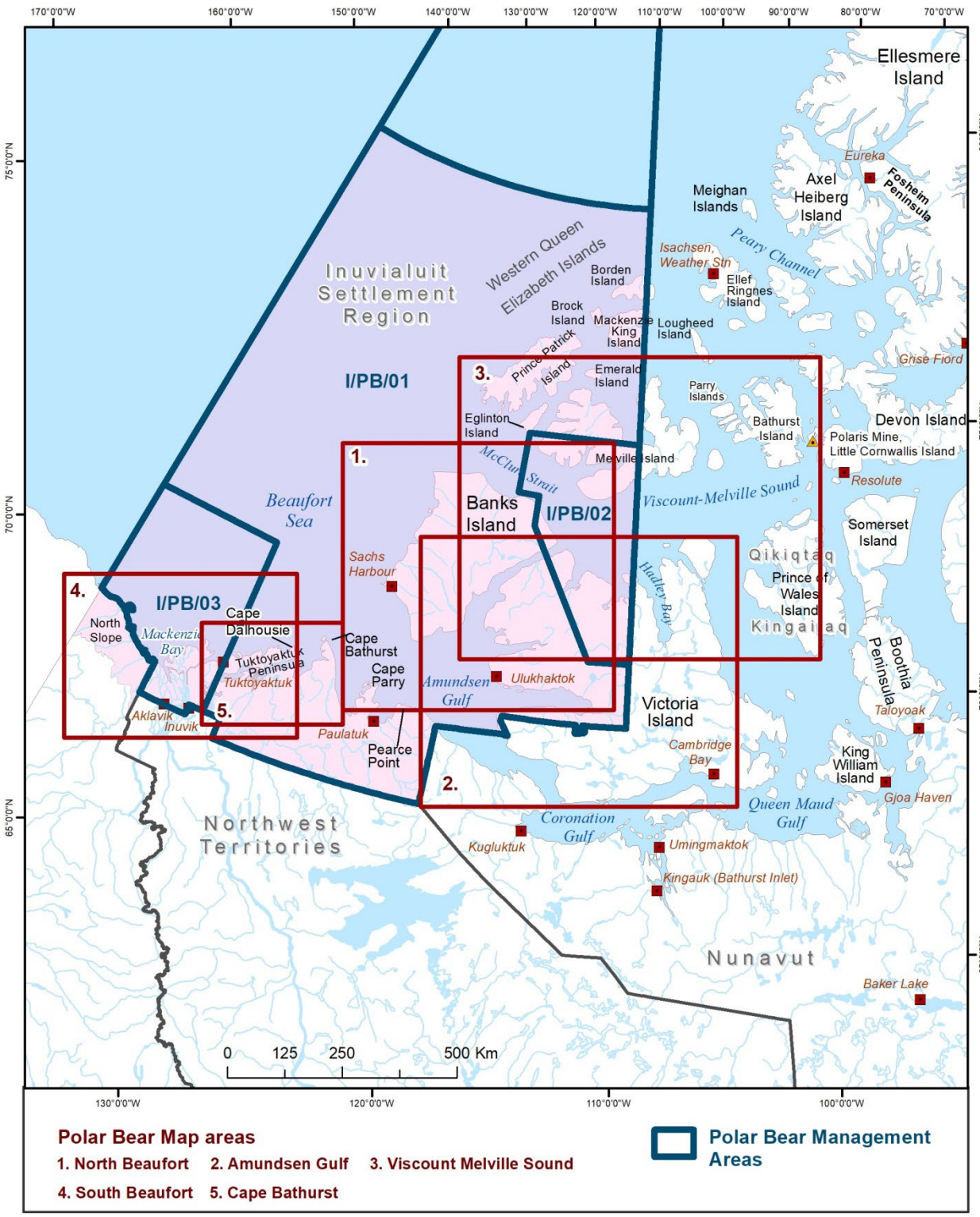

Figure 3. Overlay of Inuvialuit Settlement Region (ISR) boundaries, place names, polar bear subpopulation (management unit) boundaries, and regional boundaries used in this text to describe NWT distribution of polar bears. Map courtesy B. Fournier, ENR.

North Beaufort Area

Figure 4. Map of North Beaufort regional area. Map courtesy B. Fournier, ENR.

Historical reports on the distribution of polar bears throughout the North Beaufort area (Fig. 4) were made by early explorers Vilhjalmur Stefansson and Robert McClure. Stefansson (1913) observed: "The polar bears, common around Nelson head, are so nearly absent from Coronation Gulf that we saw there men who had grown to mature age without ever seeing a

live polar bear" (p. 454) (Fig.3). From McClure's notes while stranded in Mercy Bay (*Hitilik*) for two years on *The Investigator*, bears were not known to travel off the coast into Mercy Bay. McClure commented: "Only an occasional bear was seen, and their footprints were by no means common in this neighbourhood. One bear, however, was seen haunting the bay until fairly chased out of it" (Osborn 1856 *in* Barr 1996: 103).

These explorers gained insight on polar bear distribution from the harvesting practices of a tribe of Copper Eskimo referred to as the "*Kangiryuarmiut*". Polar bear was an integral part of the diet for the *Kangiryuarmiut* of southeastern Banks Island-Minto Inlet area, where it was recorded that "more than three-fourths of their food consists of polar bears, which they hunt with dogs, knives, and bows and arrows on the ice off Nelson Head" (Stefansson 1913: 453). Their territory extended as far west as Nelson Head (*Imnaqyuak*), to the Horizon Islands, south of Holman Island, and to the northern part of Victoria Island (Farquharson 1976). Their polar bear hunting was concentrated in the southeast coast of Banks Island between Nelson Head and DeSalis Bay (*Kangiqhualuk*) (Nagy 1999), and Cape Baring on the southwestern point of Victoria Island (Stefansson 1914).

Usher's (1970b) description of polar bear hunting areas used by Sachs Harbour Inuvialuit in the mid-1960s also emphasizes these areas:

"The southwest coast of Banks Island, particularly around Nelson Head and Cape Kellett, provides good denning habitat for polar bears.... Sometimes special bear hunting trips are made in spring to Nelson Head or north of Storkerson Bay. Occasionally bears are seen and killed along the traplines. Of a total of 59 bears killed [between July 1, 1964 and June 30, 1967], 45 were taken near Sachs Harbour and eight near Nelson Head." (p. 73–77)

In a later ethnography, Usher (1976) elaborates:

"When bears are common, the greatest number are taken within twenty miles of Sachs Harbour, generally in the direction of Cape Kellett. However, special trips are sometimes made farther afield, chiefly to Nelson Head and some distance offshore to the south, and also toward Norway Island and even as far as the northwestern tip of Banks Island." (p. 29)

The area between Nelson Head and DeSalis Bay at the southern end of Banks Island was described as a hot spot for polar bears by several knowledge holders from Sachs Harbour and Ulukhaktok in the Joint Secretariat study (2015), due to features including a recurring crack (i.e., open lead) and the abundance of seals[15,16].

[15] "They always have a crack there by Nelson Head. And it freezes a bit, and the seals come and make holes in it; and they watch them, and when they come up [thumps]." (PIN 2 [Inuvik] *in* JS 2015: 114)

Several key habitat areas for polar bears were identified more recently; specifically, offshore lead systems from DeSalis Bay to Robillard Island (Fig. 5) (Community of Sachs Harbour *et al*. 1992), and the northern, southern, and west coasts of Banks Island (Community of Sachs Harbour *et al*. 1992; Barr 1996; Slavik *et al*. 2009)[17]. These areas are frequented by Sachs Harbour residents for hunting polar bears, especially Nelson Head, DeSalis Bay, and the west coast of Banks Island from Cape Kellett north to Gore Islands (Slavik 2013). The western coast of Banks Island has been identified as a high-density area for denning bears of the Northern and Southern Beaufort subpopulations (JS 2015).

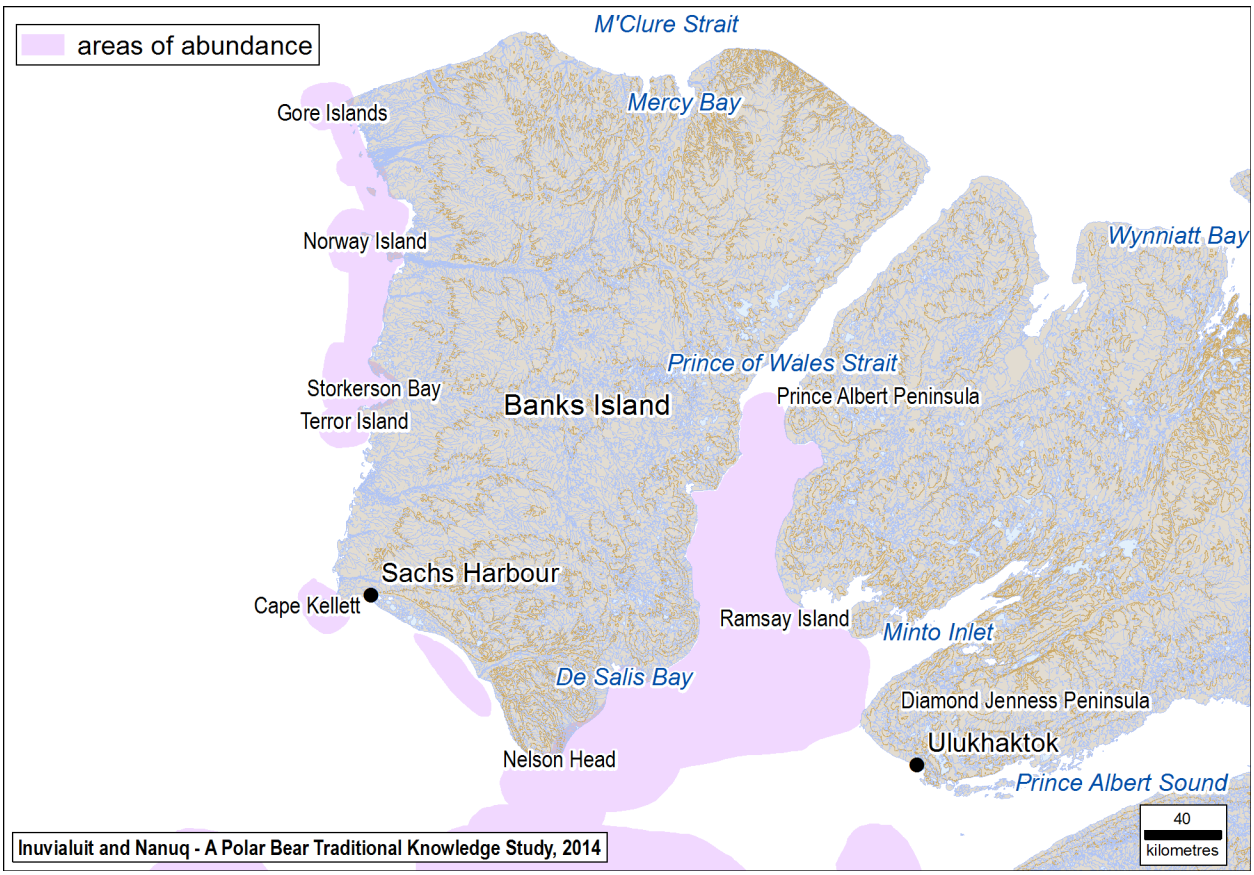

Figure 5. Areas of abundance in the Sachs Harbour and Ulukhaktok regions. Reproduced from Joint Secretariat (2015: 72) with permission.

Seasonal Ranges – North Beaufort Area

In the summer, polar bears are found along the southwest, west, and north coasts of Banks Island (Community of Sachs Harbour *et al.* 1992). During the late summer or fall, bears can

[16] "I don't know why bears like that area. The shoreline here, it's nothing but cliff – like, from this point, all the way over here [gestures]… Maybe there's an abundance of seal there, because there are usually a lot of seals when we go over there… in April." (PIN 113 [Ulukhaktok] *in* JS 2015: 75)
[17] "Around Cape Parry and southern Banks Island, however, they were quite common on occasion." (*in* Barr 1996: 69)

occasionally be seen around the middle of the island (F. Lennie [Sachs Harbour] *in* Slavik 2013). Prior to freeze-up in the early fall (October to November), polar bears can be found along the coast of Banks Island, or occasionally near the community of Sachs Harbour (F. Lennie [Sachs Harbour] *in* Slavik 2013). Some elders recall that in the early days "there was a lot of polar bears" at Sachs Harbour (*Ikahuuk*) in the fall:

"In the fall there was a lot of polar bears there [at Mary Sachs, Banks Island]. Our parents never let us play out because polar bears came from all directions. I think the bears were hungry, but we had a lot of seals piled up and this is where the polar bears used to come and eat. The men would never go out looking for polar bears to kill, they would kill them when they got them right to the houses." (P. Gruben [Tuktoyaktuk] in Berger 1976h: 4305)

Usher (1976) notes that Banks Island was regarded as the chief denning area for polar bears in the western Arctic. From October-November to March, females den in the vicinity of Cape Lambton, Norway Island, Nelson Head, and generally the entire coastal area of Banksland (Community of Sachs Harbour *et al*. 1992). The west and south sides of Banks Island are ideal denning locations because the wind blows north-east to south-west, piling snow in depressions or on banks (Slavik 2013). Specific denning areas identified by community members in *Knowing Nanuut: Bankslanders Knowledge and Indicators of Polar Bear Population Health* (Slavik 2013) include: Bernard Island, Blue Fox Harbour, Big Bluff (*Imnaqpaluk*), Cape Kellet (*Nuvuk*), DeSalis Bay (*Kangiqhualuk*), Gore Islands (*Ikkuq*), Nelson Head, Norway Island, Sachs River, Siksik Island, Terror Island, and Thesiger Bay.

In the spring, bears are in healthy condition, highly active, and ready to begin breeding. Females and cubs who den along coastal and island banks and bluffs are seen in the spring heading out on the ice (JS 2015). They will be doing most of their hunting during this time, feeding on seal pups in their dens. From March to May "*they start really migrating*" (G. Wolki [Sachs Harbour] *in* Slavik 2013: unpubl. transcript). In the spring they migrate south along the west coast of Banksland (P. Raddi and G. Wolki [Sachs Harbour] *in* Slavik 2013; JS 2015). Bears commonly travel through and around Cape Kellett, southwest of Sachs Harbour (Community of Sachs Harbour *et al.* 1992). There are so many tracks around Cape Kellett in spring, it looks like a "*polar bear highway*" (F. Lennie [Sachs Harbour] *in* Slavik 2013: 94).

Amundsen Gulf Area

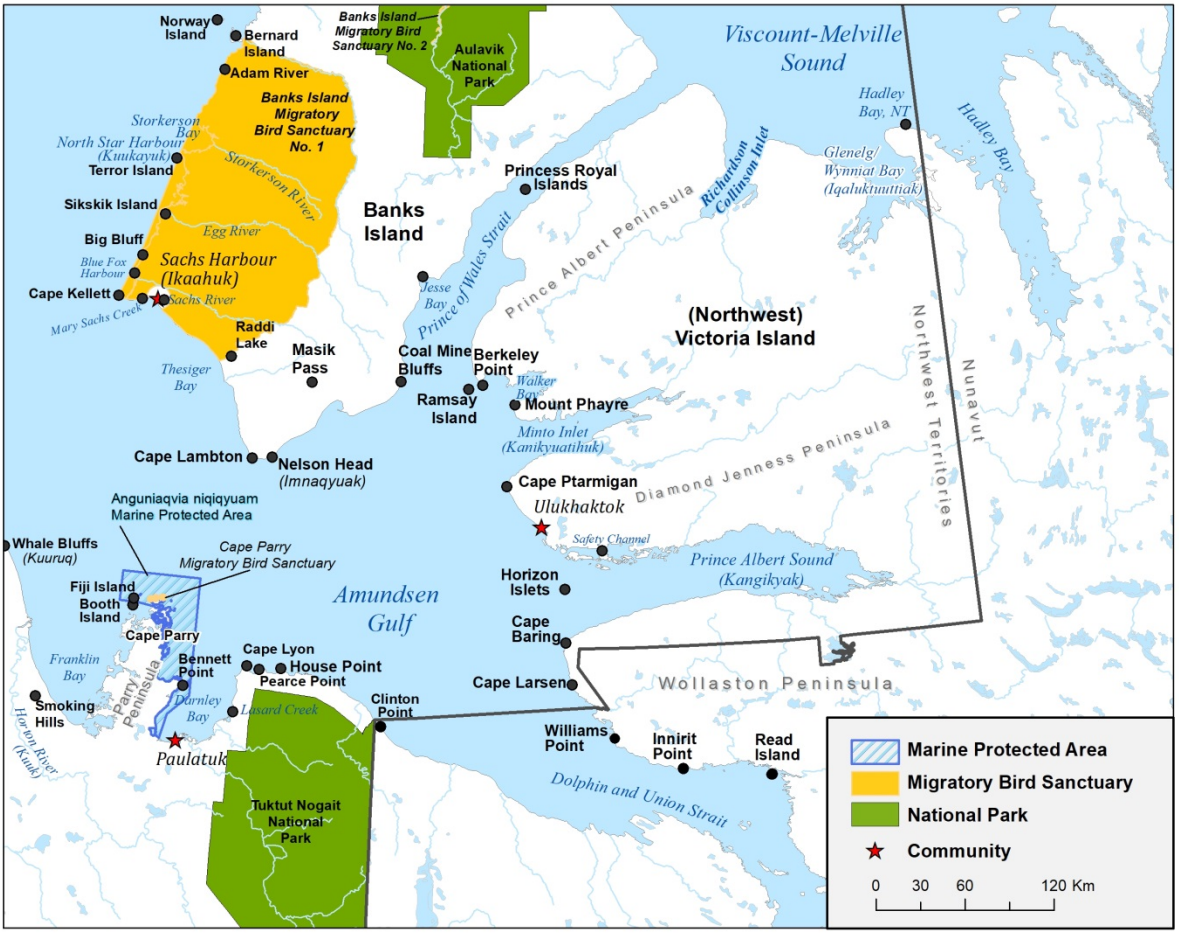

Figure 6. Map of Amundsen Gulf regional area. Map courtesy B. Fournier, ENR.

Historically, practically all of Amundsen Gulf was potential polar bear hunting territory (Usher 1976), with polar bears known to be quite common around Cape Parry on occasion (Barr 1996) (Fig. 6). In August 1911, explorers observed fourteen bears within two days around Cape Parry, "roaming about the small rocky islands, evidently marooned when the ice left the beach" (Anderson 1913: 522). Polar bears were fairly common to the Parry River area when "*big ice [came] from the North (i.e. Amundsen Gulf), but rare or entirely absent in years that the ice did not arrive*" (Gavin 1954 *in* Harington 1968: 11). The phenomenon was also observed by Usher (1970b) in the mid-1960s:

"In years when Amundsen Gulf and the Beaufort Sea are ice free, there are no bears at all (although they have on occasion been sighted swimming tens of miles from the nearest ice or land). If a heavy concentration of ice persists throughout the summer, bears may remain in or close to the area, and will be more available to hunters not only in the summer but often in the following winter as well. In 1966, when ice persisted around Sachs Harbour for much of the summer, an unusual number of bears were taken in that season" (p. 74).

The Joint Secretariat study (2015) identified areas of polar bear abundance in the Paulatuk and Ulukhaktok regions (Fig. 7). Cape Parry was historically a good area to hunt for polar bears, seals, and foxes, and that encouraged settlement in this area (Parks Canada 2004)[18]. Usher (1976) documented that most of the polar bear hunting was on the east side of the Cape Parry Peninsula. Two elders identified a massive pressure ridge between Cape Parry/Pierce Point and Victoria Island as important for polar bears (Slavik *et al.* 2009; JS 2015)[19,20,21]. Several Paulatuk hunters identified that Cape Parry was an ideal place to encounter male polar bears in March and April each year due to "a regularly recurring open lead running east from the Cape which attracted many bears" (JS 2015: 81).

Ulukhaktok hunters used to be able to travel and harvest polar bears far out on the ice, for example, towards Nelson Head on Banks Island (Fig. 7). However, commencing in the late 1990s, winter ice to the west of the community started to break up, rubble and open, making access to the sea ice in Amundsen Gulf challenging (JS 2015).

Prince Albert Sound and Minto Inlet (*Kanikyuatihuk*) were frequented for polar bear hunting in the past, including hunting bears in their dens at Mount Fair (Berger 1976e)[22,23] and where the old land-fast ice meets the new ice at the mouth of Minto Inlet (JS 2015).

Farquharson (1976) describes polar bear hunting in the Dolphin and Union Strait from 1916–55:

"the Puivlingmiut hunted polar bears on the sea ice west from Read Island far out on the ice of Amundsen Gulf and north on Prince Albert Sound. Though there were few polar bears on Dolphin and Union Strait, there were many on Amundsen Gulf. The Read Island people usually hunted them at the end of the trapping season in early May, although a few hunted bears in fall and mid-winter and, on occasion, in their dens along the west coast of Wollaston Peninsula." (p. 38)

[18] "There was not caribou [at Cape Parry] but it was good for polar bears, seals, and foxes you know, then days. That's why I guess our, our parents moved down there." (T. Green [Paulatuk] *in* Parks Canada 2004: 45)
[19] "There's a massive pressure ridge from Cape Parry to Holman Island sometimes. You could follow that, both sides, end of March." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)
[20] "From Pierce Point right across there's a pressure ridge. Somewhere close to Pierce point. A pressure ridge all the way to our island. That's polar bear country right there." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al*. 2009: unpubl. transcript)
[21] "Pressure ridges and open leads in association with Pearce Point, Cape Parry and the mouth of Darnley Bay channel polar bears from east to west, looking for ringed seals." (JS 2015: 79)
[22] "When he was in Holman you could see where he was making a trail, that's where he used to hunt bears on the ice, Prince Albert Sound area, on the bottom side." (R. Inuktalik [Ulukhaktok] *in* Berger 1976e: 3943)
[23] "He was born there. His parents, they camp at Mount Fair and then they rest when they finish, everybody going out hunting polar bear, hibernated polar bear stay in Mount Fair. The people that used to hunt there is their grandparents and their ancestors used to hunt there for polar bear hibernating in Mount Fair. He said when they went there they get a polar bear right away because they know there was a polar bear used to hibernate there." (C. Kilolaitak [Ulukhaktok] *in* Berger 1976e: 3904)

In the mid-1970s, harvest records indicated that "99% of the polar bear quota taken this year was taken within a 25 to 30-mile radius of Holman Island, and the quota was killed in approximately one to 1.5 weeks hunting time" (Berger 1976e)[24]. This suggests a high concentration of polar bears in the area. Explorer Robert McClure wintered near the Princess Royal Islands and observed a substantial bear population in the area of Prince of Wales Strait (Osborn 1856 *in* Barr 1996)[25].

Ulukhaktok knowledge holders identified the Prince of Wales Strait as an important travel corridor for polar bears at certain times of the year, especially during the spring mating season - with traffic back and forth between Viscount Melville Sound and the southern end of Banks Island (JS 2015). One hunter from Ulukhaktok stated that "[when] I go to Prince of Wales in the springtime, north of the island, there's more [polar bears] down there" (Slavik *et al.* 2009: unpubl. transcript)[26].

[24] "The Settlement of Holman Island has a quota of 16 polar bear per year to be taken by the hunters, and these 16 – say 99% of the polar bear quota taken this year was taken within a 25 to 30-mile radius of Holman Island, and the quota was killed in approximately one to 1 ½ weeks hunting time. They didn't have to put very much effort to killing their polar bears because they seemed to be coming in closer. There seemed to be more polar bear with each year as the year progresses." (R. Goose [Ulukhaktok] *in* Berger 1976e: 3974)

[25] "Pushing north through Prince of Wales Strait, McClure wintered near the Princess Royal Islands and soon discovered that there was a substantial bear population in the area." (Osborn 1856 *in* Barr 1996: 66)

[26] "Because of the ice, like ice conditions and weather conditions, the polar bears are moving up north more. More in the North, I know that! Every time I go to Prince of Wales in the springtime, north of the island, there's more down there. I know where they are at different times of the year." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al.* 2009: unpubl. transcript)

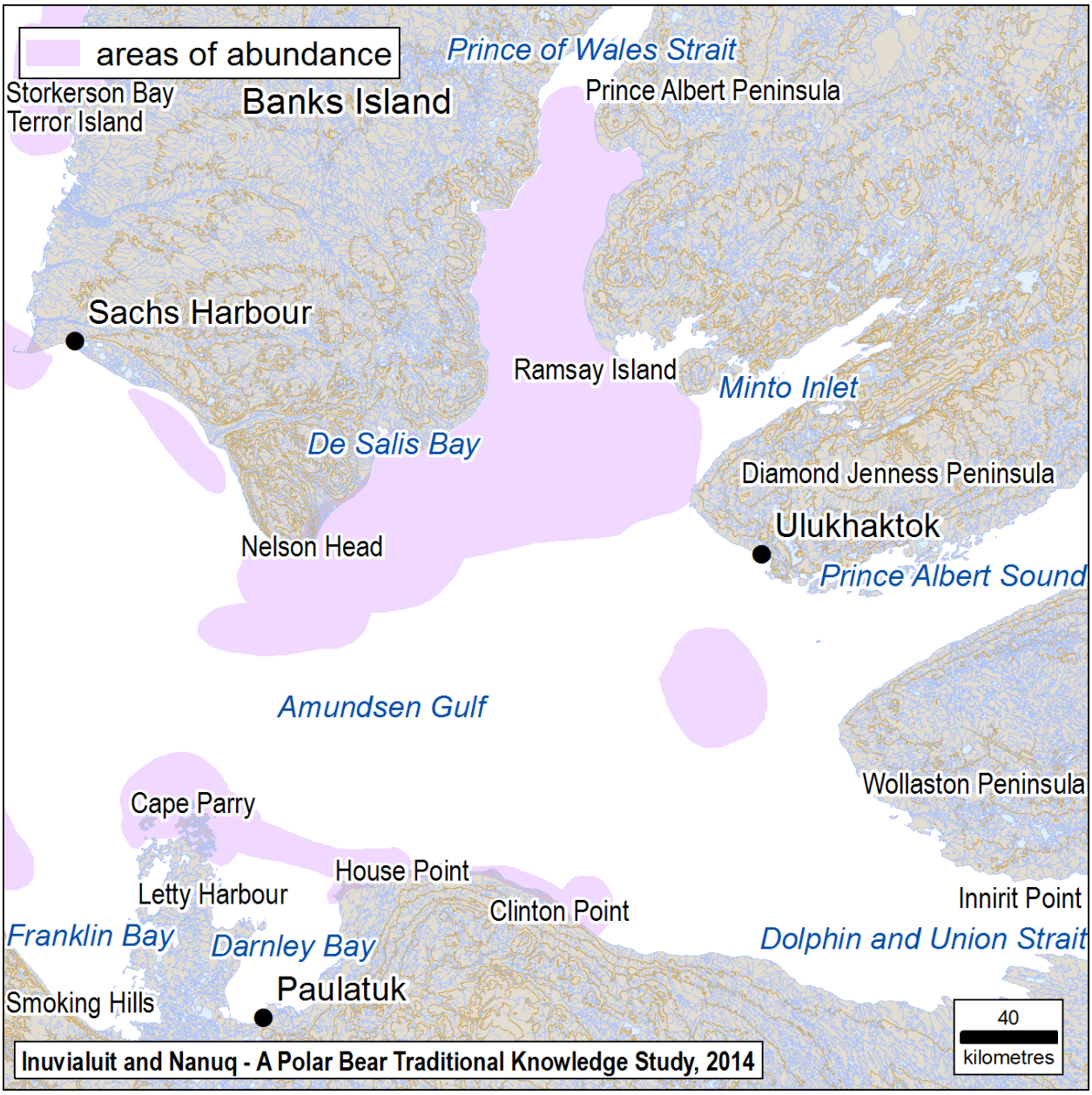

Figure 7. Areas of abundance in the Paulatuk and Ulukhaktok regions. Map reproduced from Joint Secretariat (2015: 78) with permission.

Viscount Melville Sound Area

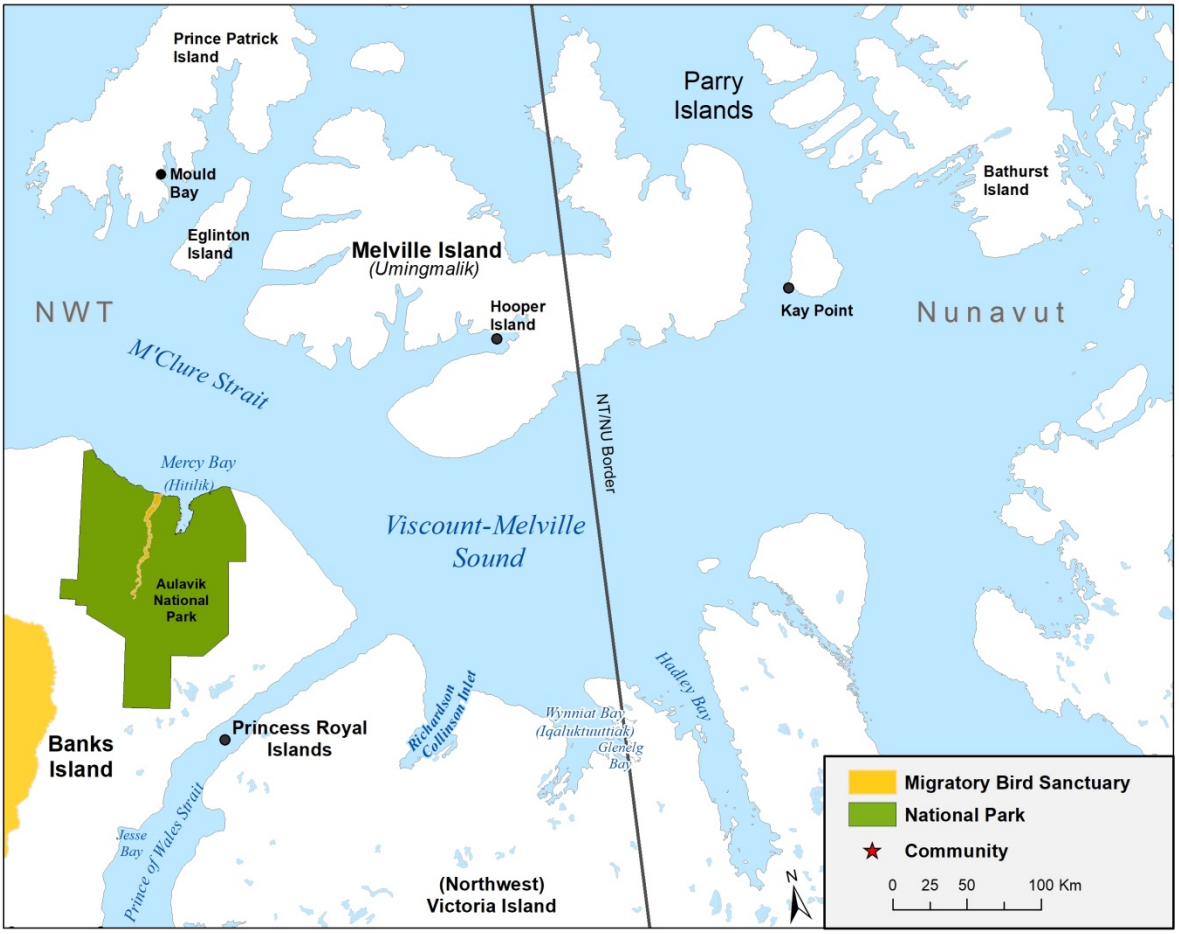

Figure 8. Map of Viscount Melville Sound regional area. Map courtesy B. Fournier, ENR.

People from Ulukhaktok and Sachs Harbour have been travelling and guiding sport hunters in the Viscount Melville region (Fig. 8) at various times over the last thirty-plus years (JS 2015). According to the Melville Island harvest data, the first sports harvests here were in 1982 and the last in 1991, when a 5-year moratorium on all hunting was put in place (JS 2015). While hunters travel to Melville Island (*Umingmalik*) infrequently, of the hunters who do make the trip, one hunter commented several times on the abundance of bears in the region:

"I've been there four different times [assumed in different years]. And every time I go, from that bay I seen [lots of bears] in one day… We used to have 12 quota down there. And every time I go, I come home with 12 polar bear skins… One time I went to Melville Island for 12 tags. I stayed out … 14 days. I seen 66 bears in Melville Island, and I shot 12. One day, me and Allen [Joss], in half a day we seen 16 bears. We never shoot that day, we were just looking at the bears. 16 bears in one half of a day. We never shoot, the next day, we shot, we go home." (P. Ekpakohak [Ulukhaktok] in Slavik et al. 2009: unpubl. transcript)

This was validated by another hunter from Ulukhaktok:

"There's this one area that I've gone to. It's an island up north — Melville Island.... They have sports hunting, as well.... There was a lot more bears up there, compared to our area. There's a lot of bear sign there. This was in the mid-'80s. I went up there as a helper. That was one of the first times that I got to use a dog team — chasing a bear with a dog team." (PIN 113 [Ulukhaktok] in JS 2015: 73)

Although many Olokhaktomiut have been hunting in the Wynniatt Bay area since at least the late 1980s, this was not identified as an area of polar bear abundance (JS 2015). Olokhaktomiut more typically use Richard Collinson Inlet and Glenelg Bay for subsistence hunting of polar bear from the beginning of November to May (Community of Ulukhaktok *et al*. 2016).

South Beaufort Area

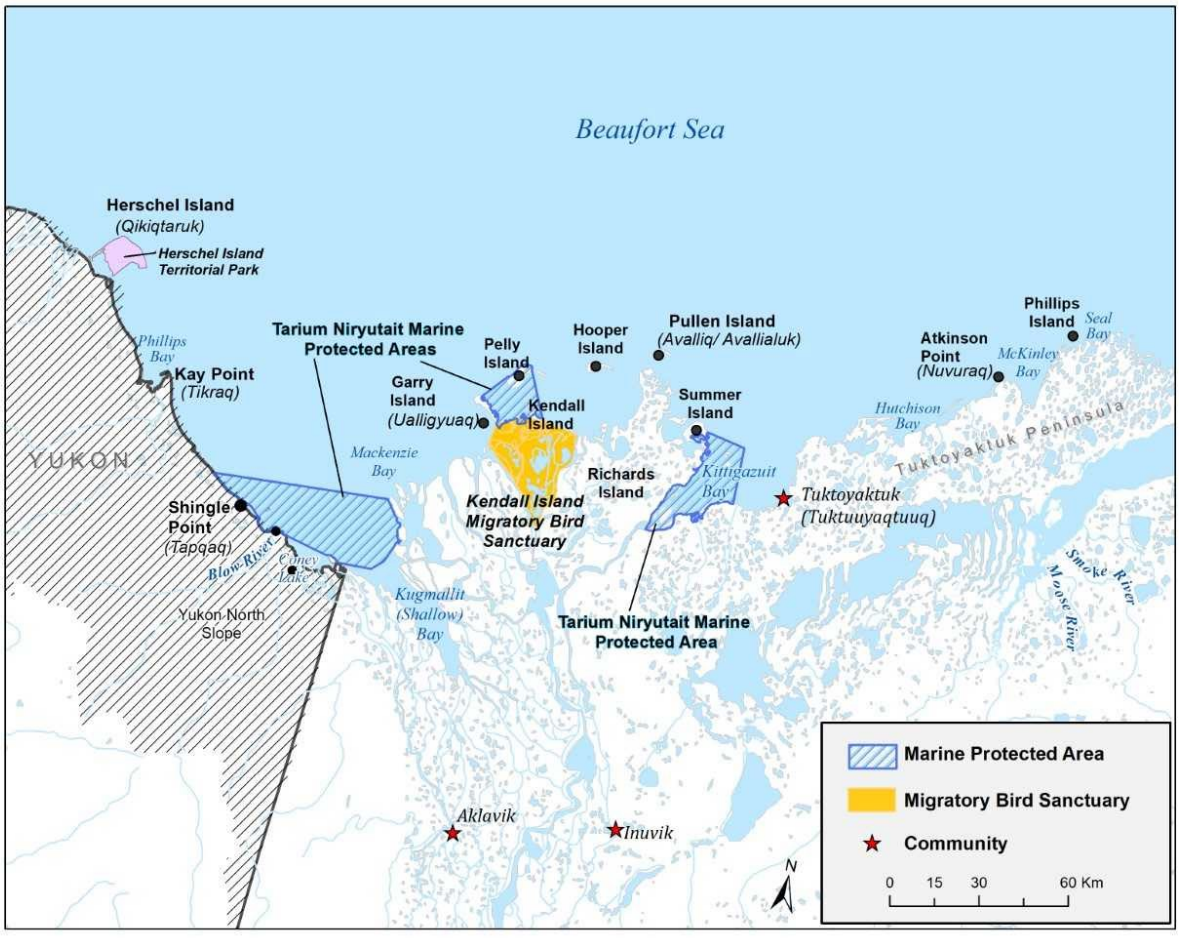

Figure 9. Map of South Beaufort regional area. Modified by B. Fournier, ENR from Hart et al. (2004).

Early explorers and whalers who summered on the North Slope of Alaska east to the Mackenzie Delta in the early 20th century observed that polar bears were not very abundant in

this area (Stefansson 1913)[27]. However, it was later noted, once the whalers began to winter on the Beaufort coast, that a "substantial number of bears" frequented the mainland coast during the winter (Barr 1996: 186)[28].

Early harvest records from Tuktoyaktuk (*Tuktuuyaqtuuq*) show that most polar bears were harvested well to the east of Tuktoyaktuk, with the winter of 1966 being one exception as ice conditions allowed harvesters to take bears about 65 km north of Tuktoyaktuk (Barr 1996)[29]. To the west of Tuktoyaktuk, people would trap and hunt for bears and seals around Pullen Island (*Avalliq/avallialuk*) (Cockney 1997)[30]. Today, the hunting range for polar bears in the Tuktoyaktuk area extends from outside Pullen Island to the mouth of the Horton River (*Kuuk*) (Slavik *et al*. 2009) (Fig. 9).

Seasonal Ranges – South Beaufort Area and Cape Bathurst Area

Knowledge holders from Inuvik and Aklavik harvest polar bears and have reported sightings between Kendall Island in the east and the Yukon-Alaska border, near Herschel Island in the west[31,32]. WMAC (North Slope) and Aklavik HTC (2018: 37) have identified areas of the Yukon North Slope used by polar bears for overland or near-shore travel and foraging (Fig. 10). However, none of the Joint Secretariat (2015) study participants spoke of "polar bear hot spots" or areas of abundance anywhere in this area.

A study that integrated scientific and Indigenous knowledge identified important maternity denning areas within the Mackenzie Delta and southern Beaufort Sea (Richardson in SARC 2012: 12, 63). Information collected during this study indicates that there are at least four important denning areas along the Beaufort Sea coast: the area from Herschel Island (*Qikiqtaryuk*) along the Yukon coast to Shallow Water Bay; the outer Mackenzie Delta

[27] "Along the Arctic coast of Alaska, east of Point Barrow, the species is not very abundant, and the same may be said of the coast east and west of Mackenzie delta." (Stefansson 1913: 522)
[28] "In the case of the mainland coast of the Beaufort Sea, very few bears were reported by the many exploring expeditions which traveled this coast in summer. It was not until the whalers began to winter during the period 1898 to 1910, and until traders such as Joseph Bernard began wintering, that the substantial number of bears which frequent this coast in winter was first recognized." (Barr 1996: 186)
[29] "In general, most of the animals were taken well to the east of Tuktoyaktuk, but in 1966 about 18 were taken on the ice about 65 km north of Tuktoyaktuk." (Barr 1996: 130)
[30] "When I was trapping, I always go to Pullen Island [*Avalliq*/*Avallialuk*] lots of times. When it get more daylight, we move our trap-lines to the ices. The ice is good for bear and seal hunting; also for trapping foxes. We travel by the edge of the open water. When the days got long I always travel in the ice. My younger brother and several others, we travel together on in the ice. We run into open water, we would shoot a few seals. Sometimes they would shoot a bear." (N. Felix *in* Cockney 1997: 125-26)
[31] "I've seen polar bears in that coastal area…just right off the shore…just travelling along, hunting…places where they've caught seals." (PIN 120 *in* WMAC (North Slope) and Aklavik Hunters and Trappers Committee (HTC) 2018: 38)
[32] "…most times, you often run into them [polar bears] … from Kay Point all along…to…the [Alaska] border, here…in this area, there's a lot of seals." (PIN 301] *in* WMAC (North Slope) and Aklavik HTC 2018: 38)

(including Richards Island, Pelly Island (*Igluligyuaq*), Hooper Island (*Kamikgik*), Pullen Island (*Avalliq*), and Garry Island (*Ualligyuaq*); the Tuktoyaktuk Peninsula from Atkinson Point (*Nuvuraq*) to Cape Dalhousie (*Nuvuk*)[33]; and the area around the Baillie Islands (*Utqaluk*), including a significant portion of Cape Bathurst (Richardson in SARC 2012: 12, 63).

Denning areas were also identified during a community workshop on Indigenous knowledge of polar bears sponsored by WMAC (NWT) (Slavik *et al.* 2009). These denning areas include: Garry Island, Kendall Island (*Ukivik*), Hooper Island, Richards Island, Pullen Island, the outer delta area of Shallow Bay[34], and Mason and Old Horton (*Kangiqluk*) rivers on Bathurst Peninsula[35] (Slavik *et al*. 2009). Dens are also observed along east banks, high up on banks, and inland in ravines or riverbeds.

[33] "Tuk[toyaktuk] Peninsula used to be a good [denning] area from McKinley all the way to Dalhousie. Don't know if it's still good because we never check anymore. [We] used to encounter them because people used to trap with dog teams. Now it's against the law to bother polar bears in dens, so people don't even bother to look. From Nuvuraq to Dalhousie." (F. Pokiak and J. Pokiak pers. comm. 2020)

[34] "A year ago, there was another interview with people about polar bear denning areas. And that's one of the main one's out there, Garry Island and Kendall Island, all those areas, Hooper Island. Even on the mainland, there's polar bears on Richardson Island – they'll den. That's why in the last few year, they seen some polar bears right in the McKenzie Delta… All along the Richardson Islands and the Outer islands. Garry, Hooper, Pullen Island. On the outer delta area of Shallow Bay." (C. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcripts)

[35] "You'll find them everywhere – even way up inland. I ran into one, one time, with two cubs. They had a den close to Mason River. They're all over the place. They don't stay close to the shore, some of them. They even go up into the land to find cliffs so they could get covered up. I find some in [Old] Horton River there. Where it's called the Old Horton River now. It's all dried up now. I used to see some there too – bear dens. It's not close to the shore, it's quite a ways up that river there." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcripts)

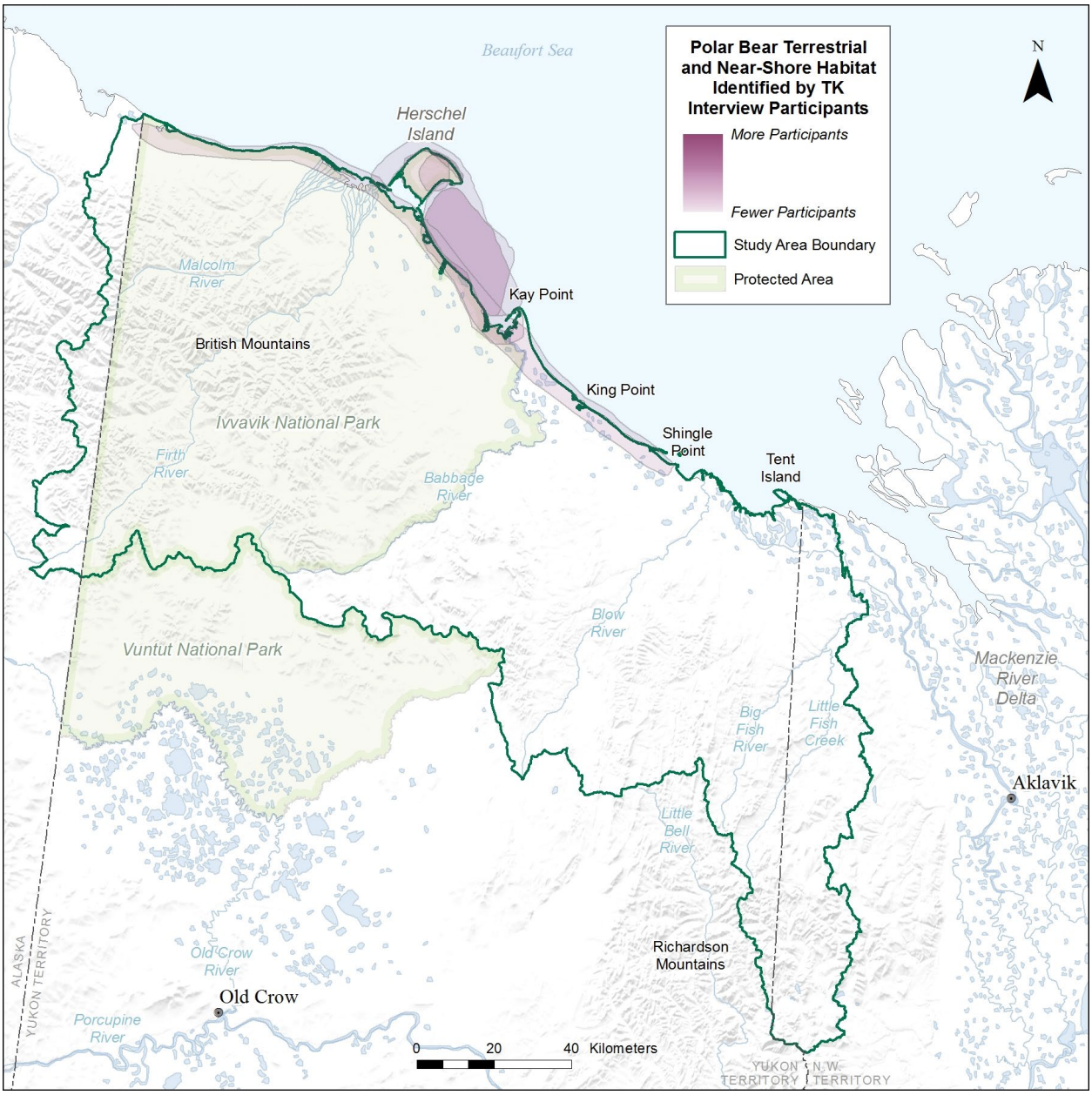

Figure 10. Areas of the Yukon North Slope used by polar bears for overland or near-shore travel and foraging. Reproduced from WMAC (North Slope) and Aklavik HTC (2018: 37), with permission.

Cape Bathurst Area

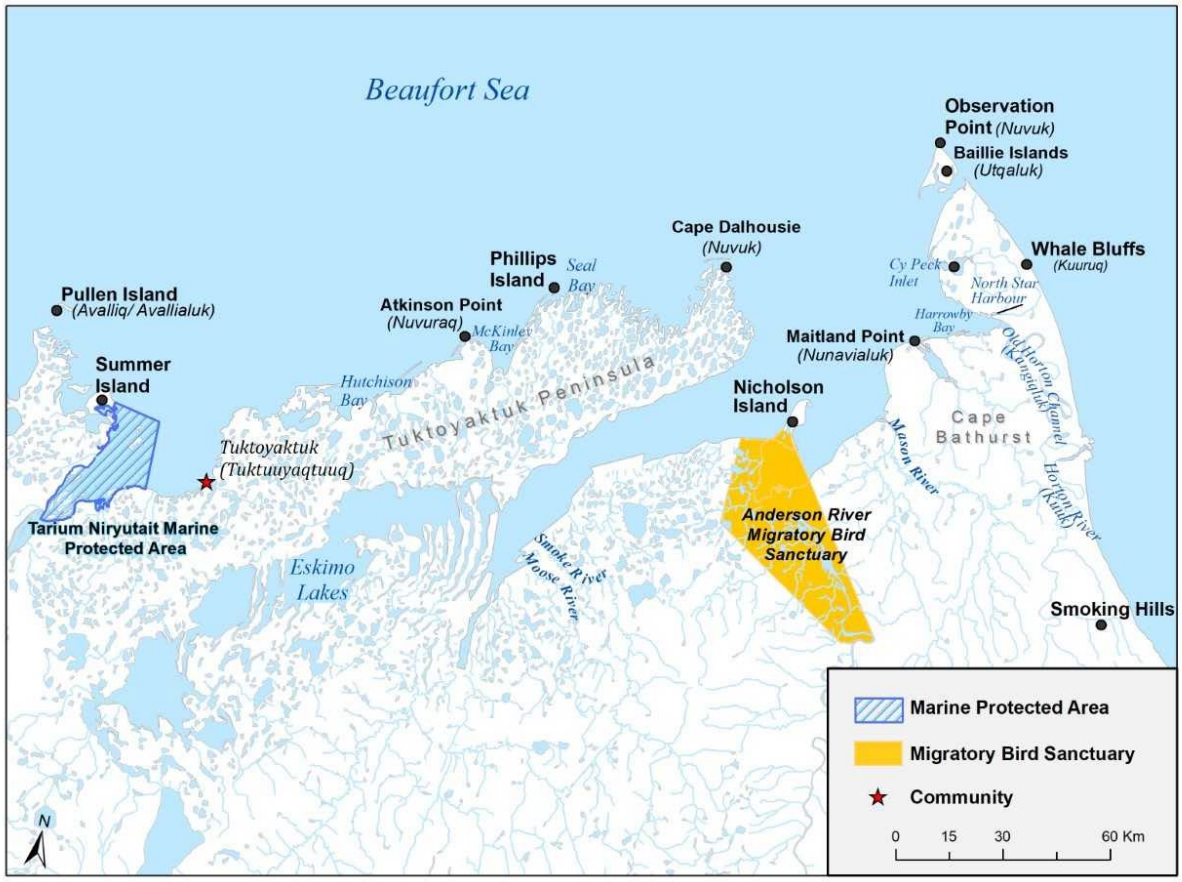

Figure 11. Map of Cape Bathurst regional area. Map modified by B. Fournier, ENR, based on Hart et al. (2004).

Numerous stories exist about polar bear hunting at Cape Bathurst (Fig. 11), as the Cape Bathurst polynya was an important place for both seal and bear hunting (Hart *et al.* 2004). This region was particularly good for polar bear hunting, "mainly on the northeast coast, where the floe edge is rarely more than five to 10 miles [8 to 16 km] offshore" (Usher 1976: 25). Seasonal camps were located throughout Cape Bathurst, with more permanent settlements at North Star Harbour (*Kuukayuk*) and Baillie Islands (*Utqaluk*). In the *Inuit Land Use and Occupancy Report*, Usher (1976) describes the ice conditions at Cape Bathurst in 1965:

"Ice develops from shoreward in the fall, and throughout winter cracks running parallel to the coast open periodically, or there may exist a true floe edge five to twenty miles from the shore, beyond which there is open water or moving ice. Off the southeast coast, the waters freeze over completely and there is no barrier to travel between Banks and Victoria Islands." (p. 44)

Bears were plentiful around North Star Harbour and Whale Bluffs (*Kuuruq*) on Cape Bathurst in the 1950s (Slavik *et al*. 2009)[36,37]. Two elders stated that, depending on the condition of the ice, "we used to see lots of polar bear tracks when we used to cross here [Franklin Bay], from Baillie Island to Cape Perry" (F. Wolki and S. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcripts)[38]. Jim Wolki ([Tuktoyaktuk] *in* Hart *et al*. 2004) describes an exceptional year at Baillie Island:

"Fred and Sandy, my sons, as did the other hunters who went to Baillie Island, reported polar bear presence, visits, tracks all over. No need to search for them they were all around, on ice, on shore, along the coast etc., even spending some time sliding on the hillside. A very exceptional year indeed as my son Fred described it, relating his experience at Whale Bluff (Kuuruq)." (p. 74)

Open water would often be close to shore (roughly three miles) around Baillie Islands, and open water around Observation Point (*Nuvuk*) meant, "*if you go out to the edge you're going to see a bear!*" (C. Gruben [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcripts)[39]. Bears would frequent the area around Maitland Point (*Nunavialuk*) when a west wind (*ungalaq*) would open up water (Hart *et al*. 2004)[40,41]. However, in years when there was no open water, polar bears would still be in the area but would have difficulty hunting seals:

"During years when leads of polynyas did not open up in the winter and there were few seals to hunt, Inuvialuit in the Cape Bathurst area counted on polar bear meat. This was also a bad situation for bears as there was little food for them to eat, and they turned into the primary animal hunted over the winter. Joe Nasogaluak also reported that in 1910 there was little open water, few seals, but lots of polar bears which were used for meat." (Hart et al. 2004: 72)

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[36] "We were at the North Star [Harbour]. There were plentiful bears in those day, see them everyday, 11 or 12 a day around whale bluffs. As soon as ice goes you see bears walking around. In the 1950s, and it never changed when we left… In the fall time it's worse! When you come around Whale Bluff you see 11, 10, 9." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: 51).

[37] "Cape Bathurst, where these guys used to have that old house there, every year there's a polar bear track in that area – never fails!" (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcripts)

[38] "We used to see lots of polar bear tracks when we used to cross here, from Baillie Island to Cape Perry… The ice conditions hardly moves, in some years only, not very often. But most of the time it's closer to shores, about three mile. But some years only – maybe after five or ten years, it's different. Depending on the current of ice." (F. Wolki and S. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcripts)

[39] "There's one island there, it's called Phillips Island, and you always know where the bears are going to come in by there. When you hunt off Baillie Island there, it's called Nuvuk, there's always open water there, so if you go out to the edge you're going to see a bear!" (C. Gruben [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcripts)

[40] "Whenever the west wind came up at that time the ice always went out and there would be open water. This was why there were always a lot of polar bears around Maitland Point [at entrance to North Star Harbour]." (J. Nasogaluak [Tuktoyaktuk] *in* Hart *et al.* 2004: 76)

[41] "At Maitland Point, James [Pokiak] noticed big chunks of land falling off – maybe losing potential denning areas." ((F. Pokiak and J. Pokiak pers. comm. 2020)

Further to this, the Baillie Islands were identified as a "polar bear hot spot", especially in the spring, largely owing to the fact that the floe edge is close to the shore in this area[42]. The Joint Secretariat (2015) study concluded that "polar bear hunting is generally excellent here but is always subject to seasonal and annual variation in ice and weather conditions" (JS 2015: 84).

Offshore of Atkinson Point and Seal Bay is an area known to Tuktoyaktuk hunters for its seasonal abundance of polar bears, owing to a recurrent floe edge by that section of coast (JS 2015). Bears were known to travel overland across Cape Bathurst and often would den inland in the fall at Old Horton River and Mason River (Slavik *et al.* 2009)[43,44]. One knowledge holder from Tuktoyaktuk described this area as a "big highway" for polar bears in good years when ice conditions are ideal (PIN 33 [Tuktoyaktuk] *in* JS 2015: 83)[45].

Polar Bear Subpopulations

Scientists and managers recognize four subpopulations (or "management units") of polar bears within the NWT: Northern Beaufort, Southern Beaufort, Viscount Melville, and Arctic Basin. However, there is consensus within all six Inuvialuit communities that the Northern and Southern Beaufort Sea subpopulations are really one single subpopulation, as polar bears frequently move between both areas, with the designation of "subpopulations" being employed in order to support and facilitate harvest management (CWS 2010; JS 2017). This perception is based on observations of the intermixing of bears from the Northern Beaufort and Southern Beaufort subpopulations (Slavik *et al.* 2009; see *Movements*) and the experience

[42] "Baillie Island…we call 'rendezvous place for polar bears'. What I mean is plenty of polar bears there because it opens up right by the beach, I hear. The floe edge is right there. It goes along the beach, [for] how far, I don't know… The Wolkis, they know that place like the back of their hands. They'll tell you. That's the reason why I think it's a good place to hunt polar bears, because it opens up right by the beach. Here, you [don't] have to go 25, 30 miles out. [Polar bears] go right to the island." (PIN 27 [Tuktoyaktuk] *in* JS 2015: 84)

[43] "But when we were in North Star [Harbour], there were usually bears making portage over the Horton River cliffs to the bay there. Used to make shortcuts. Instead of following the ocean there, it makes shortcuts over land, and that's when you see bear dens inland in the fall time, in October. Sandy know better than me." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcripts)

[44] "You'll find them everywhere – even way up inland. I ran into one, one time, with two cubs. They had a den close to Mason River. They're all over the place. They don't stay close to the shore, some of them. They even go up into the land to find cliffs so they could get covered up. I find some in [Old] Horton River there. Where it's called the Old Horton River now. It's all dried up now. I used to see some there too – bear dens. It's not close to the shore, it's quite a ways up that river there." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcripts)

[45] "Right in from Atkinson out, used to make round trips a lot of times to Tuk to here. I go out from Atkinson, go outside of Seal Bay, take polar bears right at the open water edge when it's frozen about six inches thick, like young ice. Always a big highway in that area…for polar bears… Some years I used to see, every half a mile, there's a bear in the edge of the young ice. Some years there's so much there…they follow each other…in April…they'd be travelling, making their rounds going east. That's when it's a good year, when there's a lot of bears, open water line and they're travelling east. That means a lot of bears, right at edge of young ice." (PIN 33 [Tuktoyaktuk] *in* JS 2015: 83)

that animals will constantly be moving to where the food is found (Slavik *et al*. 2009; CWS 2010)[46,47]. A boundary shift in the Southern Beaufort management unit was made in 2013/2014 because Indigenous knowledge indicated mixing of bears between the Northern and Southern Beaufort subpopulations (JS 2015, 2017). This was supported by analysis of satellite telemetry data on adult females collected in 1985–2003, which showed 50% of female bears near Tuktoyaktuk were from the Southern Beaufort management unit, and 50% from the Northern Beaufort unit (Armstrup *et al.* 2005; Stirling *et al.* 2011; COSEWIC 2018).

Search Effort

"Search effort" is a way of describing how well people know where polar bears are. Search effort by Indigenous peoples varies, but in a general sense, has a longer timeframe (many generations) and smaller spatial coverage (local, seasonal hunting areas) compared to aerial surveys of the region by biologists (COSEWIC 2018). With regard to Indigenous and community knowledge, "search effort" can be reflected by hunting ranges. These include hunting ranges for polar bears, but observations of polar bears can also be made while harvesting other species.

Indigenous and community knowledge of the best hunting places for bears can be used to infer where the best polar bear habitat could be found. Some of these locations include Nelson Head (*Imnaqyuak*) (Stefansson 1914; Berger 1976e; Nagy 1999)[48], Baillie Islands (*Utqaluk*) (Berger 1976h)[49], and the west coast of Banks Island (Slavik *et al.* 2009)[50]. Hunting ranges for polar bears and other species in the NWT have been mapped and qualitatively described in Freeman (1976), Usher (2002), Slavik *et al.* (2009), and JS (2015). These hunting ranges are

[46] "We always tell them that whatever animal they're studying, there's no boundary! They could be in Tuk one day and the next day over in Paulatuk. They don't see no lines – they go where the food is and they travel. Some of them stick around for a certain area for a period of time, but eventually they move on." (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 27)

[47] "Polar bears are constantly moving from one area to another. One year, you may not see any polar bears and the next year there are many. Elders in our community have expressed similar events from their time. Some years polar bears are entirely out on the sea-ice and then other years they have been on the land. Polar bears have adapted to survive on the sea-ice and on the land." (summary of Ulukhaktok consultation *in* CWS 2010: 88)

[48] "Near Nelson Head, however, the floe is always near shore, for whenever as easterly wind blows the ice moves off into the Beaufort Sea. Accordingly, this locality is rich in bears, and they form the chief article of food in winter for the larger portion of the Kangiryuarmiut." (Stefansson 1919: 49-50)

[49] "Before I moved to Tuk I go to Baillie Island and trap out on the ice, hunt seals there. It's one of the best place for seals in the north, and also on the west side of Banks out on the ice for my sealing there, foxes. Then when I got back to Tuk I trap out on the ice, start in January up along as far as Cape Dalhousie. Polar bears were too cheap then and I never bothered to save the skins to sell." (B. Pokiak [Tuktoyaktuk] *in* Berger 1976h: 4239-40)

[50] "Banks Island, that pressure ridge on the west side. I've been there. Seal kills every few feet." (John Lucas [Sachs Harbour] *in* Slavik *et al*. 2009: 48)

typically associated with targeted subsistence and commercial (i.e., guided) hunting activities. The Joint Secretariat (2015) study describes the rationale for polar bear hunting locations:

"As a general rule, Inuvialuit harvesting is planned according to weather and ice conditions and knowledge of where polar bears are most likely to be found. Sea ice serves as the main platform for hunting, with preferred hunting spots reached by snowmobile and/or dog teams. Inuvialuit polar bear hunters concentrate their efforts along floe edges, cracks, pressure ridges and other ice features where ringed and bearded seals haul up or have breathing holes and birthing dens. Until recently, and despite annual variation, many of these features were found with some certainty in the same locations year after year. This included headlands and across the mouths of straits and deep bays, where the currents of the Beaufort Sea bring moving ice into contact with landfast ice or ice grounded in shallow, shoal areas near shore. Inuvialuit hunters are strategic in the decisions they make about where to look for polar bears." (JS 2015: 211-212)

Often, the search strategy would be to set up a base camp in good polar bear habitat, such as near an open lead, and wait (JS 2015). The Joint Secretariat study (2015) concluded that: "No matter what time of year or where hunters are located, Inuvialuit hunting strategies are based firmly on safety considerations and knowledge of polar bear habitat, feeding behaviours and movement patterns" (p. 30).

Spatial Extent

A comparison of Inuvialuit land and sea use in the 1960s and 1990s is shown in Figure 12. The "kill locations" from the Inuvialuit harvest studies of the 1990s give an indication of where harvesting is concentrated, while "the seaward limit of polar bear and seal hunting corresponds with the normal position of the floe edge, which is rarely more than ten miles offshore" and functionally defines search effort (Usher 1976: 22).

More recently, the participatory mapping work in "*Inuvialuit and Nanuq*" (Joint Secretariat 2015) (Fig. 13) updated the spatial extent of Inuvialuit knowledge of polar bears in the western Arctic based on those interviewed for these studies. While there were some methodological inconsistencies and flaws with these mapping exercises[51], in general, they illustrate the geographic extent of Inuvialuit polar bear Indigenous knowledge and the spatial extent of historical harvesting and observation by knowledge holders in the studies. More recently, community-specific maps were developed for the 2016 community conservation plan updates (Figs. 14-16) (Community of Aklavik *et al*. 2016; Community of Inuvik *et al.* 2016; Community of

[51] "[I]t became clear during the October 2012 confirmation meetings in Ulukhaktok and Sachs Harbour that the data marked on the 2010 map biographies significantly under-represents the extent and intensity of Inuvialuit polar bear harvesting and travel activities in the Melville Island-Viscount Melville Sound area." (see JS 2015: 249)

Paulatuk *et al.* 2016; Community of Sachs Harbour *et al.* 2016; Community of Tuktoyaktuk *et al*. 2016; Community of Ulukhaktok *et al.* 2016).

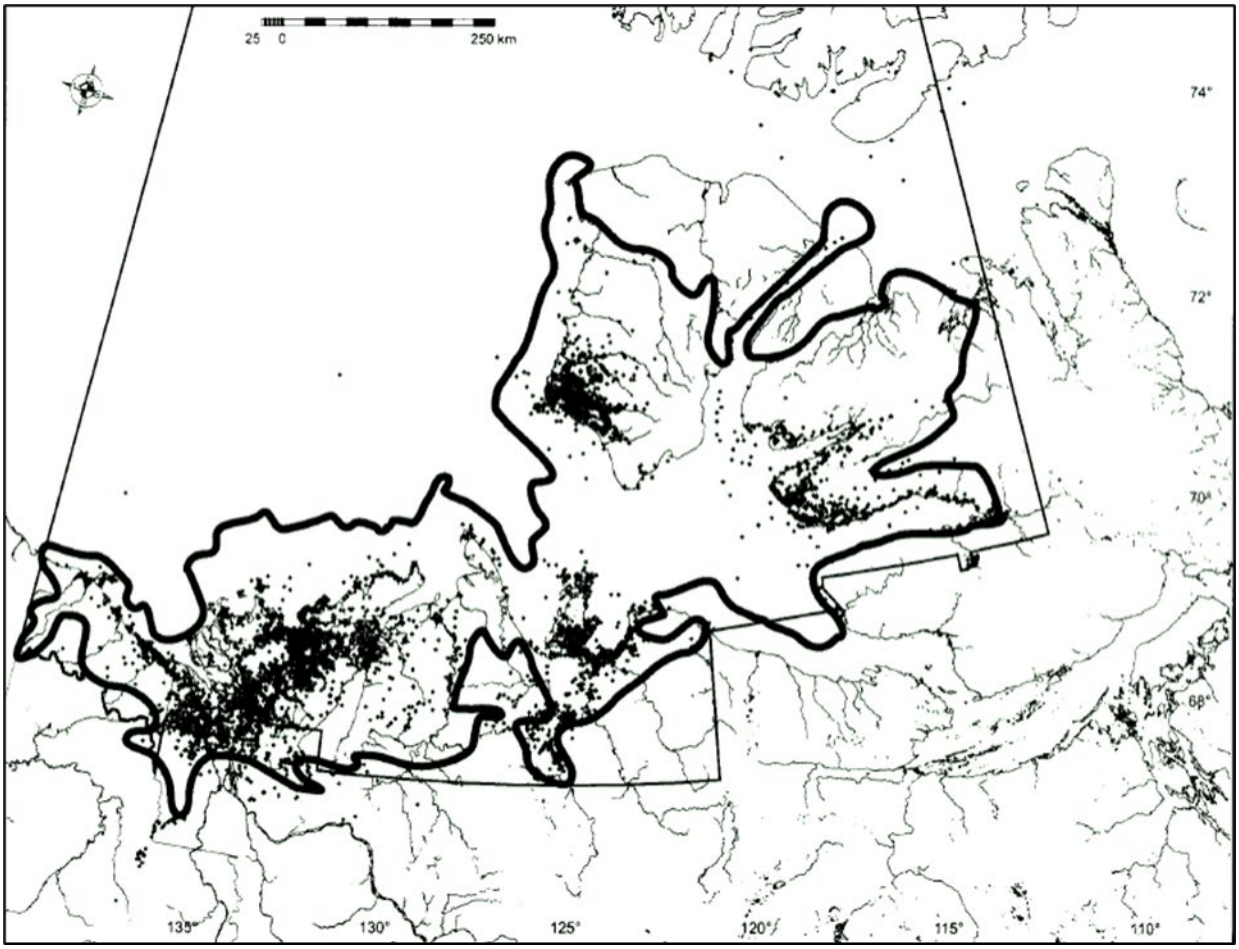

Figure 12. Inuvialuit use of land and sea in the ISR, 1960s and 1990s. The thick line shows land and sea use in the 1960s; it represents the outer limit of Inuvialuit harvesting from the mid-1950s to the mid-1970s, as documented by the Inuit Land Use and Occupancy Project (Freeman 1976). The dots, showing land and sea use in the 1990s, are based on actual kill locations (polar bears and terrestrial mammals only) in 1988-97, as documented by the Inuvialuit Harvest Study. Each dot shows the location of at least one kill. The thin line indicates the boundary of the ISR. Reproduced from Usher (2002), © Arctic Institute of North America.

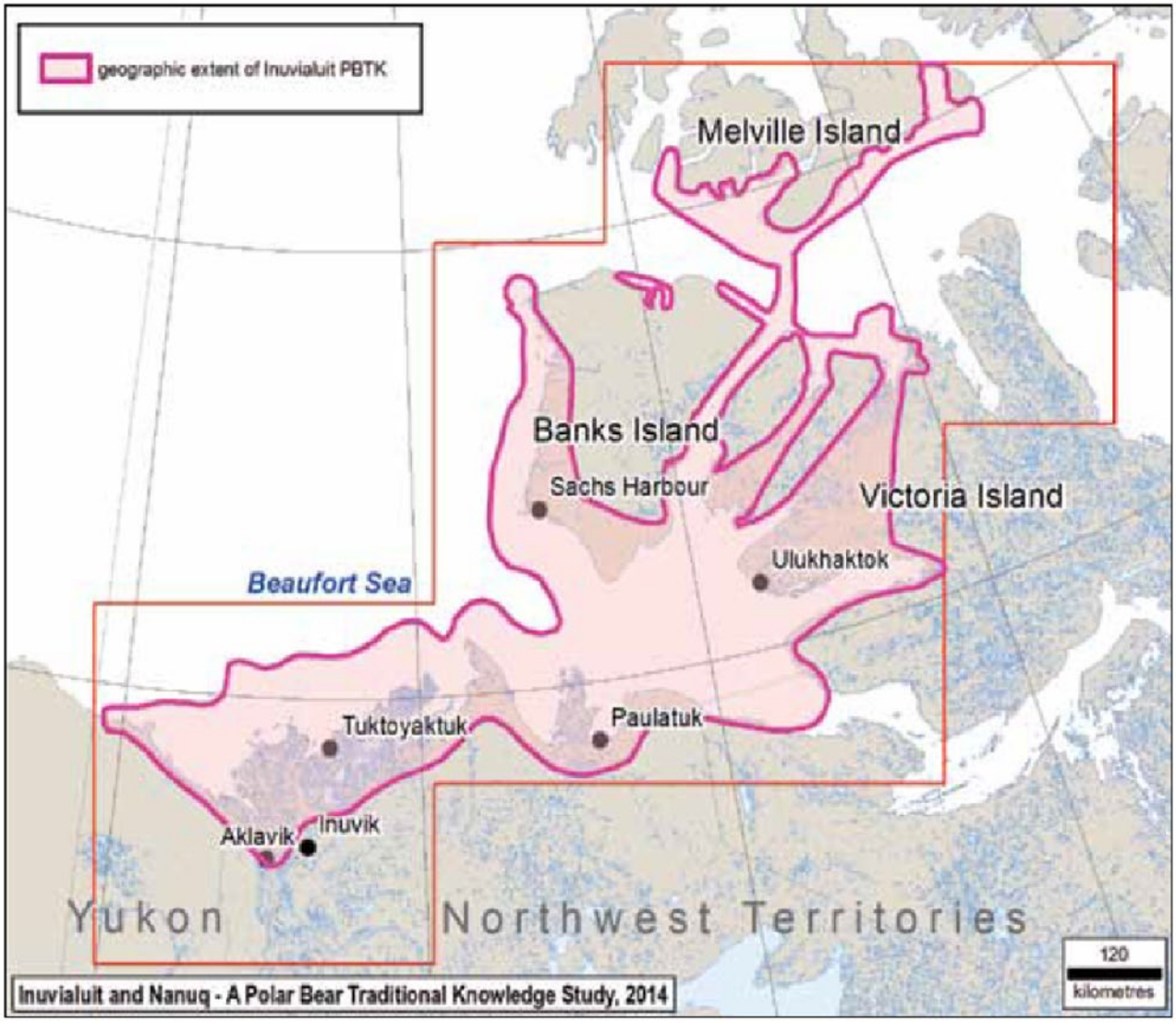

Figure 13. Geographic extent of Inuvialuit polar bear Indigenous knowledge as documented in Indigenous knowledge holder map biographies. Reproduced from Joint Secretariat (2015: 27) with permission.

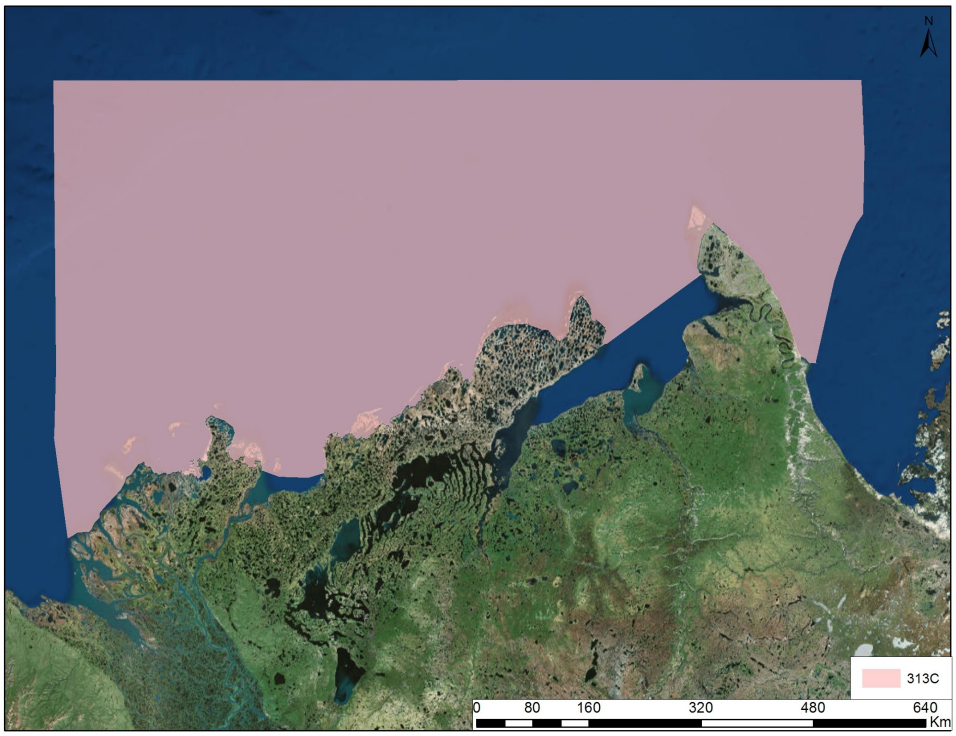

Figure 14. Winter seal and polar bear harvesting areas. Reproduced from Community of Tuktoyaktuk et al. (2016: 46) with permission.

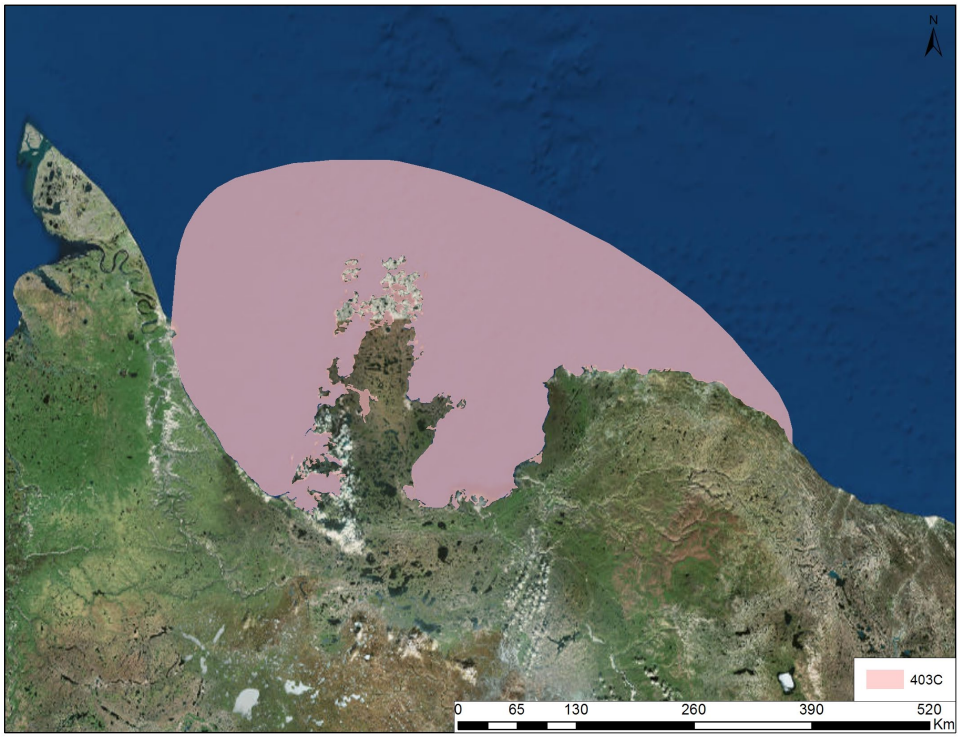

Figure 15. Spring polar bear/seal harvesting areas. Reproduced from Community of Paulatuk et al. (2016: 29) with permission.

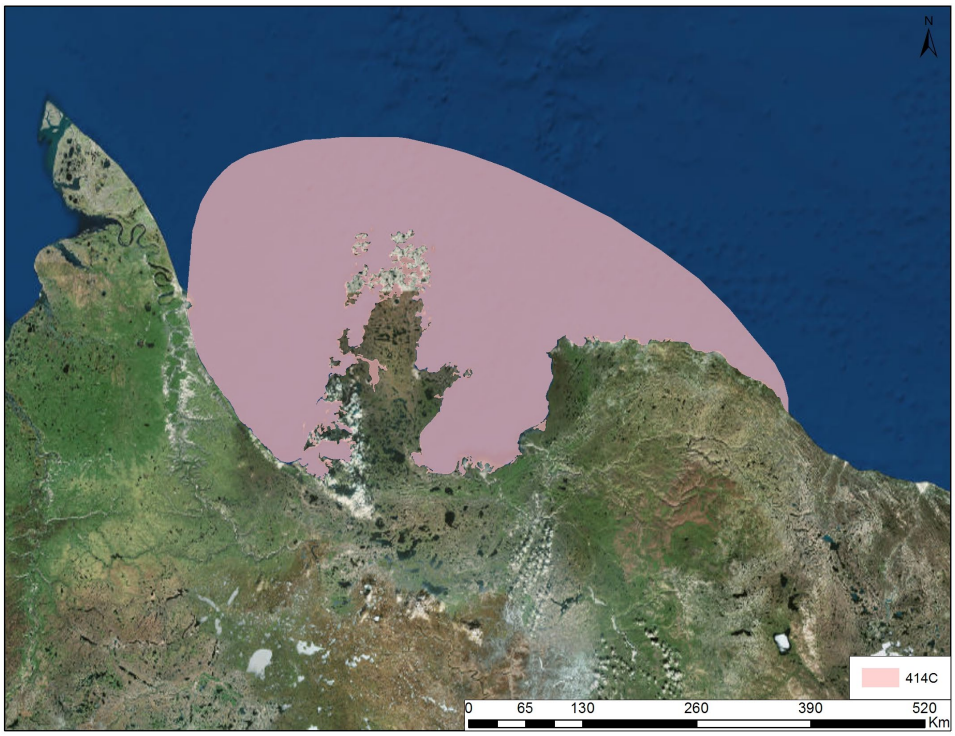

Figure 16. Winter polar bear and seal harvesting areas. Reproduced from Community of Paulatuk et al. (2016: 51) with permission.

Historical use and occupation of Melville and Eglinton islands is contested in the literature reviewed for this status report (Usher 1976; Haogak *in* SARC 2012)[52]. However, in the last three decades, hunters from Sachs Harbour and Ulukhaktok have travelled to Melville Island for both sport hunts and subsistence hunts, and certain hunters visit Melville Island frequently (Slavik *et al*. 2009; Slavik 2013; JS 2015)[53,54].

Harvesting effort, and hence "search effort" for polar bears, has been influenced by a number of factors. Hunting ranges specifically for polar bear, mapped for the years prior to 1984 and for 1984 to 2009, show only minor differences between the two time periods (Figs. 17 and 18

[52] In the *Inuit Land Use and Occupancy* maps (Usher 1976), Rink (1887) shows occupation and Steensby (1917) indicates "earlier distribution", but other cartographers do not mark the islands as previously inhabited. An elder in Sachs Harbour said that their ancestors would travel up to Melville Island (Haogak *in* SARC 2012).

[53] "I can't tell you exactly where I harvested them all. It was over 80 bears, but I can't remember exactly how many I harvest. Over 80 bears all over, most of them on Melville Island." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al*. 2009: unpubl. transcript)

[54] In the mid-1980s, some Ulukhaktok hunters used the aircraft chartered to pick up sport hunters at Melville Island to transport themselves and their gear to the same area. They returned by snowmobile. "I did go to Melville Island, but that's by airplane. That's cheating a little bit, but we got one [an aircraft], anyway… They had sport hunters down there. They were done. So, I asked Hunters and Trappers [Committee] to see if we could kind of split a charter with them when they come back. They said 'sure'. Well, we got 12 polar bear tags for Melville, and we were happy." (PIN 125 [Ulukhaktok] *in* JS 2015: 221)

(Slavik *et al.* 2009)). However, some Inuvialuit indicate that the search effort for bears may be less than in the past as hunting ranges have shrunk (Slavik 2013)[55], hunting culture has changed, and ice conditions have become unpredictable (JS 2015). The high cost of gas may also be limiting the range of some harvesters (Slavik 2013).

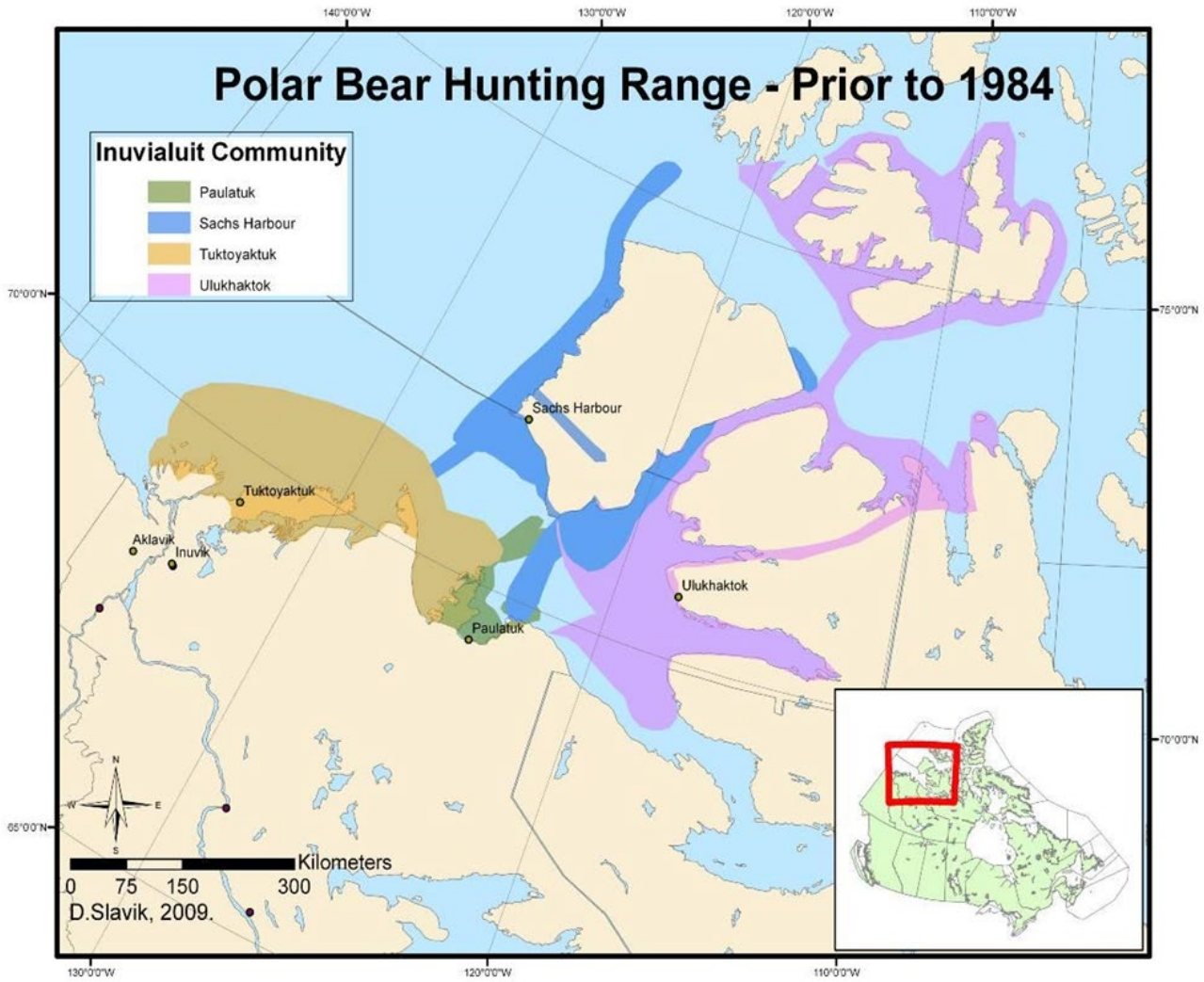

Figure 17. Approximate polar bear hunting range (prior to 1984) as described by 16 Inuvialuit participants in a workshop and through interviews. Reproduced from Slavik et al. (2009) with permission.

[55] "Our hunting area has shrunk…". (L. Amos [Sachs Harbour] *in* Slavik 2013: 169)

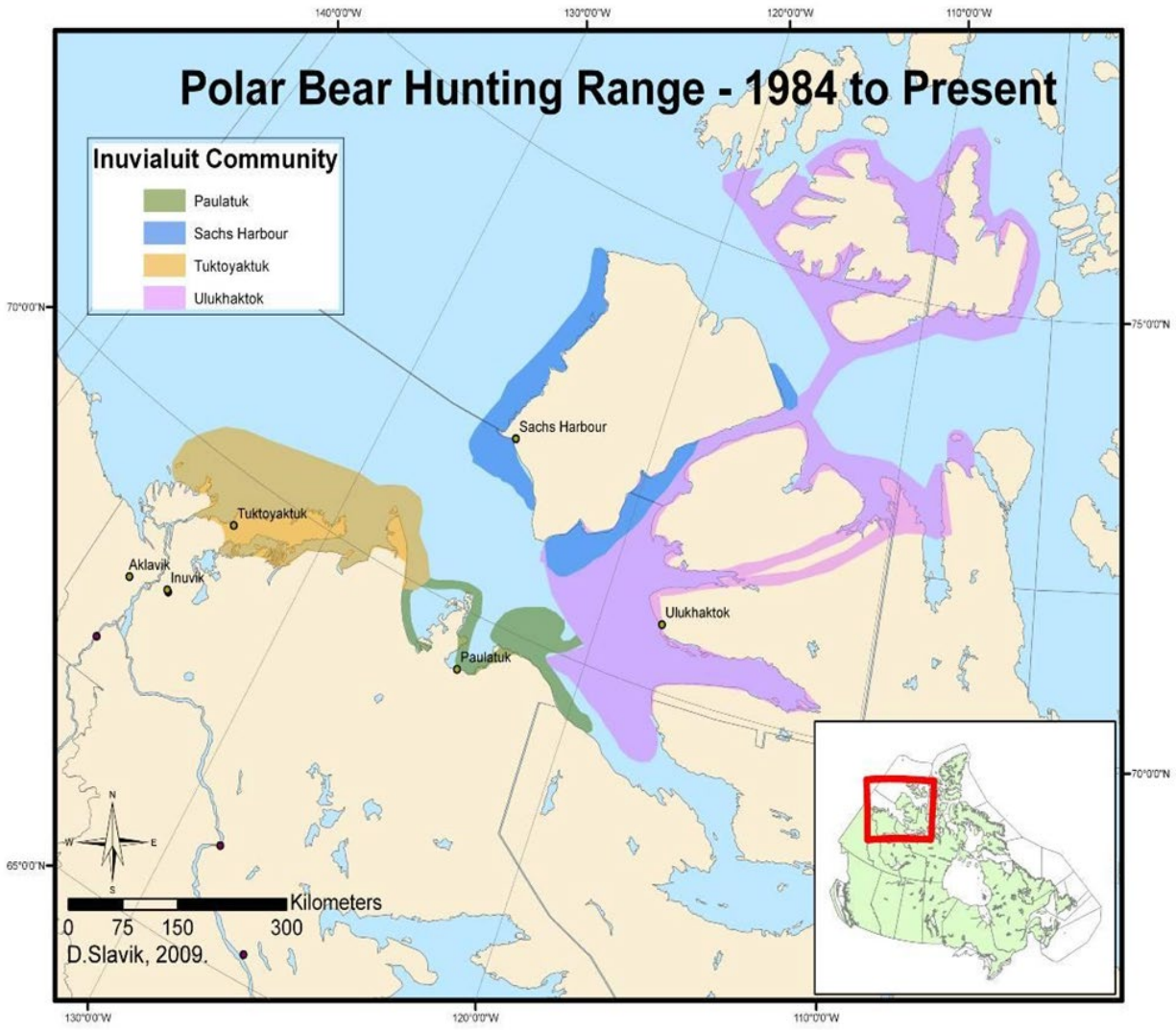

Figure 18. Approximate polar bear hunting range (1984 to 2009) as described by 16 Inuvialuit participants in a workshop and through interviews. Reproduced from Slavik et al. (2009) with permission[56,57].

[56] JS (2015: 222) notes that these figures [Figs. 17 and 18 in this report] in Slavik *et al*. (2009): "erroneously depict Inuvialuit polar bear harvesting on the north side of Melville Island and far into M'Clure Strait between the northwest tip of Banks Island and Prince Patrick Island. The mapping methodology was based on narratives and drawing highly generalized circles on small-scale maps. Furthermore, no TKHs [traditional knowledge holders] from Sachs Harbour participated in the October 2009 Tuktoyaktuk workshop were PBTK [polar bear traditional knowledge] locations were discussed." However, many residents in these workshops lived on Banks Island in the periods mentioned, relocating to Tuktoyaktuk or other mainland communities after the decline of the trapping industry. Therefore, experiential knowledge of elders and harvesting range of Bankslanders during this period was reflected in this map. However, these may only reflect the experiences of a select few harvesters, and does not reflect the intensity and frequency of use in this region as the workshop did not allow for this in-depth examination. It is advised to consider these figures in conjunction with harvest range maps provided in Usher (2002) and JS (2015).

[57] At least one Sachs Harbour resident hunted polar bears on Melville Island during the 1990's (Larter pers. comm. 2021).

As noted earlier, Inuvialuit hunters are strategic in the decisions they make about where to look for polar bears. Although safety is a prime concern, Inuvialuit hunters also purposefully camp in high traffic areas for polar bears (e.g., floe edges, cracks, pressure ridges) to maximize their chances of encountering and harvesting the animals (JS 2015). Until recently, and despite annual variation, many of these features were found with some certainty in the same locations year after year due to the interactions with currents, bathymetry, and ice features.

Temporal Extent of Search Effort

Polar bear observations have been collected throughout the year but with more intensity during hunting seasons when sea ice conditions permit safe travel and daylight hours are longer (Table 1) (JS 2015; COSEWIC 2018). The best time to hunt was during the spring months, towards the end of March because "*their fur gets real full*" (J. Memogana [Ulukhaktok] *in* Nagy 1999: 126) and conditions are more favourable at this time for the already challenging hunt. Polar bears are also observed during the warmer months while they are swimming in open water or are on land walking along shorelines, waiting for freeze-up (Lee *et al*. 1994).

Table 1. Months when polar bears were harvested, 1988-97. Reproduced from Joint Secretariat (2015: 44) with permission.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Set	Oct	Nov	Dec
1988	5	10	7	27	3	-	-	-	-	-	-	-
1989	5	11	6	15	18	-	-	-	-	-	-	8
1990	8	9	13	20	2	-	-	-	-	-	-	2
1991	5	10	12	18	7	-	-	-	-	-	1	-
1992	10	13	6	19	1	-	1	-	-	3	-	5
1993	2	1	8	13	13	-	-	-	-	-	-	5
1994	2	3	7	4	1	-	-	-	-	1	1	-
1995	2	3	11	9	-	-	-	-	-	-	-	-
1996	3	2	7	4	2	-	-	-	-	2	3	5
1997	-	3	20	16	1	-	-	-	-	-	-	1
Total	**42**	**65**	**97**	**145**	**48**	**-**	**1**	**-**	**-**	**6**	**5**	**26**

Prior to harvesting regulations, hunters could harvest polar bear throughout the year, although the greatest numbers of bears were harvested in spring, with a second peak during fall freeze-up, when polar bears would travel along the coastline waiting to access the freezing sea ice (Lee *et al.* 1994). Today, polar bear hunting is restricted to open seasons, generally from October 1 to May 31 (depending on the community), and only December 1 to May 31 for females (see the Inuvialuit Settlement Region regulations under the *Wildlife Act* 2010[58]). Since approximately 1993, this is the open season for hunting bears:

- Northern Beaufort Sea zone – October 1 to May 31 (no females are to be harvested October 1 to November 30)
- Southern Beaufort Sea zone – December 1 to May 31
- Viscount Melville zone – January 1 to May 31

Historical vs. Contemporary Hunting Practices and "Search Effort"

Historically, polar bears were killed wherever and whenever they were seen, and as a result the greatest numbers were taken closer to settlements, typically between 1 and 16 km from land, and often in association with seal hunting or trapping, resulting in a concentration of hunting pressure in space and time (Usher 1971b, 1976; Barr 1996).

Before snowmobiles were introduced in the far north, hunters would encounter or actively search for bears on foot or with dog teams. Dog teams gave hunters some advantage in locating and reaching polar bears as they could travel on thin ice conditions where a skidoo could not (Pearce 1976)[59]. Furthermore, sled dogs, with their keen sense of smell, may have also led hunters to polar bear dens (Harington 1968). In summertime, polar bears were occasionally hunted with boats (Slavik *et al.* 2009)[60]. Today, polar bears are hunted primarily with snowmobiles (*sikiituq*)[61]. Several trade-offs between hunting with dogs vs. snowmobiles

[58] Inuvialuit Settlement Region regulations are available online: https://www.justice.gov.nt.ca/en/legislation/#gn-filebrowse-0:/w/wildlife/

[59] "Dog-teams can go where a skidoo can't. Like ice that is starting to break-up. I have traveled with my dogs where a skidoo never would." (Pearce 1976: 252)

[60] "Yeah, we seen swimming polar bears when we go to Holman Island, we get two swimming polar bears. No ice and it keep swimming – hunting I think." (S. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[61] Snowmobiles were introduced at Ulukhaktok in about 1972, "at which time hunting and trapping activities were still carried out completely by dog team. In a period of just a few years, dog teams dropped out of use completely as people opted for the snowmobile as a faster and more convenient mode of transportation. Nevertheless, a few people maintained their dog teams for expressive purposes. Now that sports hunting for polar bears is becoming a profitable pursuit, more dog teams are coming back into use. The snowmobile, however, remains the primary mode of transportation for all hunters and trappers." (Condon 1983: 41)

were noted in the Joint Secretariat study (2015) and Slavik (2013), including distance that can be travelled and cost:

"Snowmobiles allow hunters to travel greater distances in a short period of time, but these benefits come at a price. In the past, one would hunt and trap with dogs and would only be limited in range by the amount of feed for their dogs. Now with skidoos, the price and availability of gas is a variable in range of hunting trips (for most families)." (Slavik 2013: 170)

In the past, harvesting effort has also been influenced by economics and the demand for polar bear hides and sport hunts. This influence began with whalers and fur-traders and accelerated with the construction of the DEW line (Slavik *et al*. 2009)[62]. Prior to this, the majority of hunters would only hunt polar bears for their hide and meat, usually when they were hunting seals (Usher 2002; Slavik 2013)[63]. As snowmobiles began to replace dog teams as the preferred method of travel, the demand for seals declined. Whereas the mean annual Inuvialuit harvest of polar bear has only declined from 68 (1960–65) to 56 (1988–97), the annual seal harvest has declined nearly five-fold (Usher 2002). Over the same time periods, Usher (2002) found the following changes in terms of harvester behaviour:

"Harvesters, defined as anyone who harvests, have declined only slightly as a proportion of the total population, but the major change has been a shift from full-time to part-time harvesting. To some extent, this has been made possible by the shift from dogs to snowmobiles, as well as the increased speed afforded by more modern technology, which harvesters have generally used to reduce the time required to harvest a targeted amount, rather than to increase harvest levels." (p. 25)

The search effort for bears may be less than in the past as the hunting range has shrunk and hunting effort (number of days spent hunting for bears) has generally declined (Slavik 2013)[64]. Today harvest is managed by co-management quotas based on biology. In addition, numerous socio-economic factors including restraints on time, travelling costs, cost of gas and supplies, and reliance on wage income are potentially interacting to limit the geographic range of most harvesters. Furthermore, the decline in sports hunting and unpredictability of environmental

[62] "And only when the DEW line started coming out, the price started getting higher and the price keep getting higher since then. So people really hunted the bear only for food at that time and they were only going after foxes – hunting and trapping foxes only – cause the bear was not worth more than a fox. It wasn't worth your time. And they use it only for food [and clothing]." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: 14)

[63] "Sometimes they'd go get for polar bear but mostly for seals, eh. They go out for seals and when they run into polar bears, sure, they get the polar bear when they have a chance." (A. Carpenter [Sachs Harbour] *in* Slavik 2013: 156)

[64] "Nobody hunts out, way out anymore…don't go for 2 weeks like they used to." (D. Haogak [Sachs Harbour] *in* Slavik 2013: 170)

conditions are potentially limiting the range of most harvesters[65]. However, new opportunities for seasonal, on-the-land employment (such as with Parks Canada or as research assistants) created opportunities for observations while flying to and from field sites, fieldwork, and other duties related to employment (WMAC (North Slope) and Aklavik HTC 2018).

Climate Change Effect on Search Effort

Changing ice conditions attributed to climate change are a key limitation to search effort (Slavik 2013)[66,67]. The Joint Secretariat study (2015) summarized that:

"The occurrence and location of multi-year and annual sea ice, pressure ridges, floe edges and polynyas have affected the location of polar bear and seal denning sites, and the distribution and movements of polar bears and seals and have altered the location of historic Inuvialuit hunting areas and travel routes. These changes are affecting Inuvialuit traditional knowledge." (p. x)

Observed impacts include a decrease in the thickness and strength of ice in some areas (Slavik 2013)[68,69], making it more difficult to predict the safety of the ice (Slavik *et al.* 2009)[70]. The ice breaks up more easily because it is not as thick, making it vulnerable to break-up from wind and currents (*sarvaq*) (Slavik 2013)[71,72]. According to an Ulukhaktok hunter, open leads take much longer to freeze enough to permit safe passage than they did twenty years previously.

[65] "The unpredictability of the weather makes it difficult for hunters in Aklavik to plan long-distance trips from their Mackenzie Delta community to the Yukon North Slope." (JS 2015: 172)
[66] "You can't go out anymore like as far as you used to. You're stuck to along the coast. Cause a lot of the bear would be way out here and you don't seem them, but what you do see close-by. A good number!" (J. Keogak [Sachs Harbour] *in* Slavik 2013: unpubl. transcript)
[67] "I'm pretty sure there's still a good number of bears out there. It's just that we can't access the same areas that we used to access 20 years – 30 years ago cause the ice conditions… You know, you could tell if a bear's healthy or bears are healthy. The ones they've actually caught closer to shore than normal, if they're healthy. You just can't travel as far as we used to. The ice is like our road. If we don't have that, how can you go out and find out if bears healthy or increased population, decreased population." (L. Amos [Sachs Harbour] *in* Slavik 2013: 169)
[68] "[The ice] used to be about 15-20 feet thick. Now it's lucky to be 4 or 5 feet." (R. Kuptana [Sachs Harbour] *in* Slavik 2013: 105)
[69] "The ice still looks the same, but the thickness and the strength of it [decreased]." (F. Lennie [Sachs Harbour] *in* Slavik 2013: 105)
[70] "There's one area here called Whale Bluff [south-east of Cape Bathurst]. It's about 300 feet high. Sandy would go so far that you can't see the bluff anymore. So just by hearing stuff like that, you can tell that ice conditions were a lot safer back then than they are now." (C. Gruben [Tuktoyaktuk] *in* Slavik *et al*. 2009: 45)
[71] "It doesn't take very much wind or very much current to break up the ice anymore." (R. Kuptana [Sachs Harbour] *in* Slavik 2013: 105)
[72] "The problem now is that the ice is thinner and more easily disturbed by wind and currents… It breaks, is frozen together again by the cold, and then re-broken repeatedly, producing a heavily rubbled surface that is difficult for hunters to travel across… May TKHs [traditional knowledge holders] spoke of the effects of thin ice on harvesting. For example, a hunter from Sachs Harbour said that even light winds can cause the ice to break off the landfast ice, taking hunters with it." (JS 2015: 163)

Where it was once possible to cross them after only several hours of waiting, now people can wait days for leads to freeze solid (JS 2015). Some attribute this to the wind, which delays the freezing process.

The lack of shore-fast ice means that open water can reach right to the shore so hunters cannot access ice on their snowmobiles (Slavik 2013). Even if hunters are able to access the shore-fast ice, they are unable to go out further than about 6-12 miles as open water, pressure ridges, and open leads affect their ability to travel far onto the ice (Reidlinger 2001; Slavik 2013)[73,74].

Since the mid-1980s, no one has been able to travel and hunt polar bears as far offshore as they had previously. Location of and access to the floe edge is no longer as predictable or accessible[75]. Ice conditions and the location of the floe edge continue to vary widely each year, but hunters are observing an overall trend in location that is closer to the shore (Fig. 19) (JS 2015). In general, "with rare exceptions, polar bear hunting beyond sight of land has been curtailed due to ice and safety issues" (JS 2015: 45) and there is simply too much thin unpredictable ice, rubbled ice, or open water too close to shore. As a result of changes to sea ice and weather patterns, "hunters are in less of a position to observe and learn from the bears" (JS 2015: 47).

[73] "In the 1970s you could go out 30 or 40 miles in winter hunting polar bear, then only 20 miles, then 10. Last year only 6 miles out and you reach ice you have to worry about." (J. Kuptana [Sachs Harbour] *in* Reidlinger 2001: 62)

[74] "In the days before climate change made long-distance ice travel exceptionally dangerous, if not impossible, a number of [Paulatuk] hunters ventured halfway across Amundsen Gulf within sight of Nelson Point on Banks Island." (JS 2015: 28)

[75] "Floe edges and areas of open leads that were once fairly predictable and occurred in more or less the same places from one year to the next have changed or else cannot be reached by snowmobile due to excessive rubbling of the ice." (JS 2015: 162)

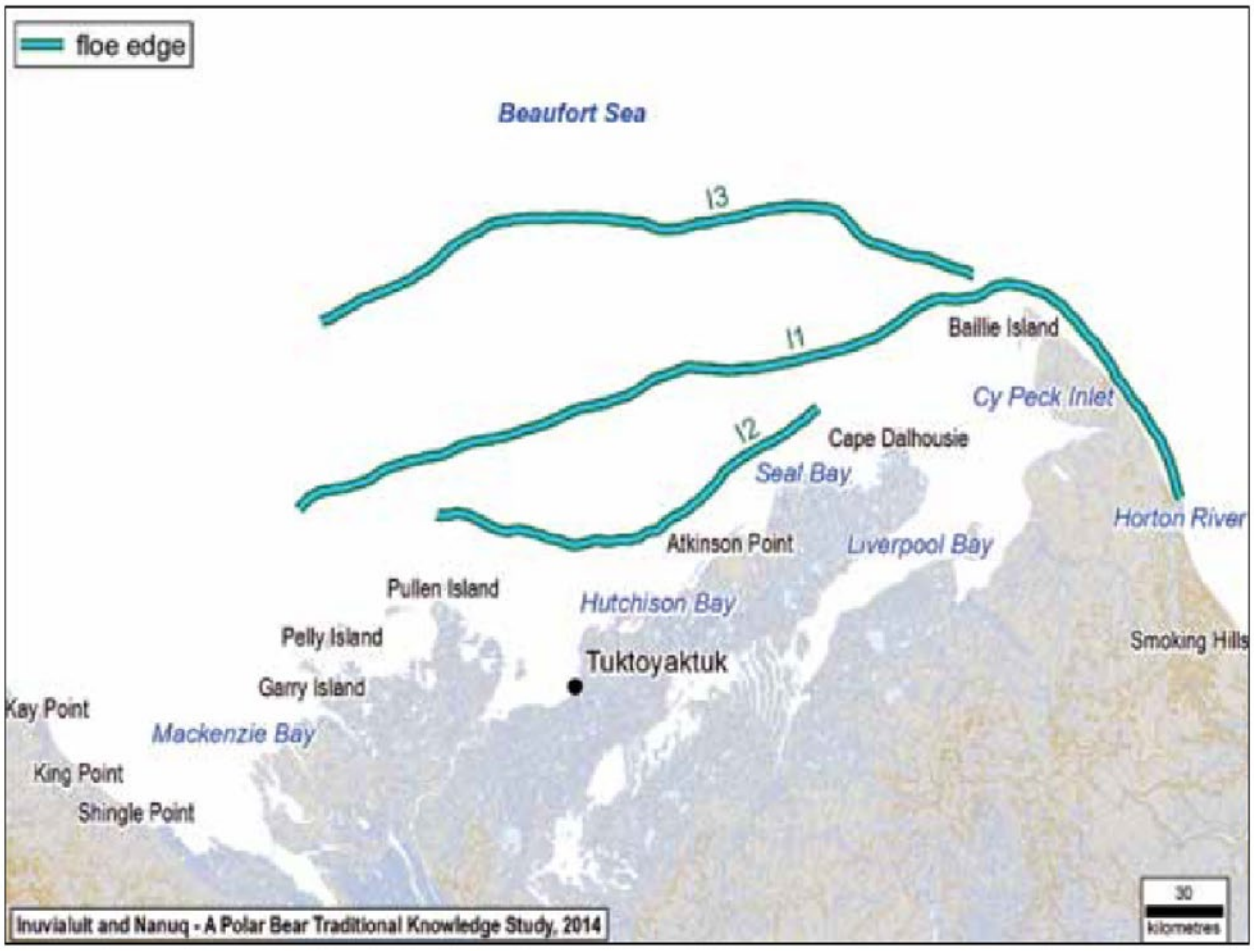

Figure 19. Changes in floe edge locations, 11 (pre-1986) to 12 (2010); 13 was a one-time hunt in the 1970s. Reproduced from Joint Secretariat 2015: 164) with permission.

Biology and Behaviour

Habitat Requirements

The habitat conditions for polar bears and their prey (i.e., seals) are determined by the dynamic nature of sea ice conditions, ice structure, and annual variation in weather patterns, freeze-up, and break-up (JS 2015). As James Pokiak from Tuktoyaktuk summarizes:

"There are the different ways that the ice has to form so you can see the polar bear. If that doesn't happen, you won't see them... I'll give you my point of view on what makes good habitat conditions for polar bears: First of all, you need ice. Secondly you need wind once and a while. You need older ice out there. And like I said, you need the wind and the current to open up so that after it calms down and re-freezes, it turns into young ice. That's the ideal conditions for polar bears. That's the best hunting spot for polar bears - in the young ice. Ice that's anywhere from a day to a couple weeks old - depending how windy it is. That's the ideal conditions for polar bears... if there's too much water, bigger bears tend to be out there, but there always tends to be bears, whether it be a small one or a big one that gets stuck on the land fast ice. Mostly those are the ones we see tracks of when it opens up and stays open for a while. But as soon as that water re-freezes again, they start seeing more and more bears closer to the shore." (in Slavik et al. 2009: 47)

Sea Ice Types

The main types of sea ice in polar bear habitat are classified as follows:

- Land-fast (attached to land) (*tuvvaq* (K); *tuvaq* (S))
- Annual (forms each winter) (*hikuliaq* (U); *hikulihaaq* (K); *sikuliaq* (S))
- Pack (continuous mass of floating ice)
- Multi-year (has survived >1 melting season) (*hiku nuulailaq* (U); *qangangnittaq hiku* (K); *piqaluyaq* (S))

Land-fast Ice

Land-fast ice, which is also referred to by knowledge holders as "shorefast" or "main ice"[76], forms in the fall each year in bays, along mainland coastlines in the NWT and Yukon, and on the coastlines of Banks Island and Victoria Island (JS 2015). Knowledge holders observe that land-fast ice is "solid, steadfast ice and is generally safe to travel and camp on, especially if it is grounded by pile-ups" (JS 2015: 67).

Indigenous and community knowledge suggests that larger, mature bears hardly come to the shore because they prefer to stay out where the ice is not moving as much, whereas smaller

[76] *Hikupiaq* (U); *hikulluak* (K); *hikulluaq* (S).

bears and mothers and cubs like to wander around close to shore and on land-fast ice where they find certain places where they can hunt by themselves (Slavik *et al.* 2009)[77]. The general belief is that "healthy" bears will stay further away from land and settlements (Slavik 2013):

"... [polar bears] migrate back, then head straight out cause they can't stay where there's water. Only some of them [come to shore] when there's [ice] floes around. Most of them head out where it's not moving, big ice floes and that is where they like to stay, the polar bear...That's where you'll find them, out there on the ice." (F. Wolki [Tuktoyaktuk] in Slavik et al. 2009: unpubl. transcript)

Annual Ice

Annual ice, also known as "thin ice", "new ice"[78], or "young ice"[79], forms in a single winter between freeze-up and break-up each year or within a new lead or crack (JS 2015). Annual ice takes a variety of distinct forms including "pancake ice", "candle ice", or "rubber ice" (very thin new ice that flexes when polar bears and humans travel across it (JS 2015: xviii))[80].

Polar bears hunt seals at breathing holes along cracks, open leads, and where young ice and older solid ice meet. Ringed seals may keep their breathing holes open in the annual ice as the ice grows thicker throughout the winter, and as snow accumulates on top, they may decide to make their birthing lairs there (JS 2015). New ice interacts with multi-year ice as these larger icebergs "glue" the young ice together and make it safer for travel (JS 2015: 167).

Multi-year and Pack Ice

Conflicting observations have been documented regarding polar bears' use of multi-year ice as habitat, with some knowledge holders stating polar bears will avoid it[81] and others noting the presence of polar bears on or around floating multi-year ice, "old ice"[82], or "icebergs"[83],

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[77] "When it start to get warmer, you could see a great difference in the current and ice movement – and for that matter I always think now that it gets so warm, ice is not coming in too much anymore, and all the bears are staying out there. They don't like, except the small ones, like to wander around where they find certain places where they could hunt by themselves – like the mothers and cubs and the smaller ones. But the bigger ones hardly come to the shore because they prefer staying out where the ice is not moving that much." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: 29)

[78] *Hikuliaq* (U); *hikulihaaq* (K); *sikuliaq* (S).

[79] *Hikuliaq* (U); *hikuliaq* (K); *sikuliaq* (S).

[80] "Candle ice only [occurs] in springtime. Around Baillie Island lots of slush in the water when it's just starting to freeze up – good for bears, seen 12 bears once on slush (with naked eye from a ridge – James). Depending on weather conditions slush can be really dangerous for people because it can look like you can walk on it but you could go right through. [It] gets 'slush' when it's snowing and trying to freeze up at the same time. [There is] not more slush lately than usual, [it is a] normal part of ice." (Nathoo pers. comm. 2010)

[81] "The polar bear will avoid multi-year ice, because they know that there's no seals in that area where there's multiyear ice. That really thick ice. They'll go to ice that is thin and also where the seals are coming up through the young ice and where they have their holes." (PIN 115 [Ulukhaktok] *in* JS 2015: 61)

[82] *Hikualuk* (U); *utuaqa hiku* (K); *utuqqaq* (S).

especially in the summer months (JS 2015: 61). These observations have been validated by Indigenous knowledge studies in the Chukchi Sea region (Voorhees *et al*. 2014)[84].

Ice Structure

There is less understanding of how ice structure (e.g., floes, leads, thickness, surface roughness, pressure ridges, polynyas) influences polar bear movements and habitat affinity, but ice structure is an important feature for both bears and their prey (COSEWIC 2018). Ice structure can be influenced by local geographic and bathymetric features. For example, several pressure ridges may occur in the same area resulting from ocean sea floor features and prevailing currents. As documented in the Joint Secretariat study (2015):

"Inuvialuit hunters associate particular geographic features with polar bear abundance, and as a result they tended to concentrate their harvesting efforts in the same places. Headlands, capes, and points that protrude into the Beaufort Sea are examples of such features. They intersect the coastal currents and associated flow of nutrients, fish, seals and whales, and dramatically shape the formation of open leads, pressure ridges, pile-ups, floe edges and other ice features that are frequented by polar bears." (p.71)

Pressure Ridges[85]

Knowledge holders from all ISR communities identified that "Pressure ridges are a major attraction for [bears]" (JS 2015: 179). Polar bears will frequent and concentrate along pressure ridges because they are an ideal place for polar bears to find seals and hunt them in their dens (JS 2015)[86]. A knowledge holder from Paulatuk describes pressure ridges:

"A pressure ridge is from two large pans of ice coming together. When there are two large pans of ice, and there's a lead, and they have no place to go, the pressure is so great that they have to build up this way. On the sides of the pressure ridge you can actually see water, because it's got a dip on both sides. You can see salt water along the edges." (PIN 160 [Paulatuk] in JS 2015: 55)

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[83] *Hikuqpai* (U); *piqaluyak* (K); *piqaluyaq* (S).

[84] "One of the most prominent observations made by hunters about polar bear habitat regards "blue icebergs", which used to arrive from the north in the fall, and which brought polar bears and other game to the area. In recent years, these icebergs have failed to arrive, and hunters make a connection between the absence of this ice and the delayed arrival of polar bears in the region. Pack ice is associated with abundant seals, and so the lack of blue icebergs coming from the north in fall has resulted in reduced prey for bears (and thus, fewer bear sightings)." (Voorhees *et al*. 2014: 530)

[85] *Ivunrit* (U); *aulagun quglugniq* (K); *kuglunik* (S).

[86] "Lots of people point out that pressure ridges are not good polar bear habitat, but that is not true. Really high pressure ridge, good and safe for hunters. Seals go and den in pressure ridges, seen polar bears hunting seals on pressure ridges even through thick ice. Went hunting with brother seen high pressure ridge, saw lots of bears and a ton of tracks. Bears digging for seals denning. James seen places where polar bear dug into thick ice with seal dens. Both Frank and James have observed this." (Nathoo pers. comm. 2020)

Ice Pileups[87]

Ice pileups are "not good a place to hunt polar bears as seals do not make breathing holes in ice like this, particularly if it is still actively building" (JS 2015: 65). Many Inuvialuit avoid hunting in these conditions.

Rubble Ice[88]

"Rubbled" or "rough"[89] ice has certain advantages for polar bears. Bears may use these areas as "a refuge from other bears, a place to eat a recently killed seal without being disturbed, or in the case of females and cubs, a refuge when threatened by males or humans" (JS 2015: 66). However, from the perspective of one Paulatuk hunter, "*too much rubble ice is not good for polar bears, because there are too many breathing holes for seals*" (JS 2015: 65)[90].

Cracks and Open Leads

"Cracks" are when an ice field cracks open. When the gap between the cracks is large enough, it is known as an "open lead". The size of a lead depends on the strength of the current or wind in the area (JS 2015). Knowledge holders agree that cracks and recently frozen leads in the zone where young ice and older solid ice meet are among the best places to hunt for polar bears. This is because the thin ice found in the cracks of frozen leads is good for seal breathing holes (Slavik 2013; JS 2015).

Floe Edges and Polynyas[91]

The "floe edge" is the zone between stable, land-fast ice and moving ice. This feature is a prime area for seal hunting as seals establish their breathing holes in fresh ice, and den under the snow in the land-fast ice near the floe edge (JS 2015). "Polar bears wander the land-fast ice in February and March hunting for seals, but Inuvialuit hunters rarely encounter them there. The best place to harvest bears is where the land-fast ice meets the moving ice, at the floe edge" (JS 2015: 69).

"Polynyas" are a type of open water feature that does not freeze during the winter or which remains open for long periods of time. Knowledge holders observed that the edges of polynyas are normally productive zones for both seals and polar bears (JS 2015). Polynyas can be

[87] *Vunrit* (U); *qaliriik hiku* (K); *ivunrit* (S).
[88] *Murarat* (U); *hikut ahiqqut* (K); *ivvuq* (S).
[89] *Qairilaq hiku* (U); *manilaq* (K); *ivvuit* (S).
[90] "Cause there was so much open places for the seals to go. They'd be all spread out all over the place and just nowhere for the bears to hunt them. And that's why they were so lean that year. The old ice creates cracks, stability, so you don't have much open areas. You have places where seals concentrate, and…that's where the bears are going to concentrate too." (PIN 163 [Paulatuk] *in* JS 2015: 65)
[91] *Hikuyuittuq* (K); *uiniq* (S).

detected by harvesters from afar because of the "fog" that forms over them during extreme cold (JS 2015: 59).

Polar bears travel, looking for the best ice conditions from which to hunt seals. The great importance of ice to polar bears was summed up by an Aklavik knowledge holder:

"[t]hey have to have ice — the polar bear. Can't live without ice. The way they hunt that seal. The seal won't go to them. They have to go after the seal to get it. In order to get it, they've got to have ice. No ice: no food." (PIN 17 [Aklavik] in JS 2015: 53)

The sea ice is the "polar bear hunting platform - they station themselves on ice when hunting at seal breathing holes or birthing lairs" (JS 2015: 53). Most of the time polar bears will be hunting on young ice, along open leads or the floe edge, where the old ice and the young ice meet (Slavik 2013; JS 2015)[92]. The best ways for polar bears to hunt seals are by ambushing them at their breathing holes (*aglu*) or killing pups in their dens. The location of seal breathing holes and dens depends on the way the ice forms, breaks, and re-freezes. Annual ice is better bear habitat than multi-year ice because seals need thinner ice to make their breathing holes (Slavik 2013).

The following conversation between Pat Ekpakohak (PE, [Ulukhaktok]) and David Nasogaluak (DN, [Tuktoyaktuk]) (*in* Slavik *et al.* 2009: unpubl. transcript) summarizes the ideal ice conditions for polar bears to hunt:

PE: Pressure ridge like opening and closing all the time. Bears like to stay there and go hunting.

DN: When it goes, everyday it moves, it never freeze, that's why they're hunting in those areas.

PE: If old ice floating around, a lot of old ice - like packed together - bears don't stay there because it's too thick. That old ice, like 10,000 years ago ice, there's no bears in the area cause it's thick ice and there's no seals. Only when there's a very few icebergs floating around, in between, that's where a lot of bears go sometimes. Cause there's young ice there and icebergs are floating around and in between there's lots of seals too. When it's packed together, there's no bears. And rough ice, when it's really rough ice, there's no bears. And hunting through smooth ice also. Smooth ice for a long ways, there's not many bears there. A little bit of "manilaq", little bit of rough ice, there's a lot of bears around there.

DN: In ridges, that's what they're going for… There's a massive pressure ridge from Cape Perry to Holman Island sometimes. You could follow that, both sides, end of March.

[92] "They use the floe edge for hunting and just going back and forth. I haven't really noticed any type of ice that polar bears use, other than travelling along the floe edge, maybe in April when the seals are having pups. Mid-April they start having pups or around the first of April. They [polar bears] start going into the main ice in April to hunt seal pups, where the ice don't move away." (PIN 161 [Tuktoyaktuk] *in* JS 2015: 70)

PE: From Pierce Point right across there's a pressure ridge. Somewhere close to Pierce Point. A pressure ridge all the way to our island. That's polar bear country right there.

Pressure ridges (*quglugniq*) and open leads (*uiniq*) or "cracks"[93] are also favourable ice features for hunting seals (Slavik *et al.* 2009)[94,95,96]. One hunter also commented that the edge of land-fast ice (*tuvaq*) near Baillie Island, where there is slushy water and pancake ice[97] or young, rubble ice[98], is good hunting habitat for bears (Slavik *et al*. 2009). Seals will make breathing holes in the ice and haul-up on the ice along the floe edge and open leads. From here they hunt Arctic cod under the surface of the ice and excavate birthing lairs for their pups in the snow on top of it (JS 2015).

When bears begin hunting seals in their dens in February and March they look for "main ice" (i.e., older ice), where there is a pressure ridge (Slavik 2013). A bear can smell a seal den through a thick layer of snow and can then pound through the ice and snow with its paws to access it (Slavik *et al.* 2009)[99]. During spring, when seals haul up, bears will also hunt basking seals beside open leads (Slavik 2013).

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[93] "Well, it really depends on the way the ice form too. Sometimes when the ice comes in, it stays in the shore like that. But there's cracks that come in from straight out when the ice is moving and you see bears following the cracks towards the shore. That's why there's plenty of bears because the ice is not moving and they're hunting in those cracks." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: 42)

[94] "Polar bears, when they hit [the pressure ridges] they would follow it cause that is the place for seal." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[95] "If it opens up and then freezes over and there's lots of breathing holes. That's the one!" (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[96] "You know, you're on the main ice and there's another lead that freezes, then it will refreeze and pile up. The further one that was out, that one would have gone with the wind – you know, when the wind changes like we were talking about earlier, like outside of Baillie Island. The wind would blow it open up, and the ice would close, that's when the bears come in." (C. Pokiak [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[97] "For two different years, on Baillie Island, I seen it out there where you go to the shearing zone [floe edge]. I been out there when there was a lot of slush on the Beaufort. A lot of slushy water with pancakes here and there. One time I was out there and counted 12 bears walking out there on the slushy stuff. It was just amazing! Maybe in a three miles span – that's not counting what was on the other side of those ones or beyond. So those slushy conditions I found were really good hunting conditions for the bears too!" (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 47)

[98] "But what I've noticed from the bear patterns out there, when you have the land-fast ice and then you have the young ice – ice that's just frozen over – you're 100% guaranteed if you reach that edge there that you're going to see break tracks coming from both directions. And not only that, but a lot of time there are young ice areas where it kind of freezes like a lake and there will be ice rubble around, I've actually watched polar bears walk in from out on the ocean side after it freezes over. You can actually watch them walk in where it's land fast ice." (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[99] "I've watched polar bears walking through the ice rubble and where there's a thin spot, and I've watched them pounding with their paws to break it open. In some areas like that, they're probably on a seal den. When you see them doing that, there's the possibility that there's a den." (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

The suitability of sea ice habitat for seals (and polar bears) can vary from year to year, as illustrated by stories of 'good' and 'bad' years. J. Nasogaluak tells of years when the sea ice froze solid and open leads did not form, preventing access to seals:

"I remember that the men had to hunt polar bears as there were hardly any seals because of the weather, and there was hardly any open water, and there were lots of bears. Most everyone lived on straight polar bear meat all winter… This was in 1910… People at Cape Bathurst also had a hard time during the winter of 1922-1923 because of bad ice conditions. There was little food at the post to trade for, and seals, foxes and bears were scarce… It was even difficult to get polar bears and seals we could only get through breathing holes in the ice. The ice was so rough that the cracks didn't open up all winter… The people would walk and hunt for polar bear but couldn't get any because the ice on the ocean didn't have any openings. They called this 'piilauyuq tariuq'. This was in 1923. That winter, all the people of Baillie Island (Utqaluk) had nothing." (J. Nasogaluak [Tuktoyaktuk] in Hart et al. 2004: 72-74)

'Good' years for polar bears at Baillie Islands occurred when westerly winds (*ungalaq*) opened leads, making seals abundant and available for polar bears to hunt:

"In the time of my youth, long time ago, I hear the old timers, wise men in their own environment and conditions of life, speaking of good and bad years around Baillie Island. They reported that years favoured with westerly winds, one could make an easy life, as open water was abundant, (and) therefore seals [were] also abundant and available. Westerly winds also provided young ice, and good road for the polar bear and also good hunting." (J. Wolki [Tuktoyaktuk] in Hart et al. 2004: 74)

Denning

The Joint Secretariat study (2015) found that "virtually all polar bear hunters are familiar with the locations of some maternity dens, as well as their basic characteristics (at least those of the terrestrial dens) and the kinds of terrain features that are best suited for them" (JS 2015: 139). As a result of this study, as well as Richardson *et. al*. (2008), there is abundant traditional knowledge on record relating specifically to polar bear denning.

Inuvialuit used to find maternity dens with greater frequency prior to the 1970s, when dog teams were their primary mode of ice transportation, and when they were allowed to harvest bears in their dens[100]. Today, they are more likely to find dens inadvertently while hunting or travelling along the coast. In late October to early November, Inuvialuit travelling along the coast expect to see a lot of polar bear tracks going inland. This is when pregnant females begin

[100] "The change from dog teams to snowmobiles as the primary means of transportation across ice and snow has reduced the frequency of maternity den sightings… The ban on harvesting females and cubs in maternity dens also appears to have affected PBTK [polar bear traditional knowledge] of dens because Inuvialuit no longer have an economic reason – food and fur – for finding them." (JS 2015: 47)

looking for dens where they can birth and feed their newborn cubs over the cold winter (Slavik 2013). Knowledge holders note that occasionally, non-pregnant females and males will also "den" (MPEG 2006)[101].

Chukchi hunters recognize that polar bears make both temporary "resting" dens and winter-long reproductive dens (Voorhees *et al*. 2014).

Certain areas are well known for having dens, and Inuvialuit frequently see females and cubs and/or their tracks in association with such places. These are usually snow dens located on land, although dens may also occur on land-fast or multi-year ice if conditions are right (Harington 1968; Slavik 2013; JS 2015). Several knowledge holders have stated these dens could be associated with pressure ridges and icebergs (large piled-up agglomerations of thick ice) against which drifting snow accumulates (JS 2015).

Ideal denning conditions include the presence of deep snow to provide insulation for the mother and cubs (Slavik 2013). Snow accumulation and depth is influenced by geography and topography, wind direction, and the volume and timing of snowfall. Bears build dens in features such as high slopes[102], the sides of shoreline banks and coastal bluffs, inland creeks and river valleys, and other locations where snow accumulates, including ravines and depressions (Slavik et al. 2009)[103].

The location of dens can also depend on prevailing winds and the aspect of the slope. Terrestrial dens are often located in the "leeward side of topographical features where sufficient snow accumulates by early autumn" (COSEWIC 2018: 20). For example, around Tuktoyaktuk, the wind blows from the north and west, so the bears typically use the south or east sides of the islands or inlets, where snow accumulates on the banks (Slavik *et al*. 2009)[104,105]. Likewise, one Tuktoyaktuk knowledge holder observed that: "If the wind is from

[101] "It's not only the female bears that use dens; when the males get too fat sometimes they go [in] the hole and rest for awhile and wait until they lose some weight before they come out again. They don't sleep like grizzlies, though; they're always up. When the male bear is hibernating, if there's too much disturbance he will just break right through the snow. When they get disturbed they get mad and stand up." (MPEG 2006: 11-32)

[102] A Paulatuk hunter said they "would look for high slopes, and they go in between and make it where they wouldn't get buried. So they know the conditions." (PIN 142 [Paulatuk] *in* JS 2015: 139)

[103] "I see them denning along the banks and also in some ravines in some areas I seen bear dens." (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[104] "In November they'll go out, in the first part of November, when the ice is thick enough, and they see a lot of tracks going inland – they just leave them alone. They know it's a female looking for a place to make a den. As Fred was saying, they wait for the wind to blow over a bank. So north and west is from where it blows so they try to go to the south side of the islands or inlet. In Seal Bay there's a lot of inlets there." (C. Pokiak [Tuktoyaktuk] *in* Slavik *et al*. 2009: 22)

[105] "…a lot of the dens I see are on the east banks. We used to get a lot of wind from the west, blowing the snow, so we get a lot of the denning areas on the east-side life. Twice in my life I've seen a polar bear den way up the Smoke River and way up the Moose River – about 40 miles inland… But even when they travel

the west, they will den in the deep drifted snow on the east side of a bluff or bank" (JS 2015: 141).

Another important variable that female polar bears consider with respect to denning is the orientation of the snowbanks or drifts in relation to the sun. Frequently, females will build dens in places where there is both exposure to the warming sun rays in the late winter/early spring and a good accumulation of snow. Such locations vary from one part of the region to another (JS 2015)[106].

When selecting a denning site, female bears will check it for its suitability, and if the snow is not deep enough, will search elsewhere (JS 2015). Female bears either excavate dens in existing snowbanks, let themselves get covered by drifting snow, or a combination of both (JS 2015). In late November to December, strong snowstorms can quickly bury a female, according to hunters from Aklavik and Tuktoyaktuk[107]. The roofs of maternity dens are thin and have small holes (the diameter of a pencil) in them so the females and their cubs can breathe. Foxes will frequently urinate around these breathing holes, which makes it easier for Inuvialuit hunters to locate the dens (JS 2015).

Joint Secretariat study (2015) participants had diverse observations about what female polar bears and their cubs do once they leave their dens in the late winter/spring each year. Some said the bears head directly for the floe edge, cracks, and breathing holes in the land-fast ice, as well as other locations where the mothers can hunt ringed seals[108,109]. Others said the bears hang around their dens for a short time while the cubs find their feet and presumably get accustomed to their new outdoor environment. Several knowledge holders spoke of the patience shown by female bears as they "coax their young out across the ice toward good

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along the banks across from Baillie Island towards Whale Bluff, way high up you can see dens up there when the snow gets deep enough. A lot of those banks are fifty plus feet." (C. Gruben [Tuktoyaktuk] *in* Slavik *et al*. 2009: 31)

[106] For example, "North of Sachs Harbour, dens on coastal islands such as Norway and Terror Island are on south-facing bluffs and banks, while those on the coast of Banks Island are on the west-facing slopes. In the Tuktoyaktuk area, females den as follows: 'pretty much a south-facing bank. And the reason for that is those are the spots that warm up quickest in the springtime… They just basically look for a bank…and Mother Nature is going to fill it in with snow. When they find this area, that is when they'll go in denning." (PIN 44 [Tuktoyaktuk] *in* JS 2015: 129)

[107] "A Tuktoyaktuk TKH [traditional knowledge holder] said he had never observed females making dens, because they usually do this during the first big snowstorms at the end of November, presumably when he and other Inuvialuit hunters had taken refuge in their cabins or some other safe haven." (JS 2015: 140)

[108] The floe edge and open leads are where young or new ice forms and where hauled-up seals and breathing holes are found. This explains why they are high-priority destinations for the family groups that den near Tuktoyaktuk, as noted by another hunter from that community. "They go out in young ice where they could get seal and feed their little ones. That's their favorite food, I guess, the seal." (PIN 28 [Tuktoyaktuk] *in* JS 2015: 153)

[109] "Females and cubs who denned along coastal and island banks and bluffs are seen in the spring heading out in the ice." (JS 2015: 72)

hunting places" (JS 2015: 154). No matter what they do immediately post-denning, the priority destinations are locations where the females can secure food, as they need to eat after several months of not eating while suckling cubs, and must find places to teach their young how to hunt for themselves (JS 2015).

Regional Den Locations

Concentrated terrestrial denning areas have been identified in polar bear range within the Inuvialuit Settlement Region (see Richardson *et al*. 2008; Slavik *et al*. 2009; JS 2015; Community of Aklavik *et al*. 2016; Community of Paulatuk *et al.* 2016; Community of Sachs Harbour *et al.* 2016; Community of Tuktoyaktuk *et al*. 2016; Community of Ulukhaktok *et al*. 2016; COSEWIC 2018).

North Beaufort Area

On Banks Island, females will make dens high up on banks such as at Whale Bluff and Nelson Head (Barr 1996; Slavik *et al*. 2009)[110]. Knowledge holders also noted maternity dens in several other locations on or around Banks Island, including Gore and Norway islands on the north coast, the coastline between Adam and Storkerson rivers, the coastline between Terror Island and Cape Kellett, the coastal zone near Fish Lake southeast of Sachs Harbour, Nelson Head, the coastline between De Salis Bay and Coal Mine Bluffs, and Jesse Bay. Polar bears will also den along inland creek and river valleys where the snow accumulates sufficiently, including at Fish Lakes (near the southwest coast of Banks Island), Raddi Lake, and the headwaters of the Egg, Storkerson, and Adam rivers. In addition to terrestrial locations, a female bear was also reported to have denned on the ice near the Gore Islands at the northwest corner of Banks Island. The Sachs Harbour Community Conservation Plan (Community of Sachs Harbour *et al*. 2016) has identified critical polar bear denning areas from November to April (Fig. 20).

[110] "In the case of major denning concentrations around Nelson Head on southern Banks Island dens are commonly dug in snow banks high on the coastal cliffs." (Barr 1996: 3)

Figure 20. Northern Banksland special wildlife area (polar bear denning area). Reproduced from Community of Sachs Harbour et al. (2016: 50) with permission.

Viscount Melville Area

Both the Sachs Harbour and Olokhaktomiut community conservation plans (Community of Sachs Harbour *et al.* 2016; Community of Ulukhaktok *et al.* 2016) identify that the Viscount Melville Sound and adjacent areas provide important habitat for polar bear and ringed and bearded seals year-round and contain denning areas for bears and pupping areas for seals from November to May (Community of Sachs Harbour *et al.* 2016).

Amundsen Gulf Area

The Olokhaktomiut Community Conservation Plan (Community of Ulukhaktok *et al.* 2016: 69) identifies that "coastal areas adjacent to Wynniatt and Hadley Bays and Richardson Collinson Inlet are important denning areas for polar bears November to May". Ulukhaktok knowledge holders knew of dens along the shores of Wynniatt Bay, on Princess Island in the Prince of Wales Strait, Ramsay Island, the shoreline area at the mouth of Minto Inlet near Mount Phayre, the coastline around Cape Ptarmigan, just north of Ulukhaktok, Safety Channel, and Cape Larson, a coastal spot near Innirit Point, and an inland spot on the Wollaston Peninsula north of Williams Point (JS 2015; see Figs. 21 and 22). In addition to terrestrial locations, female bears were also reported to have denned on the ice at Wynniatt Bay.

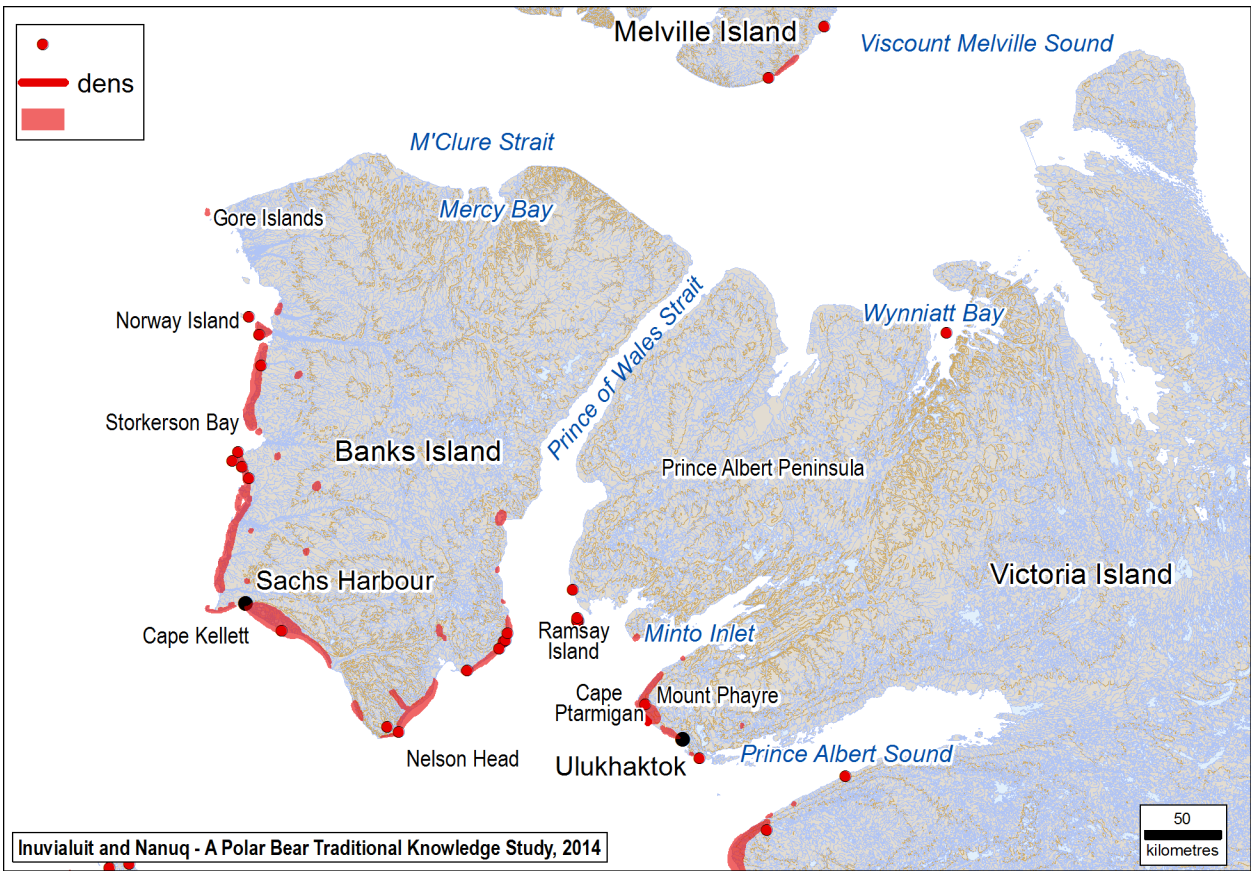

Figure 21. Polar bear maternity den locations, Banks Island and portions of Melville and Victoria islands. Reproduced from Joint Secretariat (2015: 146) with permission.

In the Paulatuk region, knowledge holders reported maternity dens at House and Pearce points and Cape Lyon on the east side of Darnley Bay, Bennett Point on the west side of the bay, Johnny Green Island, Cape Parry, and Fiji and Booth islands (JS 2015).

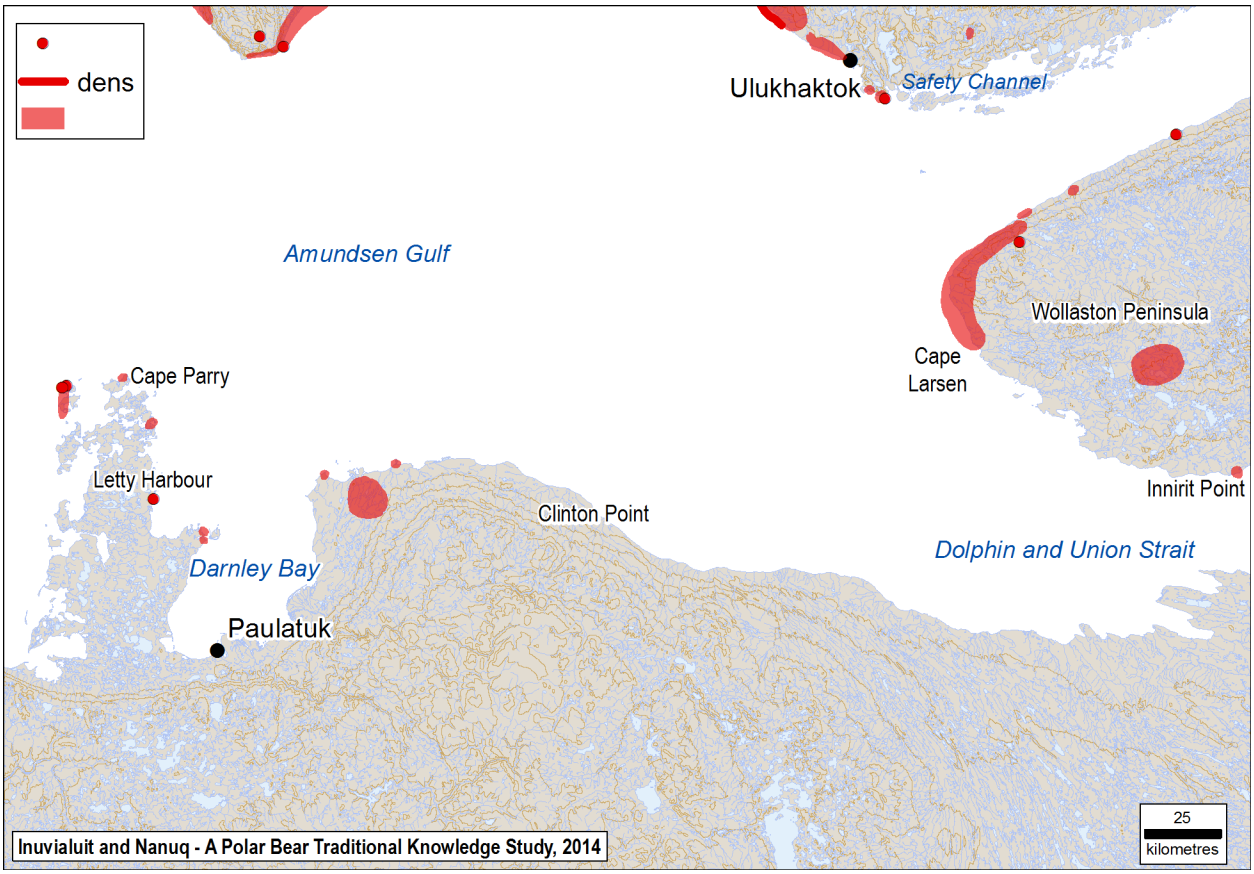

Figure 22. Polar bear maternity den locations on a portion of Victoria Island and in the Paulatuk area. Reproduced from Joint Secretariat (2015: 147) with permission.

South Beaufort and Cape Bathurst Areas

In the Tuktoyaktuk region, participants in Richardson *et al.* (2008), Slavik *et al.* (2009), and Joint Secretariat (2015) studies identified maternity den locations all along the western shore of Franklin Bay near Smoking Hills, the mouth of Horton River and the Whale Bluffs area, the coastal bluffs around Horton River, the west side of Cape Bathurst to Cy Peck Inlet, an isolated spot up the Mason River, the northern tip of Nicholson Island, Cape Dalhousie, Seal Bay, Phillips Island to McKinley Bay, Pullen and Hooper islands, and "all over Baillie Island" (JS 2015: 149; see Fig. 23). Females with cubs had also been seen in numerous locations during the spring, such as the coastal zone from Atkinson Point to Hutchison Bay, "strongly suggesting that they had denned along the coastal bluffs and creeks there" (JS 2015: 149).

The Tuktoyaktuk Community Conservation Plan (Community of Tuktoyaktuk *et al.* 2016) identifies three mainland-coastal polar bear denning areas: Kay Point to Summer Island, the northeast portion of the Tuktoyaktuk Peninsula, and the northern portion of Cape Bathurst and the Baillie Islands (see Fig. 24). These areas are important denning habitats from October to March.

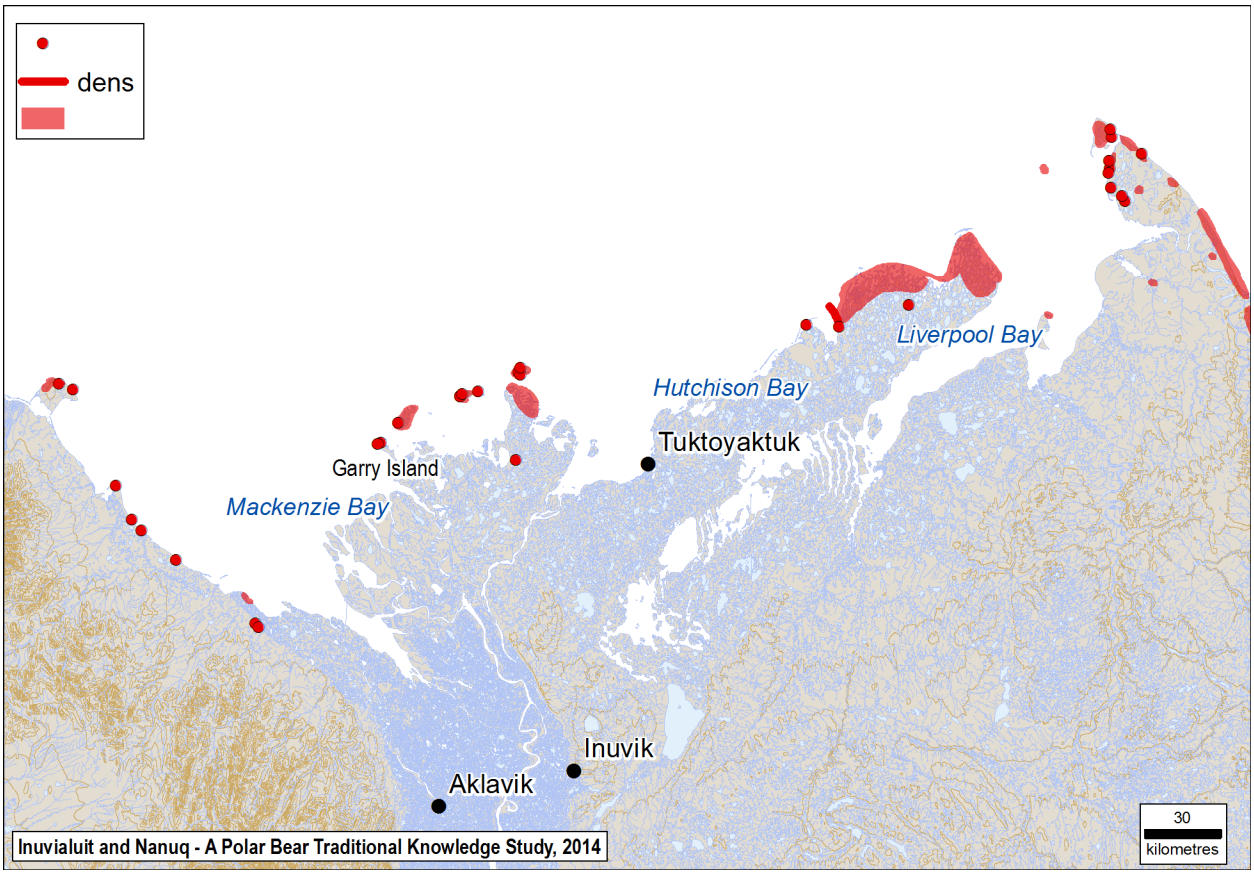

Figure 23. Maternity den locations: Tuktoyaktuk area and along the Yukon North Slope to Herschel Island. Reproduced from Joint Secretariat (2015: 147) with permission.

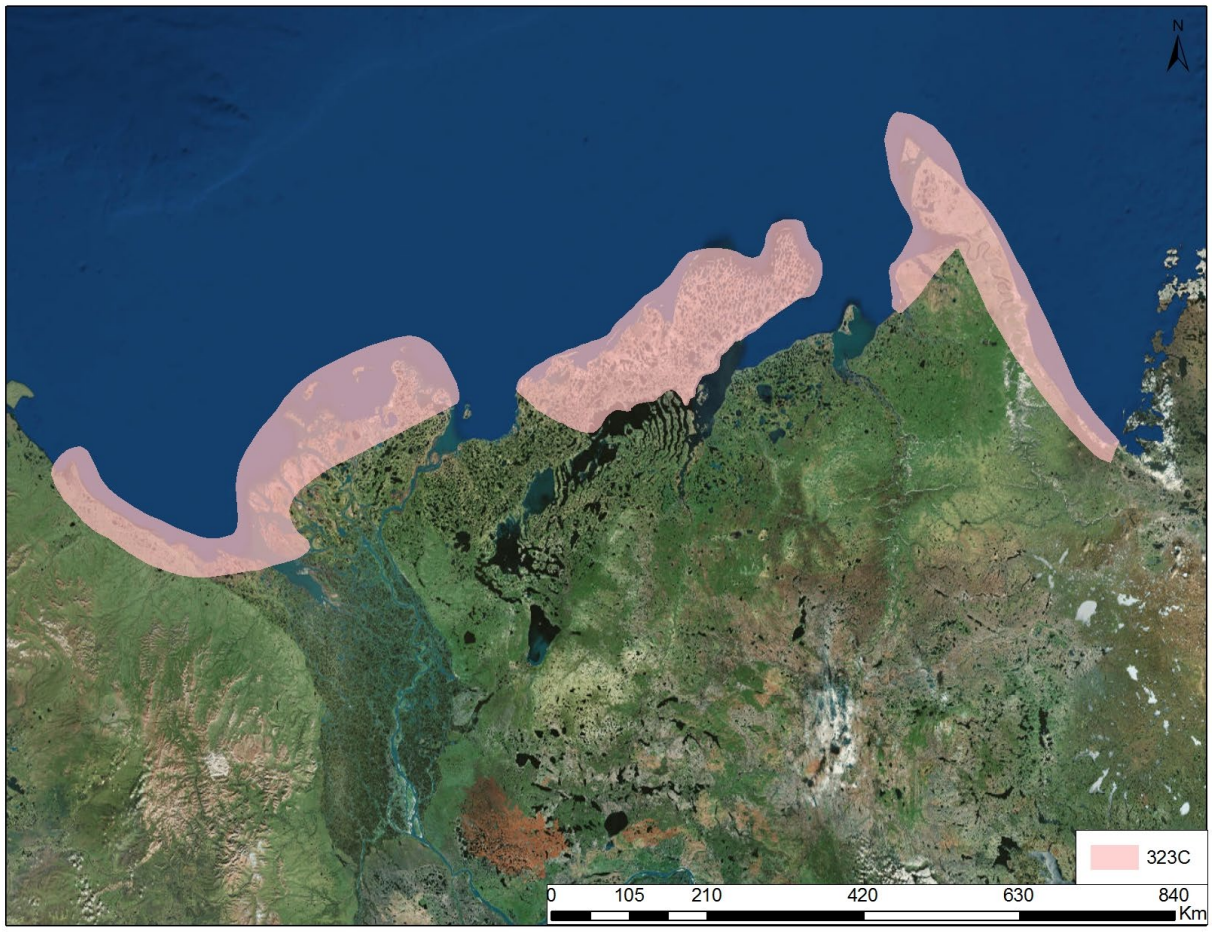

Figure 24. Mainland coastal polar bear denning areas. Reproduced from Community of Tuktoyaktuk et al. (2016: 61) with permission.

The Mackenzie Bay to Herschel Island area is used by hunters from Tuktoyaktuk, Inuvik, and Aklavik. Important denning areas identified by these communities include: the Outer Delta Islands, the Mackenzie River Delta Key Migratory Bird Habitat (November to April), the North Slope of Yukon (Eastern North Slope)[111], Herschel Island (*Qikiqtaruk*\Herschel Island Territorial Park), and Kay Point (Community of Aklavik *et al*. 2016; Community of Tuktoyaktuk *et al*. 2016). The Joint Secretariat study (2015) reported maternity dens on Pelly and Garry islands, inland at Coney Lake, along the Yukon North Slope near the mouth of the Blow River from Shingle to Kay points, and along the northern coastline of Herschel Island (JS 2015)[112,113]. Cubs

[111] The Yukon North Slope, in creeks with snowdrifts deeper than thirty feet, provide excellent denning conditions (JS 2015).

[112] In the study by WMAC (North Slope) and the Aklavik HTC (2018), it was noted: "Den sites were typically observed along the coast or on Herschel Island, although on two occasions, interviewees described den sites in inland areas. Interviewees universally described dens on hillsides or banks or in river draws, where snow accumulates through the winter. Snow accumulation was the most emphasized habitat

with or without their mothers have been encountered along the coast between Phillips Bay and Herschel Island, strongly suggesting that they den in that area.

Movements

Edward Ruben describes the general way that animals are in terms of their movement and migration:

"Animals travel, they never stay in one place, they always travelling in big circles for other people to get them too. An animal is never home in one place. My grandfather used to tell me, 'Ayualanung, you can think of an animal you want to get but you always come home without the animal you think of that day'. If someone asks you: 'When you went out yesterday did you get something?' I have to say, 'No. that place have nothing.' Then my granddad say, 'You never ever say there's nothing because there's animals traveling day and night, only time they stop is to eat and sleep" (E. Ruben [Paulatuk] in Parks Canada 2004: 160).

Polar bears cover huge distances as they move from one area to another hunting seals (CWS 2010)[114]. They can travel between continents (Canada and Russia), management jurisdictions, and scientifically defined subpopulation boundaries in a season (Slavik *et al.* 2009; CWS 2010)[115,116].

Polar bear movements are motivated largely by the search for migratory seal populations, as Fred Wolki explains:

"Every year's not the same! There might be lots of bears, but next year will be nothing. I believe they will only follow their food. Where there's a lot of seals there's a lot of bears. And the current from the waves, the water must take the seals somewhere. Or they probably drifted out by the ice and it takes longer to come back. That's why there's a lot of difference in some years. They follow their food. The seals - they migrate too, just like any other animal." (Fred Wolki [Tuktoyaktuk] in Slavik et al. 2009: 39)

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characteristic in den sites, rather than aspect or up to twenty, thirty feet deep." (PIN 120 [Aklavik] *in* WMAC (North Slope) and Aklavik HTC 2018: 36)

[113] Female polar bears den in a couple of large valleys on the north side of Herschel Island (JS 2015).

[114] "The polar bear population has always fluctuated over the years… The reason that the population goes up and down is because the bears move from one area to another to follow seals, not because of hunting." (summary of Ulukhaktok consultation *in* CWS 2010: 88)

[115] "In the fall time it's worse! When you come around Whale Bluff you see 11, 10, 9. The reason why is because a lot of bears, some of these bears come from Banksland (*Ikaahuk*), they come across and reach that area. They mix along with this herd in the west. That's why there's a lot of bears there." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[116] "Polar bears will migrate long distances between subpopulation boundaries and through a range of different government jurisdictions." (summary of Tuktoyaktuk consultation *in* CWS 2010: 83)

These movements cause polar bear numbers in certain areas to fluctuate annually as they follow their food (Slavik *et al*. 2009)[117]. This pattern is affirmed in some population studies (Slavik *et al.* 2009)[118].

"…[p]olar bears aren't stationary animals; they just travel. They find a good feeding area, they'll stay. A few times you run into a good area, like just froze up or something. And the hunting conditions are good, you see a pile of bears around." (PIN 133 [Sachs Harbour] in JS 2015: 71)

An individual bear may follow the same migration paths over several years (Slavik *et al*. 2009)[119]. Seasonal movements are also reported (Berger 1976e, i)[120,121]. Depending on the community, people expect to see polar bears at different times of the year as they migrate and travel through the Arctic. Along the southern Beaufort and Cape Bathurst, polar bears travel the most between October and April:

"They have certain times of the year when they migrate. Sometimes in October and April they start heading west, the ones that come from that way… Yeah, they start migrating back. You'll be lucky to see a bear after May 1, if it happens. Sometimes there's nothing." (Fred Wolki [Tuktoyaktuk] in Slavik et al. 2009: unpubl. transcript)

During October, female bears move towards the coast to den and may travel inland (Slavik *et al.* 2009)[122,123]. Around this time polar bears walk the coast, scavenging, and "looking for anything they can get" (JS 2015: 88)[124].

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[117] "There's a lot of bears but they just move. Sometimes one year only, sometimes nothing. Next year it could be full of bears." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: 40)
[118] "They did a study here and the population was real healthy. The next year they came back for two years and couldn't find next to nothing." (F. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 41)
[119] "When I did the interviews for polar bear denning areas, he said that you might not see any bears around Baillie sometime, you know, that same bear may go, it might be a 6 and a half, seven footer, it might take two years to come back, and then you could shoot it as a nine feet." (C. Pokiak and F. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)
[120] "When she got older in those days she knew that she sees whales every summer and when the ice flow is drifting, polar bears comes in and goes to the land. She remembers the country very well." (M. Kuneyuna [Ulukhaktok] *in* Berger 1976e: 3981-82)
[121] "Do we know how many animals pass through Beaufort Sea during the year? Summertime all the birds pass through, in summertime all the birds and seals and fish travel in the ocean. Polar bears travel in winter. Each one eat each other, but they have to live some way." (G. Ruben [Paulatuk] *in* Berger 1976i: 4520)
[122] "In the middle of October you see a lot of them heading for the shore. If you see a bear heading for the shore [in October] it means they're looking for a denning place." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)
[123] "Instead of following the ocean there, it make shortcuts over land, and that's when you see bear dens inland in the fall time, in October." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)
[124] "Right now they are just waiting for the ice to freeze, so they are scavenging on the coast. And they walk around here. This time of year you always see tracks, [but] we don't bother them. We go out by quad [all-terrain vehicle] and see some tracks travelling down on the coast here… This time of year they are pretty lean." (PIN 134 [Sachs Harbour] *in* JS 2015: 88)

During December-February, some hunters have noticed bears actively travelling from east to west (Slavik *et al*. 2009; WMAC (North Slope) and Aklavik HTC 2018), a phenomenon that has also been observed by Alaskan communities further west[125].

Historically, "there was a general belief in Sachs Harbour that the bears tended to make a clockwise migration around Banks Island" (Barr 1996: 131). In recent interviews in Sachs Harbour, hunters observed that bears will migrate south along the west coast in March, April, and May in pursuit of mates (Slavik 2013; JS 2015)[126]. Most of the time they travel where the old ice and the young ice meet, on young ice, or following open leads (Slavik 2013). However, there is not consensus on whether bears travel in only one direction at this time, or back and forth.

In spring, bears travel around the south and north sides of Banks Island to meet in the Prince of Wales Strait (Slavik *et al*. 2009)[127,128]. Ulukhaktok knowledge holders identified the Prince of Wales Strait as an important travel corridor for polar bears at certain times of the year, especially during the spring mating season, with traffic back and forth between Viscount Melville Sound and the southern end of Banks Island[129].

Harvesters expect to find lots of tracks (i.e. "polar bear highways") around Cape Kellett (the southwest tip of Banks Island) in the spring (Slavik 2013). During this time, "big male" bears travel great distances, coming in from "way out" to track down and mate with females, and hunters expect to see large male bears following behind a female's tracks (Slavik 2013). Polar bears travel around Nelson Head in the fall. It has also been noted that bears travel west through M'Clure Strait, from north of Victoria Island to Melville Island in April-May (Slavik

[125] Within the Chukchi Sea region, "Hunters see a pulse of polar bear arrival in late fall and winter, as freeze-up occurs, and another during bears' migration north in the spring. Historically, hunters associated the arrival of polar bears with winds and currents from the north, as well as with the seasonal appearance of blue icebergs, or pack ice, carried by these winds." (Voorhees *et al*. 2014: 527)

[126] "Well, when I went to Norway Island, bears always travel by around here – on the young ice [around the west side of Banks Island]. Heading up north. Once and a while they go [south] this way to Lyatt point… March and April and May, they start really migrating." (G. Wolki [Sachs Harbour] *in* Slavik 2013: unpubl. transcript)

[127] "You have to know different times of year. Like bears are migrating – that month they're over here, another month they'll move over this way. And we see which way they move. Springtime, Prince of Wales Strait. April and May there are bears going from here and another come from the north side, meeting each other. Big bears, and mainly a bunch of females coming from the north side." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al*. 2009: unpubl. transcript)

[128] "I think they go around Banks Island north side and south side and meet there. The one migrate from this side. Some of them go behind the North side of Banks Island, some of them go around the south side. That's why they meet there all the time – lots of bears in that area anyways." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[129] "Inuvialuit hunters know the polar bear mating season is imminent when they start to see mature males moving south down the west coast of Banks Island, southwest down Prince of Wales Strait or close to the mainland along the coast of the Northwest Territories." (JS 2015: 132)

2013). Polar bears are known to spend their summers along the southwest, west, and north coasts of Banks Island (Community of Sachs Harbour *et al*. 1992).

Polar bear migration routes may vary depending on habitat conditions, but polar bears are capable of travelling across varied terrain, including very thin ice (Slavik *et al.* 2009)[130,131]. If they need to, or if they smell food, bears can swim huge distances between ice and the shore (Slavik *et al.* 2009)[132,133].

In recent years, changes in polar bear migration patterns are being observed. Residents of Tuktoyaktuk noticed that "there haven't been any polar bears migrating through our area this year [2009] - they are moving further north" (CWS 2010: 84). A decline in multi-year ice along the west coast of Banks Island may be contributing to changes in polar bear migration there (Slavik *et al*. 2009)[134]. There is also awareness that as ice melts in the southern Beaufort Sea, bears will migrate further north:

"They change because the ice bergs are melting from the south. They're further away from us now and there's hardly any icebergs. There's no multi-year ice. It's melting due to the extended summer season, and they are going further north. Migration changes for that too…. Lots of animals, not only polar bears, are changing their migrations." (D. Nasogaluak [Tuktoyaktuk] in Slavik et al. 2009: 43)

[130] "You know polar bears weigh about 800 lbs. He can go through when you can't walk on top. Like every animals, you track it sometime, your feet start going through. You know how they spread their weight. When the ice get thin, they open their four legs and they just slide on it." (D. Ruben [Paulatuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[131] "You know, that part I've seen quite a few times. Polar bear could walk on real thin ice. Less than two inches – without going in." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al*. 2009: unpubl. transcript)

[132] "This female bear that was tagged and swam out to the ice flow, it came back in a couple days but it didn't have a cub with it. And they found another one when we were there. It swam into Barrow and it looked like it was going to die. It just ran to the beach and lied down. They were trying to drive it away but it came back and fell on the ground. They became concerned about it and thought it was starving. They checked it and it had thick fat. The only reason was it was so tired from swimming. After a couple days rest it got up. So all the bears they see on the shore that aren't moving, maybe they automatically think it's going to die. They really thought that bear was in bad shape and not going to survive, but all it was doing was resting – 2 days!" (F. Pokiak [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[133] "And there was another one outside of Point Barrow, when I was there last spring. It swam over 500 km straight out – a mother and a cub." (F. Pokiak [Tuktoyaktuk] *in* Slavik *et al*. 2009: 44)

[134] "The west coast of Banks Island used to be just white – never melt – the last ten years when I was there. Now you can barely see some ice floes from way out the north side. Probably north side only gets the ice floes. That's hurting the polar bear migration." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 45)

Life Cycle and Reproduction

Polar bears generally have two cubs (twins). David Nasogaluak [Tuktoyaktuk] explains:

"First year they have cubs they always have one. Second year they have two. Sometimes if it's a big polar bear, they have triplets. But the third one always small." (in Slavik et al. 2009: 32)

Annual or local variation in the number of cubs is related to the relative prevalence of seals the previous spring, when the females were mating. When triplets are born it is thought to be because their mothers fed well on seals when they were conceived (JS 2015)[135]. Pat Ekpakohak has observed triplets on several occasions north of Ulukhaktok (Slavik *et al*. 2009)[136]. Oral history exists of a bear being seen with four cubs around the Baillie Islands, which was explained as either adopted cubs, or her cubs from the previous year (Slavik 2013)[137]. Several knowledge holders from different communities stated they had never seen a female with a single cub[138].

Mating season is in March-April, when male bears will follow in the tracks of females with determination to mate (Slavik 2013)[139,140]. The Joint Secretariat study (2015) documents the efforts males will go to when in pursuit of females, including non-stop pursuit and leaving seal carcasses on ice to attract females[141,142,143]. It is widely known among Inuvialuit hunters that

[135] "A Sachs Harbour TKH [traditional knowledge holder] also said that he had never seen single cubs; normally he sees pairs, which tells him that the population numbers in the area are 'healthy'. Another hunter from the same community spotted triplets in April 2001, near Norway Island on the west coast of Banks Island. He speculated that 'the foods might've been better, prior to mating' that year. A Paulatuk TKH [traditional knowledge holder] also linked having triplets to the health of the local polar bear sub-population." (PIN 139 [Sachs Harbour] *in* JS 2015: 139)

[136] "A few times I have seen triplets, a few times. Quite a few times north of Ulukhaktok. Most of the time they have two. Sometimes, only very little times, they got one." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al.* 2009: 32)

[137] "There was one story from Baillie Island. They say five bears came into town – that polar bear had four cubs! They used to tell that story, the old timers… That was long ago! Over a hundred years ago at least." (G. Wolki [Tuktoyaktuk] *in* Slavik 2013: unpubl. transcript)

[138] "I've seen the bears walk out of the den and you could see how many cubs they had, two or three. I've never seen a mother bear with a single cub walking out. I've seen two or three bears cubs with her." (PIN 43 [Tuktoyaktuk] *in* JS 2015: 138)

[139] "Cause the males are following the females, and where the female goes, there's definitely bound to be a male following her tracks. Like you know, even though it's three or four days old and covered up really good, a big bear will follow that right until he catch the female." (J. Lucas Sr. [Sachs Harbour] *in* Slavik 2013: 83)

[140] "Late February to April is typically the time when the mating season starts, particularly after females emerge from their dens with their newborn cubs and males pursue females for great distances out on the ice." (JS 2015: 132)

[141] "Male polar bears will pursue females so persistently, so determinedly, that their feet become raw and bloodied from wear and tear…and the condition of male polar bears may deteriorate during the mating season, because they spend so much time pursuing females that they don't hunt." (JS 2015: 133)

[142] "The males are after the females… Third week of March… They are travelling all over. As soon as they run into a female, even with two cubs, and she is giving a scent, that is when they travel day and night… It

male polar bears will sometimes kill cubs, especially during the spring, when they want to mate with the cubs' mothers (Slavik *et al.* 2009; Slavik 2013)[144,145,146].

Female bears will engage in elaborate evasion tactics in attempting to throw males off their tracks and will try to fight off aggressive males to save their cubs. Alternately, males will chase their cubs away in order to mate (JS 2015). Young polar bears are "orphaned" by their mothers once she mates and/or gets pregnant again in the spring:

"The young cubs are chased away by their mothers when they get to be about six or seven feet in size, at which point they must fend for themselves… The sibling cubs will continue to hunt together for some time after leaving their mother, but eventually they separate." (JS 2015: 155)

The timing of mating is dependent on the ice conditions each year. According to a Sachs Harbour knowledge holder, polar bears "always mate where the open water starts, travelling by the edge of it, travel every day. Even follow female tracks; they catch up later on" (PIN 128 [Sachs Harbour] *in* JS 2015: 132).

Having mated in the spring, by late October–early November, pregnant females begin looking for a den to birth and feed their newborn cubs. Pregnant females spend their winters in dens[147]. Mothers and their cubs emerge from their dens in springtime (March–April) when mothers begin hunting for seals on the shore-fast ice, keeping their young cubs close by as they watch and learn the skills needed to become successful hunters (Slavik 2013; JS 2015). By the time they are two years old, the cubs know enough to be able to hunt by themselves;

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is really hard to catch up to one of those if you are tracking it down. It is just nonstop. They're travelling day and night. Some guys even say it is like they are sleepwalking. And the big ones, they can cover a lot of distance just by walking fast… They have something at the end of the trail that they want, and that is their mission in life." (PIN 158 [Paulatuk] *in* JS 2015: 133)

[143] "Two hunters from Tuktoyaktuk also mentioned sleepwalking male polar bears. One said, 'springtime is steady walking, sleeping walking… It's their rutting season…looking for females…March and April'. The other hunter described how he shot a male polar bear that was sleepwalking along a crack while following a female bear." (PIN 38 [Tuktoyaktuk] *in* JS 2015: 133)

[144] A Sachs Harbour TKH [traditional knowledge holder] noted, "once the male bear run into a male, female bear with cubs, it's gonna kill them to breed with the female. That old female really attract them… I used to hear stories long ago where people used to run into little ones that are dead, killed by ones that start following a female. You see some animals, they get in the mood, they kill the young ones." (PIN 132 [Sachs Harbour] *in* JS 2015: 135)

[145] "…if you saw a sow with three cubs, that's a pretty lucky sow, cause those males will even eat the cubs. Like right now, mating season. They'll even chomp the cubs. So that's how you can lose the polar bear population too. Cause the males are so aggressive." (W. Esau [Sachs Harbour] *in* Slavik 2013: 84)

[146] "Talking about healthy bears, scientists too have started throwing this thing around is that bears are cannibalizing. And what we've been saying is that this has been going on for generations – bears will kill another bear for food if it's starving or kill cubs in order to mate that female." (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 36)

[147] "Just prior to entering their maternity dens, female polar bears may eat small quantities of grass. Thereafter, they have nothing more to eat until they emerge late the following winter." (JS 2015: 143)

however, they continue to learn and improve their skills through their own hunting experiences (JS 2015).

Adaptations to Environment

Polar bears are very adaptable (see *Habitat Trends* and *Threats and Limiting Factors*).

Inuvialuit recognize that there are variations among polar bears, whose appearance and behaviour are distinguished in local language. It is understood that just "*like people in some areas are different shapes, bears are the same way*" (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript). For example:

"Some people say there are actually two different types of polar bears. There's a bear that you get once in awhile that has a longer neck; it's high and pure white, but looks like a weasel and runs fast like a weasel — tiriaranaq — bears and ermines are similar. Pualrisiktualuit is the polar bear that has paws as huge as a shovel, that other type, they've got another name too — nannuktauguktualuit — not scared of anybody too, those." (MPEG 2006: 11-31)

Because of its size and/or shape, this first type of polar bear is referred to as a "weasel bear" in English (*tigiaqpak* (K); *tiriarnaq* (S)). Sachs Harbour, Paulatuk, and Ulukhaktok hunters talked of large, long, narrow polar bears that resemble weasels and are very quick. The main difference is in the shape of the head and body. One *tiriaranaq* was described as "... *an 11 foot bear with the skull of a 7 foot bear. It was skinny, long and narrow and had a long neck. So that's probably for going down in seal holes and grabbing them*" (W. Esau [Sachs Harbour] *in* Slavik 2013: 80). *Tiriaranaq* are generally found on the north side of Banks[148] and Victoria islands, and around Melville Island (Slavik *et al*. 2009)[149].

Some elders and hunters have also seen or have heard stories about "monster bears" – extremely large bears that live out on the multi-year ice (Slavik 2013). These bears are also called "shovel bears" (*pualrisiktualuit* (MPEG 2006) or *angutiryuaq* (S) (JS 2015)) because their feet are as large as wide shovels. Observations of these bears are now extremely rare, if present at all, in part due to the belief that they are "extremely smart and normally head for the safety of open water when humans or dogs approach" (JS 2015: 128). These observations of extremely large bears have also been recorded in the Chukchi Sea region[150] and Nunavut[151].

[148] "I get some bears on the North side of Banks Island, they look different like that [weasel bear]." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)
[149] "Between here and Melville Islands, polar bear bodies around Melville Island is different bodies. They look more like a weasel. Weasel body – longer and skinnier. Like skinny and longer, with lots of fat on them, but they're just narrower bodies." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al.* 2009: unpubl. transcript)
[150] "In addition to regular polar bears, hunters recognize a special category of 'king bears', which measure upwards of 3.5 m in length. King bears are said to be recognizable by black marks on their shoulders;

Adaptation to Poor Conditions

In an extreme case of adapting to poor denning conditions, a bear birthed her cubs on top of the snow at a spot on the coast of Thesiger Bay on Banks Island. A Sachs Harbour knowledge holder said he had "*seen one bear didn't even make a den. Just had its young on top of the snow…. There was hardly any snow that year, I think*" (PIN 131 [Sachs Harbour] *in* JS 2015: 144).

A Tuktoyaktuk hunter said that during one April in the 1980s, he and another hunter had encountered a female with cubs who was excavating a new den. Its existing den had collapsed, possibly because warm conditions had made the snow unstable:

"When me and [a fellow hunter] were bear hunting from Tuk, we used to camp at Atkinson Point… I seen that bear den been collapsing…maybe [snow] got sugary when it collapse, maybe warmer weather. So she been making another hole right down below it with the fresh snow, snowbank." (PIN 29 [Tuktoyaktuk] in JS 2015: 144)

Diet and Feeding Behaviour

Inuvialuit knowledge holders agree that polar bears' diet consists primarily of ringed and bearded seals[152], as well as scavenged carcasses of the occasional bowhead and beluga whale[153]. Inuvialuit know what polar bears eat because "they observe them killing and eating seals or scavenging on the shores, they see the evidence of bear-hunting, such as blood and seal carcasses on the ice, and they examine the contents of the bears' stomachs as well as their feces" (JS 2015: 94; *see also* Slavik 2013).

Ice is the primary platform from which polar bears hunt ringed and bearded seals. Polar bears will lie patiently beside the floe edge as well as breathing holes in the land-fast ice, waiting for seals to surface for air. This requires immense patience as "spending hours and hours by a seal

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sometimes they also lack fur on their legs. According to the old stories, king bears are almost impossible to kill." (Voorhees *et al.* 2014: 529)

[151] "TK [traditional knowledge] collected in Nunavut indicates that bears of this special class are also recognized there, where they are known as *nanurluit* (Keith *et al*. 2005), suggesting that the presence of extremely large male bears is not unique or limited to the Chuckchi Sea population." (Voorhees *et al.* 2014: 531)

[152] "All the TKHs [traditional knowledge holders] interviewed for the PBTK [polar bear traditional knowledge] study agreed that the most important polar bear food is ringed seals, although bears appear to prefer the larger (i.e., 800- to 1000-pound) bearded seals, although they are heavier and fatter but harder to kill, particularly by smaller polar bears." "Polar bears prefer *ugyuks* over [ringed] seals; I know it. But a [ringed] seal is easier to hunt. The blubber is probably the same strength as an *ugyuk*. That is where they get their nutrition from, the blubber." (PIN 132 [Sachs Harbour]). Two Sachs Harbour harvesters believed they probably prefer bearded seals because they have more fat than ringed seals. (*in* JS 2015: 94)

[153] "Rotting whale meat is extremely smelly, which attracts bears from a great distance." (JS 2015: 99)

hole is one polar bear hunting strategy with a big payoff" (JS 2015: 112)[154]. Polar bears differ in their hunting abilities; this is reflected in differences in body condition: "Skinny, starving polar bears may be poor hunters because they are careless or too excited when stalking seals" (JS 2015: 118). Knowledge holders believe seal pups are easier to catch than their mothers, because they are less wary of the ways of the polar bear (JS 2015). Knowledge holders have contrasting observations and views about whether bears can kill seals in open water (JS 2015)[155].

When bears are in good condition, they normally eat only the fat, leaving the meat and other body parts for the foxes and other scavengers[156]. They may also bury a portion of their catch in the snow, so they can eat it later (Slavik 2013; JS 2015). Inuvialuit hunters note the seasonal variability in polar bear diets from one year to the next, with more of the seal meat being eaten in some years and seasons compared to others (JS 2015). Polar bears are likely to be hungrier in the summer months, particularly in areas where they cannot use sea ice as a platform from which to hunt seals or catch hauled-up seals. This seasonal variability in seal availability/access may result in polar bears consuming seabirds, grass[157], seaweed (kelp), Arctic char[158], sculpins, and if extremely hungry, garbage, dogs, and camp supplies.

Polar bears have acute hearing and a strong sense of smell. Polar bears can smell the seals when they are inside their dens and they listen for the sound of seals scratching the undersurface of the ice in order to keep their holes open (JS 2015). Polar bears will also hunt cooperatively, as group hunting increases their chances of killing a seal: "in places where there are multiple seal breathing holes, making noise at some holes drives the seals to other ones, where another bear may be waiting for them" (JS 2015: 105). Hunters from Sachs Harbour and Paulatuk observed other tactics:

[154] "A Tuktoyaktuk hunter saw a bear wait for days beside a seal hole: 'Those bears are really patient. They could wait for days for seals to pop out. One time I watch one for three, four days, still sitting in the same spot, good weather, bad weather, still waiting. Boy! They sure could hunt." (PIN 128 [Tuktoyaktuk] *in* JS 2015: 112)
[155] "A submarine attack is a good method of sneaking up on ringed seals when they are hauled up on the edge of the ice…or by pretending to be a piece of floating ice." (JS 2015: 106)
[156] "Arctic foxes (*Vulpes lagopus*), wolves, wolverines (*Gulo gulo*), ravens (*Corvus corax*), ivory gulls (*Pagophila eburnea*), and potentially other species benefit from polar bears' behaviour of feeding preferentially on seal blubber and leaving behind carcasses." (Stirling and McEwan 1975; Andriashek *et al*. 1985; Smith 1980; Derocher *et al*. 2002; Roth 2003; Keith and Arqviq 2006; JS 2015; COSEWIC 2018)
[157] "Some TKHs [traditional knowledge holders] thought that female bears and/or their cubs are more likely to eat grass in the spring, particularly when they emerge from their dens." (JS 2015: 101)
[158] "Three senior TKHs [traditional knowledge holders] with knowledge of Victoria Island said that polar bears eat fish." (JS 2015: 102)

"They find a breathing hole, they go there and open the thing, and put a thin layer of snow on the breathing hole. They wait, and as soon as they see snow start coming up, they give them a whack, and that's dinner on the table." (PIN 147 [Paulatuk] in JS 2015: 113)

Polar bears will hunt seals from their breathing holes, as well as when they are hauled up on the ice, and are very proficient at hunting seal pups in their dens in the spring, when they do most of their hunting (Slavik *et al*. 2009; Slavik 2013)[159]. One Paulatuk hunter said that "*male polar bears, not female, will hunt ugyuks at their breathing holes or along a fresh crack in the ice*" (JS 2015: 108).

Polar bears are opportunistic hunters and scavengers. In addition to seals, Inuvialuit have observed or heard stories of other prey species for polar bears. Some of the other species polar bears have been observed to hunt or scavenge upon include:

- Eider ducks (*qaugaq*) - polar bears hunt ducks in the open water (Slavik *et al*. 2009)[160,161]. While he had never seen polar bears eating eider ducks, one Paulatuk hunter thought it quite possible that they might scavenge them at certain times of the year, depending on the weather conditions.
- Muskox (*umingmak*) – polar bears scavenge muskox during the summer and fall (Slavik 2013)[162,163].
- Beluga (*qilalugaq*) – polar bears will scavenge beached beluga or attempt to hunt belugas stranded in an open lead (Slavik *et al.* 2009)[164]. The Joint Secretariat study (2015) documented:

"Although bowhead whales are certainly too large for polar bears to kill, their smaller cousins, belugas, are occasionally prey for the wily predators, especially when they get stranded in small

[159] "They hunt a lot of those small seals. Young ones that are born in April – the pups. And those pregnant ones, they always have holes right underneath the ice, so they get covered up right away. They just make hole underneath and makes room in there. And when polar bear smells them, they get them right away cause they're right on top of the ice. Go like this and grab it. There's a lot of bears like that – they get them really easily!" (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: 34)
[160] "You know when the ducks first come, the bears are in the ice and in the water. They're diving under and pulling the ducks down!" (C. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 35)
[161] "I just see a whole pile of [Eider] ducks go in an open lead. Polar bear go down…and attack them from the bottom." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 35)
[162] "…those hungry bears in the summer, they must get muskox too once and a while [because it's] hard to get seal in the summer." (G. Wolki [Sachs Harbour] *in* Slavik 2013: unpubl. transcript)
[163] "They scavenge in the fall time too, when there's no ice… I ran into a bear in the fall time and he was eating a muskox carcass." (J. Lucas Sr. [Sachs Harbour] *in* Slavik 2013: unpubl. transcript)
[164] "There was actually a few [bears] one time, they were trying to get a beluga whale that was trapped in the ice – trying to get the whale. So anything that they see as food they're gonna go for it… They really like whale oil! They'll finish the whale sometime – just eating, they have to finish before they leave." (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al*. 2009: 26)

polynyas. Inuvialuit know this because they harvest belugas or find beluga carcasses that have been badly scarred by polar bears" (p. 100).

> Inuvialuit hunters have harvested beluga with severe scarring on their backs, which attests to a close call with one or more polar bears. According to knowledge holders, "polar bears may grab hold of a beluga when one is trapped in a small polynya, and attempt to drag it up on the ice" (JS 2015: 119).

- Bowhead whale (*arviq*) – numerous bears (both polar bears and grizzly bears[165]) will scavenge on a beached bowhead whale (*silu*) (Slavik *et al.* 2009; Slavik 2013)[166].
- Walrus (*aiviq*) – polar bears hunt walrus along the shoreline (Slavik 2013)[167].
- Caribou (*tuktu*) – polar bears scavenge or hunt young caribou (Slavik 2013)[168].
- Other bears, including other polar bears and grizzly bears (Slavik *et al.* 2009; Slavik 2013)[169].

Another interesting feeding behaviour of polar bears is consuming grass, especially before entering into their winter dens (Slavik *et al*. 2009; Slavik 2013)[170,171]. Lyons' (1825) early account on the subject reads: "The Esquimaux affirm that during the long confinement the bear has no evacuations and is herself the means of preventing them by stopping all the natural passages with moss, grass, or earth" (p.25).

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[165] "There was one time a whale been beached [*silu*] on Baillie Island and the polar bear been finishing it, but then again it must've ran into it while it was still summer. A brown [grizzly] bear been going there and it was dead too beside the whale. The polar bear killed it. Polar bears were gathering there. They finished the whole whale." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: 36)

[166] "And bowhead one time, there was a lot of bears on that…we seen over thirty bears there." (J. Lucas Sr. [Sachs Harbour] *in* Slavik 2013: unpubl. transcript)

[167] "They always go at the back, eh, where they can't get them with the tusk. And the bears kill it by chewing on its neck. They grab it like this and hold it, and that big walrus can't get out. I know even big walruses are really scared of polar bears… They go to a herd of walruses and walk right up to them and start looking around to find a small walrus that they could kill right away." (G. Wolki [Sachs Harbour] *in* Slavik 2013: unpubl. transcript). Note: this insight happened in a context where a BBC Planet Earth documentary was being discussed, which featured footage of this event.

[168] "I've seen bears, some that go eat caribou… You know they get caribou when they die. Around February, some of the young ones freeze. They scavenge mostly, but they may hunt the caribou too." (A. Carpenter [Sachs Harbour] *in* Slavik 2013: 87)

[169] "Well, it's always been known that, if they're hungry, they'll eat another bear." (R. Kuptana [Sachs Harbour] *in* Slavik 2013: 83)

[170] "In my young days, when I was growing up we used to kill bears hibernating and under the snow. We used to dig them out and kill them. Open the stomach, nothing in it but full of grass…before they hibernate, polar bears eat grass. To keep their stomach open, I think." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al*. 2009: 37)

[171] "I used to see them eating grass in the mainland. One time, one polar bear, when we skin it after we got it, it was full of grass in its guts. Just like a herd of cows. [And the bear looked] really healthy!" (G. Wolki [Sachs Harbour] in Slavik 2013: 37)

Interactions

The sea ice is home to a variety of animals in addition to polar bears, and Inuvialuit hunters watch the behaviour of some of these animals for clues about the movements of polar bears. For example, "when they see foxes, wolves, wolverines and crows travelling across the ice, they know polar bears are out there as well" (JS 2015: 18).

Interactions with Seals

Seals are the main prey of polar bears. Polar bears depend on seals for their survival more than on any other species. In this regard, seal abundance and condition can be used as an indicator of polar bear population health (Slavik 2013)[172]. In the NWT, polar bears feed on ringed seals (*natchiq* (sing.), *natchiit* (pl.)) and bearded seals (*ugyuk/ugruk* (sing.), *ugyuit/ugruit* (pl.)). Bearded seals are much larger, but not as abundant as ringed seals (MPEG 2006). Bearded seals are less prevalent in the Ulukhaktok and Paulatuk area, which is why ringed seals are the polar bears' primary food source.

A key physiological requirement for polar bears is concentrated energy in the form of seal blubber (*uqsuq*). When a bear kills a seal, it will strip the blubber from the carcass and leave the rest of the meat, often for foxes to scavenge. It will typically only eat the carcass if it is starving, or needs the nutrition for its cubs (Slavik *et al.* 2009; Slavik 2013)[173,174].

During spring, seals are hauled up on the sea ice in high concentrations. When the sea ice breaks up, the seals go with it (Slavik *et al*. 2009)[175,176]. Other times of the year, seals are

[172] "If people start seeing the seal population crashing, we know the bears will soon follow, cause that's their main diet." (F. Raddi [Sachs Harbour] *in* Slavik 2013: 89)
[173] "Well, polar bears, when they're not hungry, they only eat the oil. They don't eat the meat. When a polar bear kills the seal and they're not hungry, they take the oil and leave the meat for the foxes. Only when they're hungry they'll eat the meat. That's why there's lot of arctic fox where there's polar bear." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: 33)
[174] "Female bears with cubs and that, they eat the whole thing. Male bears, you see that but that's rarely because they're pretty hungry having eaten for quite some time when they do that." (F. Lennie [Sachs Harbour] *in* Slavik 2013: 85)
[175] "Now you got global change so the weather temperatures get pretty warm. You see the ice take off earlier – right to the shores too. And that takes most of the seals out. There's thousands and thousands of seals in the springtime when they first come up in the cracks, but the ice is still there. But all those seals take off when the ice floes. And most of them go, so there's not very many left because, they probably come back later on. But when you go to Horton River with a boat now. You hardly see any seals. Hardly nothing! You might see one or two, but that's about all – really hard to see seals now. Not like long ago they were right among the ice floes." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: 29)
[176] "There was a lot of seals around in Whale Bluff, before break-up. Just black – thousands and thousands of seals. But they all take off when the ice take off." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: 39)

migratory and follow fish migrations (MPEG 2006)[177]. Because of the migratory nature of seals, there can be disagreement about the abundance of seals in the region. A number of interviewees in the *Inuvialuit Region Traditional Knowledge Report* (MPEG 2006) indicated that they think there are fewer ringed seals now than in the past. For example, one hunter from Tuktoyaktuk stated, "*For the past years, seals are really low in numbers*". However, another hunter from Tuktoyaktuk said that ringed seals are in "good shape" (in a discussion on population and health) (MPEG 2006: 11-23).

In the mid-1970s, numerous elders and harvesters from across the Inuvialuit region testified for the Berger Inquiry. In each coastal community they noted a decline in the number and body condition of seals (Berger 1976g)[178], as well as fewer young seals (1976f)[179,180]. People believed that oil and gas development, ocean traffic, and scientific research were responsible for this decline (Berger 1976b; Berger 1976f)[181,182]. However, after the drop in seal population health and numbers in the early 1970s, harvesters noted that the health of the population improved after 1975 (Berger 1976e)[183].

[177] "[Seals] do that. I think they're following the fish [herring] migrations. They do it every year." (MPEG 2006: 11-22)

[178] "But just recently now since they have been doing the seismic work, meaning blasting around, he notice there have been some changes and one of the things that he really recognizes is the fact that the seal doesn't normally sink in the wintertime or in September because of all the fat, but now he finds out that when he shoot a seal it sink and that's an indication that the seal hasn't had enough to eat or is not healthy enough or something. It have to have lots of fat to float." (F. Wolki [Tuktoyaktuk] *in* Berger 1976g: 4146)

[179] "Wallace Lucas said he moved to Sachs Harbour in 1958. When he first came here to Sachs Harbour there used to be a lot of animals, and anything that they hunt there used to be lots of them around. But now he said since the oil companies started working these last few years, there's hardly any seals around. He said last summer he went seal hunting all summer long and all he got was one [young] seal; whereas back in 1958 they used to get over than what they really needed. There used to be seals all over, even along the shore here in Sachs Harbour. He said he used to be able to shoot the seals." (W. Lucas [Sachs Harbour] *in* Berger 1976f: 4030)

[180] "The seals there, for the last two years they have not been having young. The ones that are doing the studies on the seals still don't know why they're not getting young ones. You see when the seals are having their young, they go in the harbors and where the still ice is, to breathe, and they have young there. But since for the last two years there's been hardly any youngs got on the island from Sachs Harbour." (A. Carpenter [Sachs Harbour] *in* Berger 1976f: 4031)

[181] "There used to be a lot of seals down in that part of that country [Shallow Bay], and the seals doesn't come early in the summer, they come on sometime in August, start going into the Bay there. Now, for the last three years [1972-75], because of the traffic, I believe that the seal isn't coming into the (Kugmallit or Shallow) Bay because of the work they are doing out in the ocean." (J. Sittchinli [Aklavik] *in* Berger 1976b: 113)

[182] "He said from experience he learned that since they were blasting in the ocean the seals vanished since then. He said he think they die from they get so scared and some of them even get deaths from the blasting." (F. Carpenter [Sachs Harbour] *in* Berger 1976f: 4031)

[183] "The year before was the only year [1974] that the seals were really poor, skinny. Last year [1975] the seals, the carcass, lungs, heart, and livers were really in good condition. This year is the same thing, it's

More recently, people have noticed that seals are impacted by climate change. Riedlinger (2001) discusses Bankslanders' observations of the effects of poor ice years on seal health, distribution, and abundance:

"As one couple described, 'last year [1998] even ugyuk (bearded seals) [are] going on the land because there was no ice' (F. and M. Kudlak). Warmer temperatures and less ice can result in increasing numbers of skinny seals, particularly skinny young seals. This is most noticeable in the last few years when early breakup results in the abandonment of seal pups on the ice. Seals have their pups on the ice in April, and if the ice breaks up before the pups are mature enough to leave, they are abandoned as the mothers are carried away by the ice. It may also impact seal health. A healthy seal should have three inches of fat on it; in poor ice years such as those recently experienced by Bankslanders 'ringed seals have only 1/4 inch of fat on them in June (R. Kuptana)." (p .62)

When interviewed in 2009, Bankslanders had observed that there are not as many seals (Slavik 2013) and that they are skinnier (Slavik 2013). However, because the demand for seals has declined and the difficulty of hunting them in the summer has increased, the search effort for seals has declined as well. Additionally, some elders have commented that seals are getting "jumpier" as a result of disturbances, perhaps making them more difficult for hunters to find (Slavik 2013).

Impacts of development and climate change on seals are likely to be felt by polar bears. If polar bears cannot hunt seals due to changes in sea ice, it may be difficult for them to adapt to hunt different prey (CWS 2010).

Interactions among Polar Bears and with Other Predators

Although the polar bear is generally considered a solitary animal, Inuvialuit have observed that bears occasionally congregate together[184]. Some of these occasions include congregating to feed on beached whales or to hunt seals in small groups (Slavik *et al.* 2009)[185]. There have also been observations that bears may possibly congregate for mating (Slavik 2013). Several hunters have observed that certain places can be "polar bear highways", especially around Cape Kellett and Nelson Head (Slavik 2013). One hunter observed this offshore from Tuktoyaktuk:

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been good. This summer [1976] in Minto the seals were extremely good." (J. Memoganoak [Ulukhaktok] *in* Berger 1976e: 3991)

[184] "I run into six polar bears - six of them. 3 ten and a half, 2 young ones, two or three years old, and three young ones. Six in one place!" (D. Ruben [Paulatuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[185] "There was five bears in one place. They were hunting seals all together in the same place and they were lying down." (C. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 34)

"And that day I saw 11 bears while we were filling the tags. There seemed to be a lot of bears. For some reason they were all headed east and traveling to the west. For some reason bears we just hit it right on and bears - I saw 11 bears that day." (L. Emaghok [Tuktoyaktuk] in Slavik et al. 2009: 41)

Inuvialuit have long been aware of aggressive interactions among polar bears such as fighting between male bears and cannibalism of other bears, including killing or cannibalizing cubs in order to mate with the females (Slavik *et al.* 2009; JS 2015) or larger, hungry bears killing smaller bears (JS 2015):

"It's always been known that, if they're hungry, they'll eat another bear... And when they're in heat this time of year, if he runs across a female and it has cubs, it will kill the cubs so the female can get in heat again. Those big bears, they're aggressive, and he'll get the females to submit because he's so aggressive. The female is scared and smaller." (R. Kuptana [Sachs Harbour] in Slavik 2013: 83)

Another observation is that "[p]olar bears require stealth, patience, speed and agility when hunting seals. If polar bears lose these skills, they get hungry, and may resort to killing their own kind for food...[or] may scavenge the offal (i.e. carcass) of bears killed by Inuvialuit hunters or their sport-hunting clients, and consume the choice oily stomach contents" (JS 2015: 104).

The majority of cases where Indigenous knowledge holders saw evidence of polar bear cannibalism are from the north coast of the NWT, on the sea ice offshore of Pullen Island, Atkinson Point, Baillie Islands, Cape Parry, and Pearce Point (JS 2015). The earliest reported incident of cannibalism, offshore of Baillie Islands, dates to the 1950s, while the most recent cases, offshore of Pearce Point and Atkinson Point, date to the early 2000s (JS 2015). More recently, the Joint Secretariat study (2015) documented two cases on the west coast of Banks Island at Norway Island and Storkerson Bay. No recent cases were reported from the harvest areas of study participants from Ulukhaktok, Inuvik, and Aklavik (i.e., Victoria Island, Mackenzie delta, Herschel Island) (JS 2015).

It is not a new phenomenon to have grizzly bears on the Arctic islands. In the late 1950s, Fred Carpenter harvested a grizzly bear in northern Banksland (Manning and MacPherson 1958). The earliest evidence of a grizzly bear in these regions, based on Joint Secretariat study interviews (2015), dates to 1949 or 1950, when Fred Carpenter shot one at Masik Pass on Banks Island (JS 2015). However, recently, more grizzly bears have been observed on Banks and Victoria islands than in the past (Slavik *et al.* 2009; Slavik 2013)[186,187]. According to a

[186] "Due to the season longer. And even grizzlies going to the North of Banks Island right now." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al*. 2009: 52)

Tuktoyaktuk knowledge holder, grizzlies are turning up on Banks and Victoria islands, where they kill muskox and end up fighting with polar bears (JS 2015).

There is also evidence of hybridization occurring between grizzly and polar bears. In March 1996, a Paulatuk hunter witnessed a polar bear and a grizzly mating on the ice (JS 2015). In recent years, an Ulukhaktok hunter encountered a hybrid grizzly-polar bear near Nelson Head on Banks Island that was mating with a female polar bear (JS 2015). In 2006, an American sport hunter guided by an Inuvialuit harvested the first recorded wild polar-grizzly bear hybrid in southeast Banksland. One knowledge holder from Banks Island recalls:

"By its characteristics, I could tell its mother was a polar bear. The way she acted. It didn't act like a grizzly bear or anything. It acted like a polar bear. Or it learned the ways of the barren land, the way that it walked. Where I tracked it for a ways after we got it, its characteristics was polar bear. You could see the way it hunts; it's exactly like a polar bear. It was taught by its mother." (PIN 138 [Sachs Harbour] in JS 2015: 94)

By 2010, two other hybrids were harvested on Victoria Island by Olokhaktomiut hunters (Wingrove 2010; SARC 2012).

Beyond inter-breeding, grizzly bears and polar bears are known to fight and kill each other (Slavik *et al.* 2009)[188]. However, not all relations between grizzlies and polar bears are acrimonious, and they will at least "tolerate one another when feeding at the same bowhead carcasses" (JS 2015: 92). Behaviours documented include tolerance, competition, displacement, aggressiveness, and attack (COSEWIC 2018). For example, numerous stories exist about interactions between polar and grizzly bears at beached whales:

"There was one time a whale been beached on Baillie Island and the polar bear been finishing it, but then again it must've ran into it while it was still summer. A brown bear been going there and it was dead too beside the whale. The polar bear been killing it [laughs]. But polar bears was gathering there. They finished the whole whale." (F. Wolki [Tuktoyaktuk] in Slavik et al. 2009: 36)

As polar bears live in such a specialized niche, they face little direct competition from other species. Other species such as Arctic fox, which are known to hunt seal pups in their dens, may compete with polar bears for prey (Slavik 2013)[189]. It has also been observed that polar bears

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[187] "Grizzlies have also recently been observed on Melville Island, which is even further north than Banks and Victoria." (Doupé *et al.* 2007)

[188] "[In 1992-93] we seen a grizzly bear killing a polar bear. About thirty miles from the shore [on the north of the island]." (J. Haluksit [Ulukhaktok] *in* Slavik *et al.* 2009: unpubl. transcript)

[189] "Well, it's the global warming thing. Cause this is where the seals den, out on this part [Prince Wales Strait]. Hardly any snow, the foxes will clean out the young seals and the bears will have nothing to eat, as the foxes would clean them out first." (E. Esau [Sachs Harbour] *in* Slavik 2013: 113).

may face some predation from wolves, both on the mainland (Slavik *et al.* 2009)[190] and on the Arctic islands (Slavik 2013)[191].

State and Trends

The underlying conclusion from the Joint Secretariat study (2015) is that "ice matters" as "everything from polar bear condition to mating, reproduction and polar bear harvest of seals to Inuvialuit harvest of polar bears depends on ice conditions" (p. 212) and "the relationship between these effects and polar bears is complex" (p. 172). This section looks to Inuvialuit knowledge and observations to better understand the complex nature of a changing Arctic ecosystem, specific threats facing polar bear populations, and perspectives on how polar bears will adapt.

Population

Abundance

The sources of Indigenous and community knowledge examined do not include estimates of population abundance (numbers), but instead make observations of relative abundance (presence/absence compared to previous time periods) and fluctuations in populations. Barr (1996) cautions against using historical data to infer species abundance, and instead suggests looking for "a pattern of relative population densities …over time" (p. 183)[192]. Table 2 illustrates the evidence for relative abundance and condition of NWT polar bears and seals from the late 1800s to early 2000s (see *Interactions with Seals*).

[190] "17 years ago I found, about 30 miles inside the tree line, I found a little four and a half foot polar bear. It was feeding on a wolf kill! The wolf been killing a moose and that little four and a half foot bear was eating the moose head. I went back a week later and it was lying dead beside the moose. I guess the wolves came back and killed the little bear." (C. Gruben [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[191] "Even wolves kill polar bears out on Banks." (D. Haogak [Sachs Harbour] *in* Slavik 2013: unpubl. transcript)

[192] "It must be recognized at the outset that the potential for using the historic record for determining absolute data on the populations of polar bears within any particular region of the Northwest Territories (or Canada), or within any particular time period, is quite limited… Nonetheless, if one bears these limitations clearly in mind, the historic record can tell us a great deal about the polar bears of the Northwest Territories over the centuries. Perhaps what emerges most clearly is a pattern of relative population densities, which is generally remarkably consistent over time. Among the marine areas with consistently high population densities are the area off southern Banks Island, Victoria Strait, from Jenny Lind Island north to Gateshead Island, the northern part of Prince." (Barr 1996: 183-184)

Table 2. Evidence for relative abundance and condition of NWT polar bears and seals over time. Note that limited major Indigenous knowledge studies were done on this topic between 1976 and 2006.

Date and place	Abundance/ condition of species	Observations	Sources
Late 1800s - Beaufort Sea/ Amundsen Gulf	Bears scarce	"For more than 20 years after the first penetration by Whites into the Beaufort Sea/Amundsen Gulf area, there were no recorded sightings of bears, or tracks of bears."	Observations recorded of early Beaufort Sea expeditions *in* Barr 1996: 64
1903-1906 - Beaufort Sea	Bears scarce	"In his account of the expedition Amundsen makes no mention of bears during his trip through these waters in 1905-06, including a wintering at King Point just east of Herschel Island. The scarcity of bears in the Beaufort Sea at this period is also confirmed by Stefansson, in this area on his first expedition to the Arctic in 1905-06. He commented: 'I went home at the end of my first polar expedition without ever having seen a bear.'"	Amundsen 1908 *in* Stefansson 1923: 283
Early 1900s - Shallow Bay	Seals abundant	"When I was young there was lots of seals [around Shallow Bay]."	A. Ookpik [Tuktoyaktuk] *in* Berger 1976h
1910 - Cape Bathurst	Bears abundant, seals scarce	"...in 1910 there was little open water, few seals, but lots of polar bears which were used for meat."	J. Nasogaluak [Tuktoyaktuk] *in* Hart *et al.* 2004: 72
1910 - Franklin Bay	Bears abundant	"...an abundance of bears in 1910 in the Franklin Bay area."	A. Tuma *in* Hart *et al.* 2004: 73
1920s - Baillie Islands	Bears abundant	"They said there was so many bears on Baillie Islands some years, that in one day they kill 32 bears in one day one time."	F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009
1922-23 - Cape Bathurst	Bears and seals scarce	"The people would walk and hunt for polar bear but couldn't get any because the ice on the ocean didn't have any openings... This was in 1923. That winter, all the people of Baillie Island (*Utqaluk*) had nothing."	J. Nasogaluak [Tuktoyaktuk] *in* Hart *et al.* 2004: 74
1929 - Sachs Harbour	Bears abundant	"That was the first trip my dad made to Banks Island, and the year was 1929. We wintered at Mary Sachs on Banks Island ... In the fall there was a lot of polar bears there. Our parents never let us play out because polar bears came from all directions."	P. Gruben [Tuktoyaktuk] *in* Berger 1976h: 4305-06

Date and place	Abundance/ condition of species	Observations	Sources
1950s - North Star Harbour, Cape Bathurst	Bears abundant	"We were at the North Star [Harbour]. There were plentiful bears in those day, see them every day, 11 or 12 a day around whale bluffs."	F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009
1950s - Banks Island	Bears abundant	"When my parents [Peter and Sally Esau] first came [in 1950s] … when they'd go and hunt geese [in the spring time], they couldn't even walk 100 yards … they had to take a gun with them cause there were so many bears."	E. Esau [Sachs Harbour] *in* Slavik 2013
1972-73 – Cape Bathurst area	Bears abundant	"Yes indeed this winter was the year of polar bear, and Sandy as well as the other trappers would confirm this statement north of Tuk, Baillie, even Horton River, Cape Parry - all over."	J. Wolki [Tuktoyaktuk] *in* Hart *et al*. 2004: 74
1972-75 - *Kugmallit* / Shallow Bay	Seals scarce	"Now, for the last three years [1972-75], because of the traffic, I believe that the seal isn't coming into the (*Kugmallit* or Shallow) Bay because of the work they are doing out in the ocean."	J. Sittchinli [Aklavik] *in* Berger 1976b
1973-76 - Ulukhaktok	Seals becoming scarce	"…for the past years [before 1975], for the past few years all they have been harvesting were males, old seals, or cows…The seals have been dropping steadily, the numbers are going down."	R. Goose [Ulukhaktok] *in* Berger 1976e: 3972
1974 - Ulukhaktok	Seals in poor condition	"…was the only year [1974] that the seals were really poor, skinny…"	J. Memoganoak [Ulukhaktok] *in* Berger 1976e: 3990
1974-76 - Paulatuk	Seals scarce	"Since they started [branding seals], we seem to be losing all the seals. Last summer, this last summer, we never see seals pass through here."	G. Ruben [Paulatuk] *in* Berger 1976i: 4480
1975 - Sachs Harbour	Young seals scarce	"…hardly any [young] seals around." "…only [harvested] one young one."	W. Lucas [Sachs Harbour] *in* Berger 1976f: 4029
1975-76 - Sachs Harbour	Young seals scarce	"The seals there, for the last two years they have not been having young."	A. Carpenter [Sachs Harbour] *in* Berger 1976f: 4130

Date and place	Abundance/ condition of species	Observations	Sources
1976 - Sachs Harbour	Seals scarce, polar bears in poor condition	"...hardly any seals any more, and the polar bears are starving due to lack of food."	W. Lucas [Sachs Harbour] *in* Berger 1976f: 4031
1976 - Banks Island	Fewer bears and seals	"I used to come here and I used to get many foxes, many polar bears, and many seals in Banks Island. He's saying that now today, he said there's hardly -- the seals have decreased to some extent, and the polar bears and the white foxes, they've gone away somewhere. He say the oil companies are come around here, the seals have decreased quite a lot."	W. Kuptana [Sachs Harbour] *in* Berger 1976f: 4042
1976 - Ulukhaktok	Seals in good condition	"...Last year [1975] the seals, the carcass, lungs, heart, and livers were really in good condition. This year [1976] is the same thing, it's been good. This summer in Minto the seals were extremely good."	J. Memoganoak [Ulukhaktok] *in* Berger 1976e: 3991
1976 - Ulukhaktok	More bears coming closer to town	"They didn't have to put very much effort to killing their polar bears because they seemed to be coming in closer. There seemed to be more polar bear with each year as the year progresses...There also was a few nuisance polar bears that have been coming around to the settlement and up until about 10 to 15 years ago it was not too common to find a few polar bear coming into the settlement, and these fortunately weren't polar bears that were terrorizing the people at Holman."	R. Goose [Ulukhaktok] *in* Berger 1976e: 3974
1976 - Baillie Islands	Seals in poor condition	"From the reports I've been getting from the hunters from Baillie Island, the seals are so poor they don't float anymore."	B. Pokiak [Tuktoyaktuk] *in* Berger 1976h: 4241
1976 - Ulukhaktok	Bears abundant	"For the 1975-76 calendar year, the Ulukhaktok settlement area had a quota of 16 polar bears. According to the records kept by the HTC [Hunters and Trappers Committee], this quota was filled in approximately one and a half weeks, with 99 percent of it in a 25-30 mile radius of Ulukhaktok."	Berger 1976e: 3974
2006 - Tuktoyaktuk	Polar bears in poor health	"...polar bears aren't in good health right now (i.e., in 2006) because the rough ice has	MPEG 2006: 11-32

Date and place	Abundance/ condition of species	Observations	Sources
		covered up the seal breathing holes, meaning the bears have to dig through three feet of ice to get the seals now."	
2008-09 - Tuktoyaktuk	Bears scarce	"…last year [winter 2009] was the first time that I hardly saw any sign. I saw a sign in December [2008] and I went out maybe 15 times during the winter, and I never saw a sign until April [2009]."	L. Emaghok [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcripts
2009 – Tuktoyaktuk	Fewer bears and seals	"There aren't as many polar bears close to town because there is less summer ice…Today there are far fewer seals, bears and dens."	Summary of Tuktoyaktuk consultation *in* CWS 2010: 85
2009 - Paulatuk	Fewer bears; bears in poor condition	Residents of Paulatuk are observing that the condition of polar bears is declining and polar bears are skinnier today than in the past.	CWS 2010
2009 - Ulukhaktok	More bears	Olokhaktomiut stated they are seeing more polar bears.	CWS 2010
2009 – Melville Island	Bears abundant	"I've been there four different times. And every time I go, from that bay I seen [lots of bears] in one day."	P. Ekpakohak [Ulukhaktok] *in* Slavik *et al.* 2009: unpubl. transcripts

Fluctuations and Trends

Indigenous and community knowledge holders indicate that polar bear abundance changes from year to year and from region to region. For example: "*… some years it's less and some years it's more. And it's always been that way*" (Martha Kudlak [Sachs Harbour] *in* Slavik 2013: 110). Jim Wolki refers to a "year of the polar bear" in 1972-73 when the numbers were especially high in the Cape Bathurst area (Hart *et al*. 2004). Inuvialuit understand that polar bear population size is cyclical over time and that populations across North America will naturally increase and decrease as the population changes or bears move from one area to another (Slavik *et al.* 2009)[193]. A similar conclusion was reached from Indigenous knowledge studies in the Chukchi Sea region[194]. Overall, the Joint Secretariat study (2015) concluded the "the number of polar bears in the Inuvialuit polar bear hunting area (generally the Canadian Beaufort Sea region) have remained relatively stable during the living memory of study participants" (JS 2015: 212).

Some hunters from Tuktoyaktuk have commented on the recent scarcity of bears (Slavik *et al*. 2009)[195] and some hunters from Tuktoyaktuk and Paulatuk have observed "fewer polar bears today compared to past when there were a lot of seals and polar bear dens" (CWS 2010: 10)[196], and that "polar bears are now closer to the mainland" (JS 2015: 184). Residents of Paulatuk also observed in 2010 that the condition of polar bears was declining, and that polar bears were skinnier than in the past (CWS 2010).

In the 2013 Joint Secretariat Polar Bear Environmental Change (PBEC) workshop[197], a hunter from Tuktoyaktuk concluded: "*I would say they are the same. Overall throughout the years, they seem pretty stable. The bears are there, just a little bit later. It's just the ice conditions that are*

[193] "Sometimes one year only, sometimes nothing. Next year it could be full of bears." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: 40)

[194] A comparable Indigenous knowledge study of the Chukchi Sea subpopulation found: "Most hunters interviewed said that despite variation in local abundance on the scale of years and decades, overall, there are as many bears now as there have always been, and that changes in abundance are cyclical. Many hunters believe that decreased local abundance reflects the fact that polar bears have moved in search of seals and better ice habitat, rather than indicating an overall decline in the CS [Chukchi Sea] population." (Voorhees *et al*. 2014: 527)

[195] "I've been hunting bears for a number of years now, and last year [winter 2009] was the first time that I hardly saw any sign." (L. Emaghok [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[196] "There aren't as many polar bears close to town because there is less summer ice. Even 30 years ago, there were areas on the sea-ice where there used to be a lot of seals and polar bears and polar bear dens. Today there are far fewer seals, bears and dens." (summary of Tuktoyaktuk consultation *in* CWS 2010: 85)

[197] A three-day workshop about polar bear environmental change was held in Inuvik in January 2013. Facilitated by the Joint Secretariat, the workshop and final report seeks consensus from a group of 12 Inuvialuit knowledge holders. These 12 knowledge holders represented five Inuvialuit Settlement Region communities and had all been interviewed as part of the 2010 fieldwork for the Joint Secretariat study (2015).

changing" (PIN 161 [Tuktoyaktuk] *in* JS 2015: 184). While a hunter from Paulatuk summarized that, "*the big picture is that they're stable*" (PIN 163 *in* JS 2015: 184).

In Sachs Harbour, some elders recently commented that there "seems to be not too many as there used to be" (Slavik 2013)[198], but some other residents of Sachs Harbour disagree (Slavik 2013). At a recent workshop, one hunter from Sachs Harbour stated: "*I don't see the numbers going down. We're seeing more around town, but that doesn't mean there's a decline in the numbers*" (PIN 160 *in* JS 2015: 184).

Olokhaktomiut have stated they are seeing more polar bears and that the population is stable (CWS 2010). In the 2013 PBEC workshop (JS 2015), one hunter from Ulukhaktok concluded: "*Maybe a little change, but overall about the same. Polar bear movements are always different every year. To me it's the same, but a little bit change since when I was younger*" (PIN 121 *in* JS 2015: 184). Pat Ekpakohak [Ulukhaktok], who has frequently harvested polar bears around Melville Island, commented on the abundance of bears in this region and his theory for why:

"I don't think polar bear population is changing. They're just moving because of the ice conditions and weather conditions. They're moving further north. One time I went to Melville Island for 12 tags. I stayed out 12 days, no, 14 days. I seen 66 bears in Melville Island, and I shot 12. One day, me and Allen, in half a day we seen 16 bears. We never shoot that day, we were just looking at the bears. 16 bears in one half of a day. We never shoot, the next day, we shot, we go home. Today, it's very different. The numbers of bears are not going down, they're just moving away cause of the weather conditions, ice conditions. Not a food problem for them - lots of seal. I think that they don't want to stay there no more some years cause the ice is not thick enough for them to stay." (in Slavik et al. 2009: unpubl. transcript)

Recent studies based on Inuvialuit knowledge suggest that the Northern Beaufort management unit remains stable and may be increasing (Slavik *et al*. 2009; JS 2015). The Polar Bear Technical Committee (PBTC 2020) reported that based on a local/Indigenous knowledge assessment, the Northern Beaufort management unit was 'stable' (COSEWIC 2018).

Inuvialuit knowledge indicates that the Viscount Melville management unit is stable, and may be increasing (CWS 2010; Joint Secretariat 2015, 2017)[199]. In light of these indications, Olokhaktomiut believed that this subpopulation needed to be re-surveyed (CWS 2010). A survey was completed from 2012-2014 and as of February 2021 results are being analyzed (Baryluk pers. comm. 2020). According to the PBTC (2020), the local/Indigenous knowledge

[198] "Just like seems to be not too many as there used to be. There used to be all ice long ago. Ice bergs sometimes they come in and that's when there's lots of polar bears around… Not too many now I notice as there used to be anyway." (G. Wolki [Sachs Harbour] *in* Slavik 2013: 103)
[199] This was based on information from CWS' Nunavut consultation meetings in 2009 and information from community consultations in Cambridge Bay and Ulukhaktok during 2012 and 2013 (see JS 2017).

assessment of the Viscount Melville indicates that the management unit has 'increased' (COSEWIC 2018).

Inuvialuit knowledge indicates that the Southern Beaufort management unit is stable (Slavik *et al.* 2009; JS 2015). The PBTC (2020) lists the local/Indigenous knowledge assessment of the Southern Beaufort management unit as 'stable' (see COSEWIC 2018).

The conclusion from the Joint Secretariat study (2015) was not definitive in terms of a collective agreement by knowledge holders regarding changes in relative polar bear abundance and condition:

"Traditional knowledge holders had a range of observations and perspectives on change-related matters. Some thought there were less polar bears compared to when they were younger, while others thought the numbers were much the same in their areas. Some thought that polar bears were skinnier compared to the past. There appeared to be no consistent pattern in these apparently differing views in relation to the age of the hunters or their affiliations with a particular community or polar bear hunting area." (p.173)

Trends are comparable to Inuit observations in the Chukchi Sea region, home to the Chukchi Sea subpopulation and neighbouring the Southern Beaufort Sea subpopulation. Knowledge holders in this region observed that the seasonal and spatial distribution and local abundance of polar bears have changed over time, though different communities report different patterns, such as polar bears arriving from the north later in fall than previously (Voorhees *et al*. 2014 ; Voorhees 2019). Despite substantial changes in sea ice, changes in the timing of freeze-up and other aspects of polar bear habitat, Chukchi knowledge holders concluded "the animals generally appear to be in good body condition, and cubs continue to be observed regularly" (Voorhees *et al.* 2014: 523; Voorhees 2019).

Knowledge holders recognize that an observed regional decline in population does not necessarily infer an overall population decline. It could be reflective of polar bears moving to different places at different times (Slavik *et al*. 2009; Slavik 2013; JS 2015)[200,201], or that hunters

[200] "You have to know where they are! I don't believe myself there are less bears today - that the number of their population is going down - because I spend my time on the ice so many times a year and the winter. I'm not seeing less bears today in our little country out here. I'm not. The number of the bears is not going down. Because I spend my time out there on the ice, a lot of time in the winter last year… I don't really believe that polar bears are declining today, because I spend a lot of my time on the ice out there, hunting bears. There's always bears there, not in one place though. At different times." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al*. 2009: unpubl. transcript)

[201] "[People are saying they are seeing] less bears, but in these days you gotta go further north. Less bears on the south part of the island. That doesn't mean there's less of a bear population, just that you have to go further north to start seeing them. And we really can't go out on the ice, out on the, more than a couple of miles out, because polar bears like to hang out 14, 15, 20, 30 miles out." (J. Carpenter [Sachs Harbour] *in* Slavik 2013: 91)

can no longer access the ice where the bears are (Slavik 2013)[202]. Individual observations on changes in polar bear abundance can also vary depending on the individual hunter's range, experience, and perspective (Keith and Arqviq 2006; Slavik *et al.* 2009; COSEWIC 2018). While some Inuvialuit hunters commented that they are seeing fewer bears, this is not always interpreted as population decline, as they are aware of the decline in harvesting range and "search effort" (Reidlinger 2001; Slavik *et al*. 2009; Slavik 2013)[203,204,205]. In addition, warmer temperatures mean that poor ice conditions arrive sooner in the spring, which disrupts Inuvialuit observations and harvesting that previously extended further into the season (JS 2015).

Population Dynamics

Through Indigenous and community knowledge, harvesters could make inferences regarding the structure of polar bear populations such as generation time, sex ratio, age ratio, birth rate, and death rate (see *Assessing Body Condition*). However, this knowledge was not included in the sources examined and, to our knowledge, has not yet been recorded. Body condition, however, is a topic addressed in some detail in the available information and is addressed in the subsections below.

The maximum age of bears recalled in the sources examined for this status report ranges from 13 to 33 years old[206]. Bears this old can grow larger than 11 feet and will often be in poor condition, skinny or starving, with worn-down teeth (Slavik *et al.* 2009)[207,208,209]. One hunter

[202] "Not really [seeing changes in the numbers of bears], no. Not on this side. You know, pretty consistent. It's just that you can't, you can't go out anymore like as far as you used to. You're stuck to along the coast. Cause a lot of the bears would be way out here and you don't seem them, but what you do see close-by. A good number!" (J. Keogak [Sachs Harbour] *in* Slavik 2013: 91)

[203] "20 years ago you could go further out and see more bears. It hasn't really changed except the ice conditions. But the bears are still there." (C. Gruben [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[204] "Well now, when you are sport hunting you can really notice it now. All the bears are further out, they are not closer. I don't know if it could be from too much traffic close by the beach or that sort of thing, but from what I have seen - all the ice that is out there has frozen this year - and you could only go so far. You can't pass a certain point because other side of that there is some more open water…that is where all the bears are. A lot of them they don't get polar bears because the bears are out here where the hunters can't reach them." (J. Lucas [Sachs Harbour] *in* Reidlinger 2001: 64)

[205] "[People are saying they are seeing] less bears, but in these days you gotta go further north. Less bears on the south part of the island. That doesn't mean there's less of a bear population, just that you have to go further north to start seeing them. And we really can't go out on the ice, out on the, more than a couple of miles out, because polar bears like to hang out 14, 15, 20, 30 miles out." (J. Carpenter [Sachs Harbour] *in* Slavik 2013: 98)

[206] It was observed by local harvesters that this 33 year old bear was in "good condition".

[207] "The oldest bear I get in my whole life is 13 years old and is eleven foot. That's an old bear and it looks poor, the skin and the fur. My old timers told me that a 13 year old bear is a real old bear. I didn't know how long they could live up to. I didn't experience that myself." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al.* 2009: unpubl. transcript)

commented that he had rarely see very old polar bears: "*It's not very often you shoot an old bear. Some of those old bear have no teeth. Don't see those anymore. I haven't seen one of those for a long time*" (E. Esau [Sachs Harbour] *in* Slavik 2013: 75). Though other hunters around Tuktoyaktuk will frequently see and harvest "old bears in good health" (Nathoo pers. comm. 2020).

Body Condition

In general, knowledge holders reported in the Joint Secretariat study (2015) that the physical condition of polar bears in their areas has remained stable over time, although there is considerable variation from one season to the next, and even within a given hunting season. Some hunters from Sachs Harbour have commented on size and body condition, observing that bears are not as big as they used to be, but there is not consensus on changes in body condition/size (Slavik 2013). For example, the late Andy Carpenter [Sachs Harbour] commented in 2009 that "*some people say 'they're not as much fat as they used to be before', but the ones that, the meat that they bring back, it seems to be pretty fat*" (*in* Slavik 2013: 70).

Differences in polar bear body condition could be a result of numerous factors, but three causes are frequently mentioned:

- Seasonality - Bears are skinnier in October and November from fasting all summer. Community residents are more likely to see these bears as they travel along the coast or visit communities in the fall.
- Unsuccessful hunters - Juvenile bears may be skinny because they lack hunting experience. "Spooked" bears may not be effective hunters, while older bears may lack agility and be in poor condition for hunting (Slavik *et al.* 2009: 77).
- Availability of prey species – If seals are less abundant, or in poorer condition, this can affect the condition of the bears (see *Population* and *Threats and Limiting Factors* for additional information).

Inuvialuit have observed in years when ice and seal hunting conditions are good, polar bears are fat, but when conditions are not good, the bears may be skinnier (JS 2015). Ultimately, body condition may be influenced by the broader ecosystem and trophic effects that influence seal health and abundance. In particular, the relationship between sea ice, ringed seals, and

[208] "One time I got one that was 33 years old. And all of his fangs, his four fangs, they were worn down halfway. But it was the fattest bear I had ever got. And it must've just come out of the open water cause it had about a 50 pound ball of ice on him, but that never slowed him down… It was 11'10!" (C. Gruben [Tuktoyaktuk] *in* Slavik *et al.* 2009: 53)

[209] "There's some that's about 23 years old, 24 years old. And they barely have, they don't have any more sharp teeth. They're kind of chipped off. You don't see any real old polar bears. They'd be skinny and starving." (M. Kudlak [Paulatuk] *in* Slavik *et al*. 2009: unpubl. transcript)

fish, requires: "the kind of conditions that are good for algae accumulation along the underside of the sea ice because Arctic cod feed on the algae and seals eat the cod. As a result, seals travel with the ice; that is where the food is" (JS 2015: 192). Variable sea ice conditions affect the seal population and ultimately, the bears' body condition (JS 2015). This includes changes in the timing of freeze-up and melt[210], ice thickness and structure[211], and snow conditions[212] (JS 2015). Likewise, knowledge holders emphasize that too much ice could also negatively affect a bear's body condition due to inaccessibility of their prey[213].

There appear to be fewer really big bears and they are not as fat as they were prior to the mid-1980s, "when apparent climate-related changes were beginning to be perceived as significant" (JS 2015: 212)[214]. Several elders and hunters have stories about "monster bears" (*pualrisiktualuit* or "shovel bears"; Slavik 2013), which they have seen, tracked, or heard stories about. "*People used to see them all the time*" (P. Ekpakohak [Ulukaktok] *in* Slavik *et al.* 2009: unpubl. transcript), but today, hunters are noticing that there are not very many "monster

[210] "The ice, it's disappearing a lot earlier and freezing later. And it's taking a long time now for the polar bears to wait for the ice to come in to hunt the seals. And that's getting them skinnier and skinnier." (PIN 145 [Paulatuk] *in* JS 2015: 178)

[211] "Speaking from the perspective of Paulatuk, one participant said that the best ice conditions for polar bears are a mixture of smooth and rubbled ice with open leads, and that when such conditions are present, hunters are more likely to encounter fatter polar bears. When the ice is less than two feet thick, however, the winds, waves and currents break it up too easily, producing a great deal of rubbling. Too much rubble ice is not good for polar bears, because they have trouble hunting seals in such conditions. Very flat, new ice is not good for bears either, because seals have few breathing holes in such ice, and there is no place for the bears to hunt." (JS 2015: 179)

[212] "A lot of times the snowdrifts aren't big enough, and a lot of the seal pups are dug out by foxes…. It happens, I guess. You just happen to run into something like that, eh? Pulled out of them…. There's so many of them, some of them got to get caught. But now, lately, I don't know about so much snowdrifts. 'Cause you don't have enough big ice to make snowdrifts. Because the winds are so fierce now that snow doesn't stay anyways… To build up… The wind blowing too hard for now… Probably have an effect on seals, where they have their pups and that." (PIN 133 [Sachs Harbour] *in* JS 2015: 191)

[213] "But if you go out there and get a polar bear, you don't see a starving polar bear, like back in our days when we had a lot of ice. Polar bears were starving, because they couldn't get the seals. They were always in seal holes, 'cause seals could have eight feet of ice. Could still have a seal hole in eight feet of ice and living under the ice itself. And that's why you see polar bears coming to town, starving and stuff." (PIN 42 [Tuktoyaktuk] *in* JS 2015: 178)

[214] "So no more solid ice. That's what's happening. And we could see that because the bears are getting more thinner. Now, they don't eat as much. You know it is getting too warm and not cold anymore. The bears are getting more thinner, from about five inches [of fat] down to about three…. It's been quite a few years…let's see, [since] about [the] 90's, [when] they started to see changes in polar bear fat. Before that, they just round: five, six inches thick. In the back, now, you barely get three inches. They're long and skinny. Before they just like a ball, round. Round as a ball." (PIN 164 [Paulatuk] *in* JS 2015: 178)

bears" around, or if there are, that they have moved north (Slavik *et al.* 2009)[215,216] or out onto the multi-year ice (Slavik 2013; JS 2015)[217].

Assessing Body Condition

The Joint Secretariat study (2015) describes in detail how and why Inuvialuit have such detailed knowledge and observations of [individual] polar bear body condition:

"Inuvialuit hunters pay close attention to polar bear condition from the second they sight or start to track a bear, because they must make decisions quickly about whether to harvest it, and the condition of a bear can help a hunter predict its behaviour. Skinny young bears can be very aggressive, extremely fast-footed and agile, and therefore more dangerous to hunt. Bears in poor condition, or too small, have little appeal to hunters or their sport-hunting clients, who are interested in valuable pelts or good trophies. Furthermore, with the quota system and its limited allocation of tags, hunters prefer to pass over smaller bears in favour of larger ones with more meat and more valuable pelts." (JS 2015: 120)

Inuvialuit hunters employ a variety of qualitative, quantitative, and comparative criteria or indicators to assess the condition of polar bears throughout the observation, pursuit, harvesting, and butchering process. These include:

- body shape (see *Physiology*) and whether bones are showing[218];
- amount and location of fat on the body (e.g., lots of fat on the rump means good health)[219];
- fur condition (e.g., length, colour, thickness, shininess);
- stomach contents (e.g., type of food, amount of seal oil in the stomach)[220];

[215] "From my experience, I went up to Melville Island quite a few times. Close to Prince Patrick Island, I seen big polar bear tracks. This one was a big one. One track you could sit inside! It was a real, real big bear." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al.* 2009: unpubl. transcript)
[216] "There's not too many left. Well, around here, they move from this area here. Ice doesn't get thick enough around here." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)
[217] "The great big bears, they stay out on multi-year ice. And once in a while they'll venture in close, in the springtime, looking for females. But you don't see them anymore, like great big bears, I mean…11-, 12-footers; the ones you don't see on land or close to shore. They stay on the multi-year ice… That's where they feed, they live, I guess. You get a lot of those great big bears that just stay in the water; they're the big healthy bears. You don't see that anymore… Multi-year ice has moved, I guess, they stay with that… Some of them get so big that the hair quit growing on their faces… most big bears are in good shape." (PIN 133 [Sachs Harbour] *in* JS 2015: 178)
[218] "The most common indicator used by PBTK [polar bear traditional knowledge] study participants to assess the condition of polar bears is body shape and whether any bones are showing. A starving bear will have a small stomach, long legs and long neck… Ribs, hip, shoulder and backbone are clearly visible through the hide when a polar bear is starving (Siglitun: *kayaaniq*)." (JS 2015: 121)
[219] "Polar bears that are in good condition have no protruding bones, they "have a lot of fat," their hides are "rolling" in fat and they "bulge out." (JS 2015: 122)

- the shape and depth of the tracks in the snow, and whether claw marks are showing[221];
- the way the polar bear walks;
- the bear's stamina (e.g., how far it can run when being chased by dogs and hunters);
- the bear's behaviour (e.g., aggressive, not afraid)[222];
- how much the bear bleeds when shot (skinny bears bleed less);
- the colour of the meat (e.g., pale if the bear is in "bad shape");
- the ease with which the bear can be fleshed[223];
- condition of the teeth (e.g., torn or broken ones indicate age or starvation);
- facial scarring (great scarring indicates age);
- number of females with cubs and the number of cubs present[224]; and
- circumstantial evidence (e.g., local or seasonal abundance of ringed seal, cod).

More recently, harvesters' observations of the characteristics of individual bears have started to be documented and considered in management. For example, through participation in ENR's monitoring program, harvesters submit biological samples for analysis (e.g., lower jaw, a small piece of fat or fur, proof of sex, and fecal matter). Frequently, the results from the harvest submissions are shared with the individual harvester and co-management agencies.

Prey Availability

Observations of seal abundance can be used to infer polar bear abundance (MPEG 2006; JS 2015)[225,226,227]. Fred Wolki from Tuktoyaktuk believes:

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[220] "In the skinny ones there's really nothing when you open their belly" (PIN 142 [Paulatuk] *in* JS 2015: 124). However, seal remains in the stomach does not automatically point to good condition, because a lot of seal meat and bone content strongly suggests the polar bear had been starving prior to its last meal…polar bears with large amounts of oil and shredded seal skin in their stomachs are in very good condition (JS 2015).

[221] See Wong *et al.* (2011) for information on how Inuit hunters estimate polar bear characteristics such as sex, age, and size from tracks.

[222] A polar bear's behaviour is another indicator of its condition. Those that show no fear of humans and dogs are probably very hungry and therefore extremely dangerous (Slavik 2013; JS 2015).

[223] Fleshing is the process of trimming off the fat and subcutaneous tissues from the hide of the animal using an ulu. A fat polar bear that is in good condition is easier to flesh. Because of the intensive, detailed, and hands-on process involved in fleshing, women can provide important information about polar bear health and body condition based on the involved task of fleshing - this includes thickness and quality (colour, texture) of fat, and scars on the hide (Slavik 2013).

[224] "Inuvialuit hunters also infer polar bear condition from the number of females with cubs (family groups) they encounter. If the bears are in poor condition, there will be fewer females with cubs." (JS 2015: 179)

"Every year's not the same! There might be lots of bears, but next year will be nothing. I believe they will only follow their food. Where there's a lot of seals there's a lot of bears." (in Slavik et al. 2009: 39)

The relationship between variable sea ice conditions, seal abundance, and polar bear condition was also touched on by an Ulukhaktok knowledge holder:

"[W]hen conditions for hunting seals for the bear… their ice conditions aren't all that great, piled-up ice and stuff like that, some years the bears are thinner, some years they're fatter…depending on ice conditions. Even what he hears from his father and his grandfather, it depends on the ice conditions for that year. If the ice conditions are good enough for the seals to be making dens in that area, the bear seal hunting area, then the bears are healthy, in good shape. But when the conditions are bad, the bears aren't fat." (PIN 120 [Ulukhaktok] in JS 2015: 66)

The 2013 PBEC workshop, as part of the Joint Secretariat study (JS 2015), reported diverse perspectives and varying observations regarding seal abundance. Participants in the 2013 PBEC workshop did not come to a conclusive assessment of ringed seal availability, other than "they are highly mobile like polar bears and go through cycles in terms of their local abundance" (JS 2015: 193). Assessments of seal populations varied significantly among communities:

- Sachs Harbour – Plenty of ringed seals in the waters offshore of the community in recent years and they had seen seals in the harbour the previous fall (2012-13) even when there was no ice for them to haul up on.
- Ulukhaktok - There had been very few seals in their waters during the previous two years (2011-13) and the previous summer was particularly poor, which was attributed to poor ice conditions[228,229]. Another knowledge holder from Ulukhaktok related the

[225] "…none of the hunters interviewed knew the population of the polar bears, but one hunter said, 'If there is a lot of seals there will be a lot of polar bears.'" (MPEG 2006: 11-32)
[226] "[Translation] When conditions for hunting seals for the bear, their ice conditions aren't all that great, piled up ice and stuff like that, some years the bears are thinner, some years they're fatter. Depending on ice conditions, even what I hear from my father and grandfather, it depends on the ice conditions for that year. If the ice conditions are good enough for the seals to be making dens in that area, the bear/seal hunting area, then the bears are healthy, in good shape. But when the conditions are bad, the bears aren't fat." (PIN 120 [Ulukhaktok] *in* JS 2015: 178)
[227] "Some years is skinnier than some years; here in Tuk got hardly any seals. Some years when they got a lot of seals the bears are in good shape." (PIN 38 [Tuktoyaktuk] *in* JS 2015: 178)
[228] "One of the participants [from Ulukhaktok] was well placed to observe seal numbers in this region because he worked with DFO as a seal monitor. He said that the reason for the low numbers may have something to do with the ice conditions. When the ice breaks up and melts early in the spring, the young seals leave their mothers too early and die. Inuvialuit find dead seals along the shore when this occurs. In particular, they tend to find dead seals along the shore following strong westerly winds with large waves." (JS 2015: 193)

absence of seals to changes in regional food availability as seals follow their food sources over great distances: "*It's hard to tell. We seem to be getting less, but seals moving – travel a long way… Sometimes they come back, sometimes they go a long way*" (PIN 122 [Ulukhaktok] *in* JS 2015: 192).

- Paulatuk – Between 2011-13, people from Paulatuk were finding an unprecedented number of dead young seals on the beaches in their area (JS 2015). Knowledge holders believe seal presence in the Paulatuk area is characterized by good years when they are abundant[230], and poor years when they are scarce. When they are scarce, one knowledge holder speculated that "*the seals may have gone farther north where the ice was or that they were 'stressed out' because of the lack of local ice*" (JS 2015: 184).
- Aklavik – Knowledge holders observe that the Yukon North Slope between Shingle Point and Herschel Island has an abundance of seals (JS 2015).

Habitat

Habitat Availability

Although habitat is observed to be changing as a result of climate change (see section on *Habitat Trends*), there appears to be little concern among knowledge holders regarding the overall availability of habitat. Multi-year ice is disappearing, but "annual sea-ice will still be available for polar bears" (CWS 2010: 11). Numerous hunters believe that bears will be more successful in annual ice, and others believe bears will move north as annual ice replaces multi-year ice (Slavik *et al.* 2009). One Olokhaktomiut knowledge holder commented:

"Polar bears don't use multi-year ice because they cannot find seals there. They are found more frequently around annual ice. Annual ice is rough; with more pressure ridges and areas of open water; that is where seals are found." (CWS 2010: 88)

While this is generally agreed upon, hunters from Sachs Harbour also know and have seen bears living on the multi-year ice pack west of Banks Island and have encouraged population

[229] "A couple of years now, we're having a hard time with seals. Because the ice keeps breaking up and opening up and going early. When it used to never break, we used to have seal pups; because seal pups, with their mom, they stayed on the ice and it never break. We have lots of young seals and seal population grow. But now, the place where we used to hunt seals, the ice is starting to break up; and the place where they have their pups, the ice takes off and drifts out. And that's how come the place where we used to have young seals hardly have any more young seals… Right now [16 February 2010], the ice what we've got right now, it's not breaking. People that are getting their seals, they've got pups inside. So, it should be a good year. But if the ice keep breaking, what is going to happen with the seal again?" (PIN 117 [Ulukhaktok] *in* JS 2015: 191)

[230] "And we're seeing an abundance of seals now in this area. Getting way too much seals now in this whole area here, where fish congregate… From Lasard Creek area from all the way down here… Feeding on char and cod." (PIN 160 [Paulatuk] *in* JS 2015: 192)

surveys in this area (Slavik 2013)[231]. See *Habitat Requirements*, *Habitat Fragmentation*, and *Distribution Trends* for more details on the role of multi-year ice, its current and projected availability, and polar bear movement in conjunction with multi-year ice.

Habitat Fragmentation

Polar bears' habitat of sea ice is naturally fragmented because its suitability for polar bears varies in space and time. The degree of fragmentation varies depending on numerous factors, including weather and temperature as well as the level of marine traffic in the region (see *Threats and Limiting Factors*). Local and regional ice conditions account for much of the variability in the views of Inuvialuit knowledge holders. There has always been significant annual variation in sea ice conditions and hence in the local abundance, distribution, and condition of polar bears and their primary prey.

Inuvialuit knowledge illustrates a number of ways in which natural habitat fragmentation can occur. When there is too much open water, bears have to swim between land and ice floes (Slavik *et al*. 2009)[232]. While a polar bear is capable of swimming "*for hundreds of miles without ice, it [has] to hunt on the ice floes*" (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 40). Long stretches of open water will change its migration route:

"Open water changes [the] migration of the polar bears. When there's straight open water, there's no polar bear. When ice comes in from the north, solid ice, there's the polar bear!" (D. Nasogaluak [Tuktoyaktuk] in Slavik et al. 2009: 44)

Natural habitat fragmentation can also occur when there is too much solid ice or the ice is frozen so thick that polar bears cannot hunt seals from their dens or breathing holes (Slavik 2013). Joe Nasogaluak ([Tuktoyaktuk] *in* Hart *et al.* 2004: 73-74) referred to this as "*piilauyuq tariuq*". These conditions require bears to travel to better hunting grounds in search of better sea ice or availability of prey.

The disappearance of large pileups (typically referred to as icebergs) and significant decline in multi-year ice has also resulted in habitat fragmentation, although this is typically attributed to

[231] "We have some scientists saying that bears aren't in [the old ice]. Yet my dad [Andy Carpenter Sr.] and all the elders I've talked to, we've sat down in meetings together and they say they've gone out there in the past with dog teams and that's where mainly the big bears are. Yet these guys, the scientists are saying there's no bears because it's not the proper habitat for them. It's all old ice, there's no young ice, so there'd be no seals. Well they should know that bears can go a long time without eating seals. Especially the big bears, cause they go and den for so many months, the females and even some males too. I think that's where we're having the biggest clash right now - we're telling them, 'okay, we want you to go and study this area, the main pack ice'. And they're like 'Oh we can't. There's no bears there so why would we do that' (L. Carpenter [Sachs Harbour] *in* Slavik 2013: unpubl. transcript)

[232] "When there's lots of open water you can't see bear because no ice is coming in…they only start coming later when the ice start getting thicker." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: 44)

the effects of climate change. This is significant, because in the past, icebergs played a crucial role in facilitating freeze-up by anchoring or stabilizing newly formed young ice, especially when they grounded in shoal areas closer to shore (JS 2015). An Inuvik elder reflected:

"[W]hen they used to cross back and forth between Banks Island and the mainland, they would see large icebergs blackened by mud and sand as a result of being stuck close to shore or grounded on shoal areas. They no longer encounter this type of ice." (JS 2015: 166-7)

Participants in the Joint Secretariat study (2015) from across the ISR concluded that as a result of climate change, there is no more multi-year ice anywhere in the southern Beaufort Sea along the coast of the Yukon and NWT, nor in Amundsen Gulf off the coast of Ulukhaktok (JS 2015):

"Like grounded ice, thick multi-year ice has a stabilizing effect on thinner, first-year ice that prevents it from being rubbled by winds and currents. Multi-year ice also has a calming effect on ocean waves and swells, which reduces breakage and rubbling of the ice. Several hunters discussed the role that multi-year ice once played in "gluing" the new ice together and making it safe to travel far out from Cape Parry on the mainland towards Nelson Head." (JS 2015: 167)

Beyond being important to stabilize ice formation, multi-year ice also provides a stable platform for camping, especially when it is grounded in shoal areas, and helps to stabilize waves, which facilitates travel with small boats for Inuvialuit harvesters (JS 2015).

Knowledge holders from Tuktoyaktuk observed that multi-year ice had "disappeared from the coastal area north of Tuktoyaktuk by about 2000" (JS 2015: 168). When the research was done for the Joint Secretariat study (2015), old multi-year ice was far offshore of Banks Island and could no longer be reached by snowmobile. However, multi-year ice could still be found in the Prince of Wales Strait, Wynniatt Bay, and the M'Clure Strait area between Banks and Melville islands (JS 2015).

Indigenous and community knowledge indicates that this fragmentation of sea ice is amplified by climate change and industrial activity. This is discussed in the following section on *Habitat Trends*.

Habitat Trends

Indigenous and community knowledge indicates that polar bear habitat is changing in association with climate change. Starting in the late 1980s, Inuvialuit began to notice significant environmental changes, including warmer winter temperatures, changes in the timing of freeze-up and break-up, shrinking multi-year ice, fewer icebergs, thinner winter sea ice, increasingly frequent and severe fall storms, more hot weather during the summer, low summer water levels, unprecedented summer thunderstorms, melting permafrost, mudslides,

soil erosion, and other significant environmental changes (Reidlinger 2001; CWS 2010; JS 2015).

Rising temperatures associated with climate change are resulting in a slower rate of ice freezing, so that open water does not freeze over as fast as it did in earlier days (Slavik *et al.* 2009)[233]. People in the communities are noticing that freeze-up is later (CWS 2010) because of warmer temperatures, strong winds, strong currents, and absence of multi-year ice to anchor ice formations (Reidlinger 2001)[234]. Likewise, spring break-up happens earlier with the warmer temperatures (Slavik *et al.* 2009)[235]. The shore-fast ice breaks up earlier in the spring, potentially taking seals out with it (Slavik *et al*. 2009)[236].

Reidlinger (2001) discusses general changes in sea ice based on observations from Sachs Harbour residents:

"Changes in the timing and rate of freeze-up and break-up, or ice consolidation and ablation events, are seen by the Inuvialuit as indicators of changes in the overall weather of the region, or climate. Everyone who commented on ice spoke about earlier break-up, later freeze-up and a

[233] "I don't know the conditions right now, but I feel there must be a big change right now with the climate change. Before, the weather was really cold, 50-60 below when I was growing up, and it was really different and now, because there's always ice in because of cold weather - it freezes overnight when it opens up. Things like that and it's plenty full of bears when it's like that. But now it's like, I hear from hunters when they go out, that it's open water and it doesn't close up anymore. I do feel, that when we stayed at Baillie Island, some years there's lots of open water. When there's lots of open water there's hardly any bears until the ice start getting thicker. When the ice start getting thicker, the ice start getting further and further piled up, that's when the bears start coming in, because it freezes right away because the ice is thick. And the bears start coming in more after that. In the fall time before that, it takes a long time for a bear to come to the shore cause there's too much open water. So, the way that I hear, there's more open water than before. So there must be hardly any bears coming to the shore when it's in that condition." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[234] "There is a lot of difference if there is not ice out here in the fall time. It doesn't freeze-up for a long time because you always have wind smashing up the ice and taking it out. When there used to be ice quite a few years back it used to freeze up right away. But now there is no ice out there, nothing to hold when the ice is formed. It just keeps breaking with the wind." (J. Lucas Sr. [Sachs Harbour] *in* Reidlinger 2001: 60)

[235] "We've got extensions on both sides. Spring, two weeks earlier than used to. In the fall time, two weeks later. So we have a one month extensions of thawing out the ice. We used to have a lot of ice floes before that happened. The ice melting away now, and that's what I'm worried about." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[236] "Now you got global change so the weather temperatures get pretty warm. You see the ice take off earlier - right to the shores too. And that takes most of the seals out. There's thousands and thousands of seals in the springtime when they first come up in the cracks, but the ice is still there. But all those seals take off with the ice floes. And most of them go, so there's not very many left because, they probably come back later on. But when you go to Horton River with a boat now. You hardly see any seals. Hardly nothing! You might see one or two, but that's about all - really hard to see seals now. Not like long ago they were right among the ice floes. In the 1950s there was big ice all over the place. Now you don't see that ice anymore cause they take off with the ice. They go with the floe once the ice take off, most of the seals. But I don't know where the float take them - might be straight out." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

subsequent longer ice-free season, as well as increased variability associated with these events. Earlier break-ups are more noticeable than later freeze-ups, but both events are considered to have changed… While the timing of the spring break-up has changed what is more noticeable is the rate of this event. Break-up is occurring earlier and faster. Once the ice starts breaking up, it goes out right away. Now when spring comes the leads open up faster because of the weather and boat travel is possible by early July." (p. 59-60)

Wind and currents are key natural drivers that shape polar bear habitat by opening leads and causing pileups (Hart *et al*. 2004; Slavik *et al*. 2009)[237,238]. Some hunters have observed a change in direction of prevailing winds (Slavik *et al.* 2009; Slavik 2013)[239,240]. Winds blowing in different directions and at different speeds can lead to open leads or pile-ups (both potentially suitable habitat for polar bears), or large areas of open water as the ice moves away from shore (potentially unsuitable and inaccessible habitat) (Slavik *et al*. 2009)[241,242]. Climate change combined with strong currents and winds can cause positive feedback loops. For example, with less sea ice, the winds can be stronger. And with thinner ice, the currents can more easily break the ice up (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009)[243]. According to recent observations, there has been a lot more open water in the last few years, with the exception of 2008-09 (CWS 2010).

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[237] "It's ice conditions, wind. If there's no good ice there, polar bears make a living someplace else - like me!" (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al.* 2009: 39)

[238] "If it's ice or open water, when there's too much wind the ice is steady piling up - it's never the same after the wind shifts. It's ever-changing! You can't just take a picture one time and expect it to be the same after a wind or a storm. It's forever changing." (M. Kudlak [Paulatuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[239] "Nowadays too, you notice that we have a lot of different winds than when we were growing up. It used to be mostly west and east. A lot of time we used to have mostly west winds, which pushes all the ice in. Now you get a lot more east wind than west wind, so you have a lot of open water… Our winds are not the same anymore!" (C. Gruben [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[240] "Our winds here for years have been [west-ward], they're switching now they say to more Northwest. But west-wind coming from the east. Now it's northeast, an east wind. It used to be our prevailing winds, cause you could see the drifts would always go like this, now they're going more from the northeast." (L. Carpenter [Sachs Harbour] *in* Slavik 2013: 81)

[241] "A lot less grounded ice out there nowadays…the winds are different today…east winds open it up, cause there's less west winds nowadays. Like Chucky said there's a lot of open water." (L. Emaghok [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[242] "When the ice, in Paulatuk, we get a lot of North winds for three or four days and the ice piles up. The seals, they have breathing holes in these little bays… Close to the land, when it's a north wind, they have permanent holes close to the beach. But other years when it's not as rough they're more out. North wind always helps the ice in that area - same as the east wind that blows it out… It's good for [bears] for seals, but for us, we can't go unless - we're getting to a point where we need a boat and paddle because there's so much open water now." (M. Kudlak [Paulatuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[243] "And I believe that it's the weather conditions right now that changes everything. It could change a lot of things like current, the current could get stronger and open it up because ice is so thin now, and for that matter, the cold doesn't reach the water anymore, it can stay warmer and easier to open." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: 46)

People from all coastal communities have noticed a decline in the number and the size of pressure ridges – a key ice feature from which bears hunt seals. This is attributed to thinner ice and increased ice movement (Reidlinger 2001; Slavik *et al*. 2009; CWS 2010)[244,245,246].

Inuvialuit have been noticing a decline in multi-year ice since the late 1980s and attribute it to climate change and increased activity in arctic waters (Slavik *et al*. 2009; Reidlinger 2001)[247,248] (see *Habitat Fragmentation* for additional discussion on multi-year sea ice). The presence of multi-year ice helps to freeze everything and create good habitat for polar bears, as well as for hunters to travel (Slavik *et al.* 2009)[249]. Hunters in Tuktoyaktuk commented recently that they no longer see multi-year ice (Slavik *et al.* 2009)[250], while in Sachs Harbour, they no longer see multi-year ice floes in the summer (Reidlinger 2001; Slavik 2013)[251]. While multi-year ice remains off the west coast of Banks Island, it is no longer as close to shore (Reidlinger 2001; Slavik 2013)[252]. A decline in multi-year ice along the west coast of Banks Island may be

[244] "Several people in the community described seeing less local pressure ridges now because of thinner ice and more ice movement; one man commented that they cannot really be called pressure ridges anymore, 'just piled up ice' (J. Keogak [Sachs Harbour]). One woman described how the pressure ridges now are smaller, likely in the same sense." (*in* Reidlinger 2001: 62)

[245] "There have been changes over the past forty years in our area. In the 1960s there used to be more pressure ridges on the sea-ice. These are good areas for polar bears to hunt seals. Today, there aren't as many pressure ridges out there. There has also been a large decline in seals in those areas." (summary of Paulatuk consultation *in* CWS 2010: 92)

[246] "And the ice not thick enough to pile up nowadays. Long ago you used to see mountains of ice. But you don't see that anymore, because ice is not as thick. We used to get 7 feet thick ice sometimes when it packs up. You could go, just like climbing a mountain in some places. I don't think you see that anymore out in the ice." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: 45)

[247] "So much wind and warm weather…[started to change] around the 80s. Late eighties I guess." (P. Ekpakohak [Ulukhaktok] *in* Slavik *et al.* 2009: unpubl. transcript)

[248] "[I stopped seeing multi-year ice] when all those ice breakers and submarines started coming. That's when it started I believe. They've got icebreakers here from three or four different countries… And the way they go through that ice is to look for open leads. If you leave that open lead alone it's going to freeze up and build-up ice again. But if you keep going into those leads and keeping them open, of course they're going to go someplace." (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[249] "… like Fred said, when there's open water there's no bears. And it never froze all winter out there. Just cause of the ice conditions, there's no more multi-year ice to kind of freeze everything, and there was no bears last year." (L. Emaghok [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[250] "Even 10 years ago you could go further off shore because there was some multi year ice. Up until about 10 years ago, I used to go out yearly, I used to see quite a bit of multi year ice until then, and now I never see any. And because there's no multi-year ice, you can't go as far, where the polar bears are as abundant, way out on the open ice." (L. Emaghok [Tuktoyaktuk] *in* Slavik *et al*. 2009: 45)

[251] "The ice floe of Banks Island this summer, no more ice floes, and they're really high when you're approaching to Sachs Harbour and you don't see nothing, a few chunks of ice further north from the west coast of Sachs Harbour. The means it really change a lot. That ice used to never melt the whole summer when I was there from 1960 to 1970… Now you can barely see some ice floes from way out the north side. Probably north side only gets the ice floes. That's hurting the polar bear migration." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 45)

[252] "I don't see anymore old ice - last I heard there was old [multi-year] ice, closest was probably up here [Gore Islands]." (L. Amos [Sachs Harbour] *in* Slavik 2013: 104)

contributing to changes in polar bear migration there (Slavik *et al.* 2009)[253]. There is also awareness that as ice melts in the southern Beaufort Sea, bears will migrate further north (Slavik *et al*. 2009)[254].

As multi-year ice is being lost, it is being replaced by annual ice. Pat Ekpakohak comments on how the ice in the Amundsen Gulf is changing and the impact this has on hunters:

"…the other thing I know is between the Paulatuk area and the Nelson Head area, there's no old ice - there's no pile-up ice. "Manilap" they call it, rough ice… It used to be smooth [ice] all the way [to Nelson Head], good ice. Now we can't even go out there straight from Holman anymore… When I used to go out to Nelson Head long ago, when you go down here, you start seeing Cape Perry area without hitting the rough ice. Now you can't even go out here in the winter time… It's all open water and rough ice. So much wind and warm weather… [started to change] around the 80s. Late eighties I guess." (P. Ekpakohak [Ulukhaktok] in Slavik et al. 2009: 50)[255]

As noted in *Habitat Availability*, although multi-year ice is disappearing, "annual sea-ice will still be available for polar bears" (CWS 2010: 11). In fact, many hunters believe that an increase in annual ice, as it replaces multi-year ice, will be advantageous to polar bears (CWS 2010). Polar bears are also seen as being very adaptable. In 2009, some Inuvialuit commented that they believe some polar bears will adapt to climate change and changes in sea ice: "they will learn how to change their diet and possibly live on land; bears have adapted to survive on sea and land and will adapt to climate change" (CWS 2010: 11). With regard to adapting to changes in habitat, some Olokhaktomiut have commented:

"Polar bears are constantly moving from one area to another. One year, you may not see any polar bears and the next year there are many. Elders in our community have expressed similar events from their time. Some years polar bears are entirely out on the sea-ice and then other years they have been on the land. Polar bears have adapted to survive on the sea-ice and on the land. There shouldn't be a concern about polar bears adapting to survive on the land; they already are adapted." (CWS 2010: 88)

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[253] "The west coast of Banks Island used to be just white - never melt - the last ten years when I was there. Now you can barely see some ice floes from way out the north side. Probably north side only gets the ice floes. That's hurting the polar bear migration." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al*. 2009: 45)

[254] "They change because the ice bergs are melting from the south. They're further away from us now and there's hardly any icebergs. There's no multi-year ice. It's melting due to the extended summer season, and they are going further north. Migration changes for that too… Lots of animals, not only polar bears, are changing their migrations." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[255] "People used to be able to travel all the way from mainland to Nelson Head (Banks Island) ice conditions were so good. Really depends on ice conditions. Sandy Wolki said best way to get bears is to go straight out into the ice until you can't see Whalehead anymore. It's very scary to leave so far away from the mainland, but that's where you'll see bears, and it's true. But fewer harvesters going out so far or spending enough time out there. Further offshore the more bears you'll see." (Nathoo pers. comm. 2020)

Observations concerning changing sea ice and weather conditions and other climate change effects were documented in the context of the Joint Secretariat study (2015) (see page 162):

- *Freeze-up occurs a month later than it did previously, and break-up occurs a month earlier*[256]: These observations about changing freeze-up and break-up times are consistent throughout Inuvialuit territory, though there is still much annual and regional variability in freeze-up and break-up timing (JS 2015). An Ulukhaktok elder commented that changes in the timing of freeze-up and break-up appeared suddenly in the 1990s (JS 2015). Even after freeze-up starts, warm conditions, strong winds, ocean swells, and stronger currents may open up the ice again. When the ice finally does form, it does not thicken fast enough to permit safe travel until later in the winter (JS 2015).
- *Warmer winter temperatures*: Inuvialuit in Sachs Harbour used to experience -50°C temperatures in December, which was excellent for ice formation. Such extreme low temperatures are now rare.
- *Land-fast ice is thinner, and wind and currents can easily break it up and rubble it*[257,258] (for discussion on the sea ice conditions that constitute good polar bear habitat, see section on *Habitat Requirements*).
- *Ice does not ground on shoal areas the way it used to because it is thinner*: Huge (up to 40 ft.) pileups of thick ice are no longer seen where they have traditionally appeared, grounded in the shallow waters (JS 2015). As noted earlier, this grounded ice stabilizes larger ice formations, preventing winds and currents from breaking it up and producing rubble ice. Annual ice in harbours is weaker and thinner, and therefore, less safe for travel (Reidlinger 2001).
- *There have been significant reductions in multi-year ice in many parts of the Beaufort Sea region* (Reidlinger 2001; Slavik 2013; JS 2015).
- *Floe edges are closer to shore and less predictable*: Floe edges and areas of open leads that were once fairly predictable and occurred in more or less the same places from one year to the next have changed or else cannot be reached on snowmobile due to excessive rubbling of the ice (JS 2015).

[256] An Inuvik participant who spent many years on Banks Island talked about the 1950s, when there was still enough sea ice in the bay in front of Sachs Harbour on July 1 to have dog-team races; multi-year ice would drift into the shallow shore areas, and huge "icebergs" would ground there as well. Some years, sea ice stuck around all summer. Winter temperatures were extremely cold, unlike today." (JS 2015: 163)
[257] "[I]t's not thick enough, and that's why it turns to rubble ice. Unlike the old days, when it's cold. Now, any kind of wind you get out there, it just moves the ice along and it's really rough." (PIN 164 [Paulatuk] *in* JS 2015: 64)
[258] "Until the 1980s, Beaufort Sea ice used to freeze at least seven feet (two metres) thick, and stay solid well into the spring." (JS 2015: 163)

- *Changes in distribution and extent in local pressure ridges*: Pressure ridges that used to form predictably in the same location from one year to the next are no longer there (Slavik 2013; JS 2015)[259].
- *There is more open water (and rougher water) than ever before*: It is no longer possible to travel straight out on the ice from Ulukhaktok towards Nelson Head because of open water and/or unsafe ice conditions. Similarly, people can no longer travel any great distance north of Cape Parry towards Nelson Head or from Ulukhaktok south toward Clinton Point on the mainland (Slavik *et al.* 2009; CWS 2010; Slavik 2013; JS 2015).
- *Changing wind patterns*: Winds shift unpredictably across a number of directions, where prevailing winds used to persist for many days (Reidlinger 2001; Slavik 2013; JS 2015). As noted earlier, prevailing winds have been observed to have shifted from a westerly to easterly direction[260]. In addition, wind velocities have increased noticeably, according to hunters from Aklavik, Paulatuk, and Ulukhaktok, as has the frequency of strong winds and winter and summer storms (JS 2015). Changing wind patterns and velocity affect the speed of freeze-up and break-up each year. Wind direction is an important variable in creating good polar bear denning conditions and is "a key factor in Inuvialuit wayfinding when travelling and harvesting" (JS 2015:170). Wind patterns and velocity are also linked to "deteriorating ice conditions that are often too unsafe to permit travel and polar bear hunting" (JS 2015:170).

Since the mid-1980s, Inuvialuit have observed and been impacted by substantial climate-related change in Beaufort Sea ice conditions and weather systems. Later freeze-ups, earlier break-ups, warmer temperatures, thinner ice, stronger multi-directional winds, and other effects have "complicated the already dynamic nature of this complex interplay between weather, ice, seals, and polar bears, adding more unpredictability from an Inuvialuit harvesting perspective" (JS 2015: 53)[261].

Knowledge holders confirm that sea ice is changing but also state "with equal vigor that ice conditions have always been highly variable" (JS 2015: 212). The 2013 PBEC workshop concluded that: "there has always been annual variation in sea ice conditions, and as a result

[259] One Sachs Harbour hunter said that polar bears have had to change their hunting methods due to the absence of pressure ridges (JS 2015: 111).
[260] "Westerly winds also bring polar bears toward the landfast ice nearer to the community, at which point hunters head out in search of them. With climate change, easterly winds — which separate the bears from Inuvialuit hunters — are much more common." (JS 2015: 179)
[261] "In general, study participants agree that not only has their climate become warmer and the Beaufort Sea increasingly ice free over the last twenty or thirty years, but the weather has become increasingly unpredictable. Formerly, Inuvialuit could use TK [traditional knowledge] to forecast the weather, but such techniques are now less reliable." (JS 2015: 172)

the numbers, distribution and condition of polar bears has varied as well…[emphasizing that] *everything depends on annual ice conditions* [emphasis added]" (JS 2015: 186).

Distribution Trends

This section describes evidence for changes in the distribution (or range) of NWT polar bears.

Moving Further Inland

On rare occasions in the past, polar bears could be found below the tree line south of the coast (Slavik *et al*. 2009)[262,263]. Although still relatively infrequent, in the past decade there have been a number of publicized cases of polar bears being observed south of the treeline. A female polar bear with two cubs travelled more than 400km south of the Beaufort coast into the Great Bear Lake (Délı̨nę) area, and a solitary male polar bear travelled to the Ft. McPherson area (CBC 2008). There was also a sighting of a polar bear in Old Crow Flats (Yukon) within the last decade (Frost *in* SARC 2012: 19). More recently (July 2020), a polar bear was observed across the Arctic Red River from Tsiigehtchic (CBC 2020). While polar bears are known to make shortcuts across land, they are not generally known to travel this far south (Slavik *et al.* 2009)[264,265], although the above-noted observation was not the first time that polar bears have been seen at Great Bear Lake (Bayha pers. comm. 2012).

On Banks Island, bears can occasionally be seen around the middle of the island during the fall or summertime (August to September), but otherwise are usually known to stay near the coastal areas of the island. According to observations, these inland incursions have generally been made either by denning females, or by young or sub-adult male bears that were thought to be portaging or taking a shortcut across land (Slavik 2013). Elders in Sachs Harbour said that in the past they did not hear of bears travelling inland, but "*now you'll see that a little more often*" (A. Carpenter [Sachs Harbour] *in* Slavik 2013: 95).

Coming into Towns

Many of the sightings made by Inuvialuit are of bears that wander into communities. In Sachs Harbour, the bears that wander into town are generally curious, young (2-3-year-old) bears, or

[262] "17 years ago I found, about 30 miles inside the tree line, I found a little four and a half foot polar bear. It was feeding on a wolf kill! The wolf been killing a moose and that little four and a half foot bear was eating the moose head. I went back a week later and it was lying dead beside the moose. I guess the wolves came back and killed the little bear." (C. Gruben [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[263] "In Paulatuk they got one two years ago [2007], about 11 foot, just near the tree-line, just plowing through the deep snow in the wintertime. Didn't have much fat, but it was a big 11 footer." (M. Kudlak [Paulatuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[264] "…that's the first I start hearing of bears going inland like that [as far as Aklavik and Deline]" (F. Wolki [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[265] "It's new I think, when the bears was around Aklavik, we've never seen that before" (E. Storr [Aklavik] *in* Slavik *et al*. 2009: unpubl. transcript)

hungry bears (*katyaaq*/*kayangnituk*) in poor health (Slavik 2013). In the past, when the community of Sachs Harbour was established, there used to be "a lot of bears" in the fall, as they were curious about the new settlement and were attracted to the seal carcasses brought in by hunters in the community (Berger 1976h)[266].

The Joint Secretariat study (2015) documented that polar bear visits to Ulukhaktok, Paulatuk, and Tuktoyaktuk are rare, and visits to Aklavik and Inuvik are extremely rare given their locations far up the Mackenzie River delta, beyond polar bear habitat. In Ulukhaktok, it was "not too common" to have bears coming into settlements until the late 1960s, and "these fortunately weren't polar bears that were terrorizing the people" (Berger 1976e)[267]. In Tuktoyaktuk, it was "*very seldom that a bear that would come into town - once every ten or twelve years*" (F. Pokiak *in* Slavik *et al*. 2009).

The number of polar bears observed near some communities may have increased in recent years. More bears are being seen along the coast near Tuktoyaktuk in the fall in recent years (JS 2015). One of the Paulatuk workshop participants said that he had seen a polar bear near the community only once since he moved there in 1975, while another said they had seen more[268]. However, the Joint Secretariat study (2015) concluded that there have been no increases in the frequency of visits by polar bears to camps and communities, with the exception of Sachs Harbour. In contrast to all the other Inuvialuit communities, Sachs Harbour has experienced many more visits from polar bears in recent years[269], which is attributed to the prolonged open water season in the fall (JS 2015). Although a consensus on this matter is not clear, there is consensus that the number of bears coming to a community fluctuates seasonally depending on ice conditions and availability of food (Slavik 2013). Voorhees *et al*.'s (2014) study in the Chukchi Sea region yielded similar findings:

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[266] "In the fall there was a lot of polar bears there [at Mary Sachs, Banks Island]. Our parents never let us play out because polar bears came from all directions. I think the bears were hungry, but we had a lot of seals piled up and this is where the polar bears used to come and eat. The men would never go out looking for polar bears to kill, they would kill them when they got them right to the houses." (P. Gruben [Tuktoyaktuk] *in* Berger 1976h: 4306)

[267] "There also was a few nuisance polar bears that have been coming around to the settlement and up until about 10 to 15 years ago it was not too common to find a few polar bear coming into the settlement, and these fortunately weren't polar bears that were terrorizing the people at Holman." (R. Goose [Ulukhaktok] *in* Berger 1976e: 3974)

[268] "We had to kill a couple back then in the community, polar bears… Back in the '80s. Since then we've never seen polar bears come into town. Other than the one Bobby got on top, inland… There was another one, mid-'90s or early 2000s. They ran into bear tracks… But I've never heard or seen any problem polar bears since [the] '80s… I heard a couple days ago or last week, that they shot a polar bear, a problem bear, in Sachs Harbour, two or three weeks ago." (PIN 160 [Paulatuk] *in* JS 2015: 188)

[269] "Recently, since the PBTK [polar bear traditional knowledge] study interviews concluded in the fall of 2010, there have been more sightings along the coastline of Banks Island near Sachs Harbour, as well as visits to the community." (JS 2015: 88)

"Bears are sometimes encountered within village boundaries. The condition of these bears varies: some are fat, and some are skinny. Hunters say that many of the bears that venture directly into town are simply young, curious, and inexperienced, rather than starving. They suggest that bears may be coming into villages for three reasons: because they have been orphaned and lack knowledge of how to survive, because diminished – and sometimes absent – shorefast ice brings polar bear habitat closer to the village, and because bigger bears may be forcing weaker or younger bears into marginal habitat." (p.528)

Moving North

A consistent statement made by sources in all NWT coastal communities is that polar bears are adjusting their range further north and further out on the multi-year ice (Slavik *et al.* 2009; summary of Tuktoyaktuk consultation *in* CWS 2010; Slavik 2013)[270,271,272,273]. The common belief is that polar bears are doing this as a direct result of climate change, observed as an extension of the summer season and changes in the sea ice, including lack of summer ice floes (Slavik *et al*. 2009). Several elders have commented that polar bears are changing their migrations and will travel further north to follow the colder temperatures and more favourable ice conditions (Slavik *et al.* 2009)[274]. Pat Ekpakohak ([Ulukhaktok] *in* Slavik *et al.* 2009: unpubl. transcript) has observed that:

"...because of the ice, like ice conditions and weather conditions, the polar bears are moving up north more. More in the North, I know that! Every time I go to Prince of Wales in the springtime, north of the island, there's more [up] there."

[270] "Another thing is climate change. I said we got an extension from summer season. One month. That's what we call climate change. I don't believe in that global warming, it's the extension of the summer season, we get one month extra for summer. That's why the ice melted and the animals go further north, they follow the cold temperature." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)
[271] "Another important thing that I heard you say is that polar bears are heading North because of the climate change. And that's right because they gotta go somewhere to live!" (E. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)
[272] "And we hardly get, like this last few years, there's been hardly any ice flow and that's a big sign of climate change. And [the bears] are starting to move more North. You get a few inland. Climate change is just the big thing - it's all over the world." (T. Lennie [Sachs Harbour] *in* Slavik 2013: unpubl. transcript)
[273] "There haven't been any polar bears migrating through our area this year; they are moving further north." (summary of Tuktoyaktuk consultation *in* CWS 2010: 84)
[274] "The polar bear especially lives in a colder temperature than any other animals, so they follow the cooler temperatures, they go further north. Due to the global warming, but there's no global warming, summer seasons get warmer that's all. That's what the animals, even the caribou gets lots of disturbance, with the caribou, with the extension. Lots of animal migration change with the global warming, but I say the summer season longer. Lots of animals, not only polar bears, are changing their migrations." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

Hunters from Tuktoyaktuk believe bears prefer not to stay on the mainland of the NWT (Berger 1976i; Slavik *et al*. 2009)[275,276] and that "*bears don't come in [to shore] anymore because there's too much water, unless they swim across*" (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: 22).

"When there's too much open water, there was no bears around. Cause they'd rather hunt [on] not moving ice. The only ones that come to the shoreline are the small ones, like the females and young males, that go through the shearing zone [floe edge]. You go further out, you see big ones. And they stay out there, they don't come to the shoreline… But if there's too much water, they rather prefer staying where there's no movement of the ice, where there's cracks… Maybe about 50 miles out sometimes. That's where the bears are! They don't come to the shoreline anymore sometime - there's too much water" (F. Wolki [Tuktoyaktuk] in Slavik et al. 2009: unpubl. transcript).

Polar bears are also following their food source, seals, which are migrating to different areas: "*Where the seals are, that's where the polar bears are - and the polar bears know the country! They know where their food is, that's why we don't see them much anymore*" (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript). Stronger currents and changes in the ecosystem are causing seals to move to different areas to get their prey, and polar bears to follow (Slavik *et al*. 2009)[277].

As polar bears travel further out, it gets harder for hunters to access them (Reidlinger 2001)[278]. Because hunters' observations and search efforts are also limited by climate change, many of

[275] "Polar bears always stay on the ice [but] they never stay one place. Like Arctic Islands they could stay, but he don't stay on the mainland side - too warm for them. They go further north where the ice is." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al*. 2009: unpubl. transcript)

[276] "Hunting polar bears, they go out on the sea to hunt bears because polar bears don't usually go too much inland. Of course, once in a while, you see polar bear across the country but they don't live up here. They live out in the open sea" (G. Ruben [Paulatuk] *in* Berger 1976i: 4433).

[277] "And for that matter, I think that the climate change makes the bears go out. If the water's warm, there's more current than used to be. You could notice that every spring, when the weather gets warmer you see the current start to get stronger! That's probably what's happening. And if there's current there's a lot of stirring of seafood. That's where the seals are eating… But if that current is taking them somewhere and the seals follow the food just the same way as a polar bear follows its food. They probably go somewhere else. And the seals are following their food to where it's plentiful. So that's what I think. And where the seals are, that's where the polar bears are - and the polar bears know the country! Just like us, we travel on land and we know where we are. And they know where their food is, that's why we don't see them much anymore." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[278] "I think eventually the bears are going to get further. Even the polar bears they hunt where there is really thin ice, where there is a lot of seals. They wouldn't hunt like up here where there…the seals are going to be where there - where they feed. I kind of find a difference…you know…within the 10 years I was…within the 30 odd years I been doing this. Polar bears are getting further out. We are left up here hunting and they are out there… [We can't get there]…because there is open water out there…there is a crack up here that you can't pass really because it is too thick." (J. Lucas [Sachs Harbour] *in* Reidlinger 2001: 64)

the statements above are inferred through Indigenous knowledge and cultural beliefs, reinforced by experience, that animals will constantly be changing their range.

Denning Locations

The 2013 PBEC workshop concluded that Inuvialuit are seeing changes in the locations of maternity dens due to changing wind and snow conditions (JS 2015)[279]. This comment was made regularly about denning locations on Banks Island[280] and in the Nelson Head area:

"When I started going here [Nelson Head to De Salis Bay area, '70s and '80s] with dogs, I used to see quite a bit of dens. Quite a bit, but I never see them anymore. They must go more high up to the land… Elders used to tell me a lot. You could see dens anywhere, but not anymore… You don't see them anymore [south side of Prince Albert Sound]. Maybe they moved their dens somewhere, maybe higher up." (PIN 121 [Ulukhaktok] in JS 2015: 186)

However, observations of polar bear dens are limited by changes in harvesting ranges and search activities (see section on *Denning*), and contemporary knowledge of maternity den locations is constrained by the fact that hunters no longer use dog teams to tend traps along the coast (JS 2015)[281,282,283].

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[279] "No more snowbanks. Right down to the ice, right down there; it's finished. So, [they] go elsewhere on the mainland to have the young ones, somewhere at the rivers or the banks, some place where there's a little bit of snow… Lots of change down in Cape Parry. I was born up there and in them old days when I was growing up, lots of east wind. Nothing but east wind, out there… What happened to the east wind? We are getting more and more north wind now. That's changed to north, from east to north now. Big north wind now. And that's why it quit building up snowbanks on the west side of Fiji there. East wind, it build up the snowbanks. North wind it's, phhh, nothing now, no snowbanks build up there." (PIN 164 [Paulatuk] *in* JS 2015: 186)

[280] Long ago there use to be a lot of denning areas here. I know all around the coast, when you travel even up on land you used to run into dens in November, when they first start going, this time of year, late October, first part of November… But now you hardly ever see that anymore. … But now we don't really travel that often. There is a few here and there that we see in the late spring that come out… Not as much as back then [in the] '70s, '80s… Some of the bears that have dens up inland, they're coming out way earlier, like say two, three weeks earlier than we used to start seeing them in the middle of May. Now you start seeing them in March. It kind of dawn on us that travelling in March, you don't expect to see a mother bear with cubs until the middle of May, or third week, or first part of, but now you start seeing them third week in March, heading out to the pack ice… I mean it's kind of unusual for us, 'cause we used to see them in second week of April on, that's what it was." (PIN 132 [Sachs Harbour] *in* JS 2015: 185)

[281] "As a hunter we're not looking for dens. We just accidently run into them, or when you're going through a bank where there's usually a den. If [it's a] high denning area, well then you watch for that, because you don't want a bear charging out of the den at you. So it's just by chance a lot of the time, and if you see a track [of a] mother and cubs going out, then you just backtrack them…to see where they came out. That's how you're able to identify these ones here." (PIN 43 [Tuktoyaktuk] *in* JS 2015: 187)

[282] "There is no differences in the dens, but nowadays, it's hard to tell, because we don't see them or there's not enough snow out on the ocean… When he lived on Read Island, he knows there used to be dens year after year, but nowadays, there are no more dens there that he has [not] heard of or seen there. I think the same at Ramsey Island, too. It must be the same thing… We don't use dog teams anymore. We're very different now, so it's hard… We used to tell with dogs; the dogs used to smell it…

The Joint Secretariat study (2015) documented changes in denning observed across communities:

- *Ulukhaktok*: "In the Ulukhaktok area, a number of former den locations have been abandoned because prevailing winter winds shifted to the east and snowbanks suitable for denning have not formed there. Hunters used to find dens in the Ramsay Island area with the help of their dogs in the old days, but this area no longer has much snow and therefore no dens. Recently, less snow in some areas may explain why females and cubs have been seen emerging from their dens a little earlier than normal (i.e., March). Even though there was little snow one year, hunters encountered a female and cubs on multi-year ice in the Wynniatt Bay area and surmised that they may have been denning in the snow accumulated alongside a glacier there. A number of valleys on Victoria Island may be good for denning because of accumulated snow, but Ulukhaktok hunters do not travel in the area and as a result, they cannot confirm the existence of dens there." (JS 2015: 189)
- *Paulatuk*: "With shifting winds, Paulatuk hunters have not seen dens on Fiji or Booth islands in the Cape Parry area for the past ten years. One of the Paulatuk workshop participants said he recently saw a den on the east-facing slope of Fiji Island that he had never seen before, and he was anxious to return to see if denning was still occurring there. An area by Pearce Point looks as though it would be a good denning location, but the only people who travel that way are going out to check Distant Early Warning (DEW) Line sites, and they have not reported seeing any females, cubs or dens there." (JS 2015: 190)
- *Tuktoyaktuk*: "Tuktoyaktuk workshop participants reported that they get a lot of snow in their region, but the timing of it varies annually. Although they do not experience the high winds that Ulukhaktok does, the prevalence of open water late into the fall may have an effect on coastal snow accumulation. Without ice, snow cannot drift ashore to build up along the bluffs. They have incomplete knowledge concerning den locations these days because few people travel the entire coastline after freeze-up, which would put them in a better position to observe dens. Despite this change in land use, however, in recent years they have observed female polar bears heading inland to den if there is not enough snow along the coast to support denning. One of the participants said that *'[p]eople have seen tracks even in the tree line. I have seen tracks between Inuvik and Tuk*

Snowmobiles got no sensor… Those dogs were the very important travelling equipment." (PIN 122 [Ulukhaktok] *in* JS 2015: 185)

[283] "Previously, dogs would sniff out dens along creek banks and in other locations where drifting snow accumulated." (JS 2015: 189)

in November, so if there is not enough snow, they go as far inland as they could' (PIN 161). The terrain along the shores of many lakes on the Tuktoyaktuk peninsula is steep, which creates good snowbanks and therefore good denning conditions. Females and cubs emerge from their dens at much the same time each year – end of March, April – as they did in the past. In general, over the years, this '*observation of polar bear dens along the coast never really changed'* (PIN 161)". (JS 2015: 190)

There is a broad concern that climatic conditions (wave action, erosion, and a lack of snow accumulation due to open water) may alter denning habitat (JS 2015) or render previously important habitats unsuitable (JS 2017). Harvesters in Nunavut have also reported that there is less snow accumulation in recent memory compared to earlier times, and this may affect denning (Dowsley 2005; KAVIK-AXYS Inc. 2012; COSEWIC 2018).

Threats and Limiting Factors

Several threats and limiting factors to polar bears and their habitat in the NWT were identified in the sources examined. The most serious threats identified are changes in sea ice habitat, offshore oil and gas exploration and development, and increased marine traffic (CWS 2010). Climate change is identified as causing or compounding each of these (CWS 2010). The combined effects of climate change with rapidly increasing development and activity in the Arctic are cause for high uncertainty and concern about cumulative impacts on polar bears and their habitat:

"Some reports state that [summer] sea-ice may be gone by 2030. If those estimates are accurate then there will be an increase in both industrial development and tourism within polar bear habitat. With less sea-ice in the future, Sachs Harbour residents foresee that there will be an influx of industrial development and tourism in the north." (CWS 2010: 97)

Climate Change and Changes in Sea Ice Habitat

As discussed in the previous sections, changes in sea ice associated with climate change, and impacts on polar bears, are being observed in the NWT. For example, one hunter observed that "*most of the polar bears aren't in good health right now [2006] because the rough ice has covered up the seal breathing holes, meaning the bears have to dig through three feet of ice to get the seals now*" (MPEG 2006: 32). The increase in open water due to a longer ice-free season and more open leads could also affect their health and diet (Slavik *et al.* 2009)[284]. Polar bears may change their range and migrations as a result of climate change (Slavik *et al.* 2009). Some of

[284] "That's the cause of it that you don't see too much bears because there's so much open water because of climate change. Everything changes when the weather gets warmer - the current gets strong and all that stuff is stirring up with seafood and things like that." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: 39)

these changes are already being observed (see sections on *Distribution Trends* and *Movements*). Inuvialuit believe that in response to changes in sea ice, as well as increased offshore activity and industrial development, polar bears will adjust their range further north (Slavik *et al*. 2009; CWS 2010; Slavik 2013). However, as polar bear movements are determined largely by the migrations of seals, their ability to adapt to more northern (or southern) ranges would be contingent upon the availability of prey species. If polar bears cannot hunt seals due to changes in sea ice, it will be difficult (but not impossible) for polar bears to adapt to hunt different prey (CWS 2010).

The adaptability of polar bears was emphasized by some Inuvialuit elders who believe that some polar bears will learn how to change their diet and possibly live on the land (CWS 2010). Others believe this would be very difficult, as they depend on seal blubber for the majority of their diet (Slavik 2013)[285]. However, while polar bears are adept at hunting and scavenging on land, there would likely be a decline in population before sufficient adaptation to new ranges could be made (Slavik 2013)[286].

Offshore Oil and Gas Exploration and Development

Elders who spoke during the Berger Inquiry in the mid-1970s (Berger 1976a-i) were in agreement about the impact that offshore oil and gas drilling would have on polar bears and their arctic habitat:

"Once that's polluted, if that water is polluted with oil, I mean that's it! That's the end of everything for us. We wouldn't have our fish and then on the Beaufort Sea itself the people wouldn't get the whales, the seals, and all marine life will be destroyed." (F. Greenland [Inuvik] in Berger 1976c: 3870)

Stories from long ago foretell of the impact this would have on local people, as told by Sam Raddi ([Inuvik] *in* Berger 1976c: 3461):

"For the people that want to drill on Beaufort Sea, Mr. Berger, I want you to take note of this. I spent a lot of time with my father, he is 74 years old, and his cousin, Phillip Nuviak, who is 84 years old. I have recordings from them on tapes that they tell me in their stories that the old-timers, their great grandfathers, would tell them that one day if the ocean, the Beaufort Sea ever lose its fish and wildlife, the whales, the fishes, the seals, the polar bears, the Beaufort Sea will

[285] "I don't know if they'll be able to survive up on land, like grizzlies or other bears. I'm sure they can, but what they really live on is the blubber of the seal. You know. Sure they'll eat meat and that, but they prefer the oil and blubber." (F. Lennie [Sachs Harbour] *in* Slavik 2013: 85)

[286] "They will change their ways because of global warming, you know - If this global warming continues, the bear will change its ways. Some are going to die of you know, starvation or drowning. But I believe there are a few that are going to survive because they are going to change their diet and learn to live of the land, such as muskox or some other carrion." (R. Kuptana [Sachs Harbour] *in* Slavik 2013: unpubl. transcript)

lose that, the natives - the Eskimos will have very little chance to survive... If they ever drill on the Beaufort Sea, if they ever have an accident, nobody really knows how much damage it will make on the Beaufort Sea. Nobody really knows how many fish it will kill, or whales, polar bears, the little whales and the bowheads."

Observation and acknowledgement of this threat began during the early oil and gas exploration period in the early 1970s. People in several communities witnessed a negative impact of seismic research and blasting upon seals (Berger 1976f and g)[287,288]. In North Star Harbour and Sachs Harbour, a decline in seal health associated with seismic research resulted in a decline in polar bear health:

"It was good all the time until the oil companies start working around here. He said it's so bad now that there's hardly any seals any more, and the polar bears are starving due to lack of food, no food around. He said there was even a couple that came right into the community and ate a live dog - that's how starving they were... He said from experience he learned that since they were blasting in the ocean the seals vanished since then. He said he think they die from they get so scared and some of them even get deaths from the blasting." (F. Carpenter [Sachs Harbour] in Berger 1976f: 4031)

Beyond the impact of disturbance from exploration and operations, there is the risk of a spill or blowout, which would be catastrophic to habitat and all species in the Arctic - including the Inuvialuit (Berger 1976g and h)[289,290]. As V. Steen ([Tuktoyaktuk] *in* Berger 1976h) shared at the

[287] "But just recently now since they have been doing the seismic work, meaning blasting around, he notice there have been some changes and one of the things that he really recognizes is the fact that the seal doesn't normally sink in the wintertime or in September because of all the fat, but now he finds out that when he shoot a seal it sink and that's an indication that the seal hasn't had enough to eat or is not healthy enough or something. It have to have lots of fat to float." (F. Wolki [Tuktoyaktuk] *in* Berger 1976g: 4146)

[288] "I used to come here and I used to get many foxes, many polar bears, and many seals in Banks Island. He's saying that now today, he said there's hardly - the seals have decreased to some extent, and the polar bears and the white foxes, they've gone away somewhere. He say the oil companies are come around here, the seals have decreased quite a lot. They die of something. I also have seen people who came home with these dead seals without no mark of any wound or anything from any weapon. That is why now the polar bears are dangerous today because they are hungry and they haven't got enough food to go around." (W. Kuptana [Sachs Harbour] *in* Berger 1976f: 4042)

[289] "If it happened to have a blowout they're going to be harming the animals in the sea like fish and seals and things like that, and if the fishes and seals are harmed by the gas or oil or things like that, then they're going to come down to polar bears and there's a shortage of food and things like that, not only animals will have a shortage of food but also the people that live up here." (A. Kimiksana [Sachs Harbour] *in* Berger 1976g: 4154-4155)

[290] "He also said that if the things from the oil company ever destroy the ocean water, they will be killing all the bugs that are in the sea, what the seals eat. He said that he know that since, they started blasting a lot of seals been dying. He said now that if they work some more, he said the polar bears will be next to go." (J. Wolki [Tuktoyaktuk] *in* Berger 1976h: 4180-81)

Berger Inquiry, an oil spill of any size would cause a chain reaction in the fragile Arctic ecosystem:

"If they drill out there, if they finish off what little whales are left, what little seals are left, what little polar bears are left, with one oil spill of any size big enough to hurt those animals, we're finished. The Eskimo population and culture is finished, because you have to live as a white man and you have nothing left. You have no more seals to feed the foxes. You got no more fish to feed the seals, and you've got no more seals to feed the polar bears, and the polar bears are going to go looking for some white men then, because they've got nothing left to eat." (pg. 4207)

Polar bears are a sensitive species with excellent senses (CWS 2010). Disturbances from increased development (sound, smoke, etc.) will scare bears away and impact their migration (Berger 1976h; Slavik *et al.* 2009)[291,292]. Conversely, if there are starving bears, they may be attracted to camps, which would pose a threat to themselves and to people (Slavik 2013). Industrial activity near the shoreline can interrupt bears' denning cycles or cause them to abandon their young cubs (Slavik *et al.* 2009)[293]. Concerns remain very high today about the current and potential impact of offshore oil and gas exploration and development on polar bears, their habitat, and their movement patterns (Slavik *et al.* 2009; CWS 2010)[294,295]. One

[291] "He also said he's worried about the oil companies coming because he said the white peoples are really after oil, but if they ever start burning it, or if the smell ever come out into the air, he think it's going to be really bad, so the animals that are living around here, he said because he know the animals himself that they don't even like to smell a human - human beings around them. He said oil would be worse than that, and even the small animals he think that they'll all disappear if they ever have an oil spill or an oil blast, there would be no more animals around here." (F. Nuyaviak [Tuktoyaktuk] *in* Berger 1976h: 4175)

[292] "I could tell you what I think what's not good for the habitat. All the oil company stuff that's happening out there - all the drilling proposals, the seismic. It's right in the habitat of the polar bear - summer and winter… With all that activity that's happening, polar bears tend to shy away from activity. And with all that's happening there, which is the prime habitat for polar bears, summer and winter, there's no telling where, ten years down the road, how much effect it's going to have on what's coming in close to the land or in to the beach." (L. Emaghok [Tuktoyaktuk] *in* Slavik *et al.* 2009: 57)

[293] "…a couple of elders I interviewed there said if there's a disturbance - too much noise - the bears will come out of their denning, the females. They'll try and move because they're trying to, in the early fall they go to a bank on the south side and get covered over, so sometime they get chased away because of too much activity and they have to leave their young ones." (C. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 31-32)

[294] "I'm not too worried about global warming myself right now. What I'm more concerned about is that we all know that industry is coming back to the area and now they want to do work off-shore, a lot further now than they used to. And I really believe that if they start, I think we're going to start seeing even more changes in the migrations of not only the polar bear but all the marine mammals along the Beaufort Sea." (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 56)

[295] "We don't want to see [polar bears] disappear because of industry you know. Well, sooner or later they are going to start drilling for oil and gas up here. The arctic is very sensitive to this kind of stuff, especially if it goes under the ice. If there's an oil-spill, it will affect everything… It will affect the seal. And the polar bear will get it. It's just a chain reaction, you know." (R. Kuptana [Sachs Harbour] *in* Slavik 2013: 74)

Tuktoyaktuk hunter noted that the location of the floe edge had changed considerably as a result of the artificial islands built for Beaufort Sea oil and gas exploration (JS 2015).

Marine Traffic

As a result of melting sea ice, the opening of the Northwest Passage to marine traffic is seen as having the potential to be one of the most serious threats to polar bear habitat (CWS 2010). Marine traffic in the form of ice-breakers, submarines, cargo ships, and cruise ships could travel through open leads, preventing the leads from re-freezing properly, and by doing so, contribute to the decline in multi-year ice (Slavik *et al.* 2009; summary of Tuktoyaktuk consultation in CWS 2010)[296,297].

Residents of Sachs Harbour are "concerned that ship traffic, especially tankers, and seismic activity and related low-level flying could cause the cumulative destruction of seal lairs and polar bear den sites in multi-year ice, and that noise from ships could affect polar bear and seal communication and social functions" (Community of Sachs Harbour *et al.* 2016: 22)[298]. In the Viscount Melville Sound and M'Clure Strait, the community has concerns about ship traffic affecting the fall and spring migration of polar bears between Banks, Victoria, and Melville islands, as well as impacts of ship noise, seismic activity, and low-level flying on polar bear denning sites and habitat (Community of Sachs Harbour *et al.* 2016).

Olokhaktomiut are concerned that potential marine traffic in the Richardson Collinson Inlet and Glenelg Bay area will have a negative impact on polar bear denning and on a critical community harvesting area. Specifically, the community is concerned that ships will destroy polar bear dens in multi-year ice, that the noise from ship traffic will disturb denning bears, and that ship tracks will pose dangers to hunters in the area.

The Paulatukmiut are concerned that future tanker and ice breaker traffic and oil/gas development will have a negative impact on polar bear denning in the Parry Peninsula, Franklin Bay, Darnley Bay, Amundsen Gulf offshore, and offshore islands (Community of Paulatuk *et al.* 2016).

[296] "That's when all those ice breakers and submarines started coming. That's when it started I believe. They've got icebreakers here from three or four different countries… And the way they go through that ice is to look for open leads. If you leave that open lead alone it's going to freeze up and build-up ice again. But if you keep going into those leads and keeping them open, of course they're going to go someplace" (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: unpubl. transcript)

[297] "Marine traffic in the Northwest Passage breaks up sea-ice. This could have negative impacts on polar bears. Breakup doesn't allow the sea-ice to freeze back up properly and that is the reason why there is less multi-year ice in general. If the sea-ice is left alone it will thicken up." (summary of Tuktoyaktuk consultation *in* CWS 2010: 85-86)

[298] The community suggests that the DOT [Department of Transportation] should designate flight restrictions over key polar bear denning area." (Community of Sachs Harbour *et al.* 2016: 23).

Other Threats

In addition to the most serious threats described above, Inuvialuit are also concerned about other activities that threaten individual bears. These include invasive research techniques used on bears as well as behavioural changes caused by disturbances or nutritional stress.

People in communities have expressed concerns about invasive research techniques impacting polar bear health (CWS 2010)[299]. While many Inuvialuit realize the value of conducting biological research, the perception of the impact of research on bears varies. Although some people believe that research has not changed polar bear behaviour (CWS 2010), others are very concerned that "research is starting to harm animals, not help them" (CWS 2010: 83). For example, satellite collars can hinder bears' hunting efforts and possibly lead to cuts, contusions, and infections (Slavik *et al*. 2009)[300]. Some harvesters have also seen wounds from tranquilizer darts become infected (Slavik 2013). The invasive procedures used in tagging and examining bears can disturb them and encourage them to avoid further human contact (Slavik *et al.* 2009)[301]. Harvesters and elders from numerous communities have discussed how chasing and immobilizing polar bears with helicopters so that they can be tagged can "spook" bears. 'Spooked bears' (*kayaaniq*) are jumpy (*kogluk*) and ineffective at hunting seals at their breathing holes, forcing them to scavenge and eventually suffer from starvation (Hart *et al.* 2004; Slavik *et al*. 2009; JS 2015)[302,303,304]. Other Inuit communities and organizations have

[299] "Elders view research techniques (helicopter, collars) as invasive and may have adverse effects on polar bears so work should be done to improve techniques. Research is thought to harm bears, not help them." (CWS 2010: 11)

[300] "When they put a collar on the bear and try to go after a seal, and the collar gets all iced up and gets heavy, and then that bear can't hunt anymore - it's too heavy, gets too thick with ice… They even start going into the meat, that collar. Start to go in." (C. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 58)

[301] "I think that's why after they collar and disturb the bears they have to go somewhere else. I mean they're trying to get away from man-handling and putting collars on them." (L. Emaghok [Tuktoyaktuk] *in* Slavik *et al.* 2009: 58)

[302] "All this time the polar bear was very, very skinny and just as dangerous. Even his skin was stuck to his bones, it was so starving. Here there were so many seals on the sea. The polar bear couldn't get any seal and that is why it was so skinny. The elders said that when a hunter is supposed to get the bear and also those that are barked at by dogs, these are the bears that are unable to ever hunt again. Then they become very skinny to the point of starvation. This is what the old timers spoke about. Even when a seal comes up the breathing hole, the seal is startled and goes back down. The old timers say this is what happens to polar bears that were supposed to be caught by a hunter but escaped. From a very long time ago we call them *kayaaniq*. Those that are very skinny even though there are a lot of seals around? The bears become very hungry and skinny and are very dangerous. The people didn't even try to eat it. They just used it for the dogs.'" (J. Nasogaluak [Tuktoyaktuk] *in* Hart *et al.* 2004: 79)

[303] "Not really, but elders from long ago, always tell stories that once you shoot at a bear and miss it and he gets away from you, they said it gets scary and become some poor hunters. Every time they hear a seal, they know when the seal comes up to breathe. And when they jump, the seal just goes down. And they get to be poor hunters that way. They get scared." (F. Wolki [Tuktoyaktuk] *in* Slavik *et al.* 2009: 56)

[304] "You know when they get hungry, they get "jumpy" when they're hunting. They never get seals anymore. If they been disturbed before with the chopper or anything, like dogs, you get starving bears

expressed concern about the impacts of immobilization drugs and handling on the health, behaviour, and survivorship of polar bears (Nirlungayuk and Lee 2009; Henri 2012; JS 2015; York *et al*. 2015; JS 2017; Laforest *et al*. 2018). Accidental deaths resulting from research activities are taken out of the total allowable harvest, though such incidences are rare (COSEWIC 2018).

While experienced hunters will comment "*there's always been the odd starving bear*" (R. Kuptana [Sachs Harbour] *in* Slavik 2013), several harvesters have recently observed signs of nutritional stress that include consuming the entire seal carcass (see section on *Interactions with Seals*). If bears begin to starve because of changes to their habitat or prey availability, it is likely they will become nuisance bears as they scavenge for food and become less shy of people. This is a threat to both people and bears, as starving bears are aggressive (Berger 1976f and h; Slavik *et al*. 2009)[305,306,307] and do not scare away as easily (Slavik 2013). Therefore, an increased number of starving bears (*kayanaluit* (S), *paatchaluk*, (S), *katyaaq* (U)) may lead to an increase in nuisance kills. Increased starvation may also potentially result in more instances of cannibalism (see section on *Interactions with Bears and Other Predators*).

Pollution and contamination are being more frequently observed, especially in the form of marine plastics:

"Polar bear TK [traditional knowledge] holders speak of opening up stomachs and finding plastic. In one situation a TK holder speaks of three starving bears, one of which 'had a little piece of green plastic inside his stomach'… A second TK holder notes, 'if you open up the stomach to see what they got… I've seen bits of those plastic garbage bags.'" (JS 2017: 28)

Other concerns briefly mentioned in the sources examined include disturbances from aircraft and snowmobiles, and competition for food from foxes, grizzly bears, and other species (Slavik 2013; see section on *Interactions*).

Polar bear hunting, whether for subsistence purposes or guided (outfitter) sport hunts, was not identified in the sources examined as being a current cause for concern. Several Inuvialuit

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because when they go hunting they get nervous. That's what my grandfather told me and my dad." (D. Nasogaluak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 56)

[305] "… polar bears are dangerous today because they are hungry and they haven't got enough food to go around." (W. Kuptana [Sachs Harbour] *in* Berger 1976f: 4042)

[306] "He said a long time ago even they knew that the polar bears were hungry, they never used to try to attack the people. He said sometimes they used to see a few, and as soon as they see a human being they used to get scared; but now he said he's starting to hear that the polar bears even attack human beings, which they never did long ago when they were hungry." (J. Wolki [Tuktoyaktuk] *in* Berger 1976h: 4181)

[307] "One time I opened up a polar bear that was killed by defense and I find people parts! I mean, if that bear is hungry, it's going to eat anything! Most of the time it eats seal. Only in certain chances when it's a starving bear, whatever it sees moving, it's going to go after." (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 38)

insisted that hunting is not a threat (CWS 2010), and one commented that "*the Inuvialuit have never caused a species to be at risk*" (CWS 2010: 94). Sources confirm the socio-economic and cultural value of hunting (Slavik *et al.* 2009; CWS 2010).

It has been observed in the past that market factors can drastically increase prices of polar bear hides (Barr 1996; Berger 1976e)[308,309]. It is possible that increased harvesting pressure could be put on polar bears should the price of hides rise on the world market (CBC 2011). This harvesting pressure, however, will continue to be checked by harvesting quotas based on science and Indigenous knowledge of the status of bears, not on market values (CWS 2012).

Limiting Factors

Limiting factors, which were not mentioned directly in the sources examined but can be inferred from concerns mentioned, include natural mortality and hunting.

Olokhaktomiut point out that while there is a lot on emphasis on the polar bear population being threatened due to climate change, "it is also common for polar bears to die from natural causes; even with young bears" (CWS 2010: 88). However, in the experience of most Sachs Harbour hunters, few have ever come across the carcass of a bear dead from natural causes besides occasionally running into a carcass of a bear killed while fighting (Slavik 2013). It is uncommon to see a bear carcass, even on land. One hunter commented:

"There's a lot of starving bears, the year before. I guess we don't see them die, that's all, don't see the carcasses. Maybe they have a place to go die or something like that. They could fall down anyplace I guess." (E. Esau [Sachs Harbour] in Slavik 2013: 72)

In the last few years, some hunters in Sachs Harbour and Paulatuk have noticed bears consuming the entire seal:

"Most times [in] the last few years, you would be lucky to find a nail off a seal from a bear kill. Now they just about devour the whole thing. They like eating ringed seals or bearded seal, they call them ugyuk. And you see them hanging around the ugyuk for a few days until it was pretty much finished... Big change." (F. Lennie [Sachs Harbour] in Slavik 2013: 88)

[308] "The start of construction of the DEW line in the summer of 1955 with the influx of relatively affluent southerners, both military personnel and civilians, into the Arctic provided the Inuit within reach of numerous bases with a ready market for bear pelts. The prices rose dramatically and the Hudson's Bay Company and other companies were forced to raise their prices to compete. The outcome was a dramatic increase in the number of bears being killed." (Barr 1996: 174)

[309] "The income from these polar bear would be approximately seven to $800 per hide this year. Since the Japanese went polar bear crazy a few years ago... What I mean by "polar bear crazy" is that they upset the fur market and made the rise - made the polar bear price up, they raised the price right up to two or three grand in some cases for a hide, and that was only for one year. Then after that the market went right down to $700 to $800 per hide, as compared to $3,000 or $2,000 per hide." (R. Goose [Ulukhaktok] *in* Berger 1976e: 3974-3975)

"When I used to hunt in earlier years I noticed that polar bears used to eat only parts of the seal; they would eat the fat but leave the carcass. I have noticed some of the bears are skinnier, but the main difference is that I don't see any seal carcasses on the ice anymore. The polar bears are eating the whole thing." (summary of Paulatuk consultation in CWS 2010: 92-93)

Positive Influences

Management and Legislation

Inuvialuit have "been managing polar bears for generations" and have taken leadership roles to ensure harvesting practices are sustainable (CWS 2010: 11). Some of the codes of conduct and traditional practices that help guide hunters' harvesting decisions include (*all from* Slavik *et al.* 2009):

- Do not hunt more than you can eat; do not waste polar bear meat;
- Adjust harvesting practices to leave certain areas of land to "rest";
- Try not to shoot or even bother the females when they are with cubs;
- Do not harass or bother a bear and her cubs while denning;
- Do not speak (disrespectfully) about animals;
- Hunting animals helps to keep the populations and ecosystems in balance;
- Give younger bears a chance to live their life and preserve them for future generations of hunters; and
- Do not let animals suffer.

An additional positive influence in the NWT has been the development of collaborative management regimes. Inuvialuit collaborate with each other through hunters and trappers' committees (HTCs), as well as with management authorities, other Indigenous groups, and biologists to "ensure that hunting the polar bear is sustainable" (CWS 2010: 12). Inuvialuit roles and authorities in managing lands, resources, and wildlife are outlined in the *Inuvialuit Final Agreement* (IFA), signed on June 5, 1984, with the Department of Indian Affairs and Northern Development (DIAND 1984). The goals of the IFA are to preserve Inuvialuit cultural identity and values within a changing northern society, enable Inuvialuit to be equal and meaningful participants in the northern and national economy and society, and protect and preserve Arctic wildlife, environment, and biological productivity (DIAND 1984). In addition to protecting Inuvialuit harvesting rights to polar bears and other wildlife, the IFA introduced a wildlife management regime that established the paramountcy of conservation and preservation of wildlife, and made the Inuvialuit partners in all matters related to the management of wildlife in the Western Arctic. The agreement also recognized that the knowledge of the Inuvialuit

would be given full weight in determining the conservation status of wildlife populations (JS 2015).

Many of the harvesting rules and regulations (i.e., "by-laws"[310]) have been imposed by the Inuvialuit upon their own hunters to conserve polar bears, providing incentives and penalties that encourage hunters to abide by the rules (Slavik *et al.* 2009). Inuvialuit take pride in the fact that they use a "precautionary principle" when making quota decisions to ensure that wildlife populations will not be negatively affected by the harvest, even when uncertainty exists (Slavik *et al.* 2009)[311,312]. The Wildlife Management Advisory Council (NWT) considers best available information (scientific and all other sources) and recommends a quota to the Minister of Environment and Natural Resources. The Inuvialuit Game Council then allocates the quota amongst the HTCs and decides how many tags each community gets and from which subpopulation. The individual HTC then allocates tags within the community and designates which can be used for sport or subsistence harvesting. Often sport hunters will opt not to harvest a bear because it isn't "big enough". In this case, if the sport hunter is unsuccessful, the tag is retired from the quota[313]. With a quota and tag system in place, harvest numbers are controlled and lower than in the past. In some communities these harvest quotas have not been filled for 25-30 years, yet they still provide valuable guidelines to ensure harvesting is sustainable (Slavik *et al.* 2009).

Polar bear management in the ISR has been "a success story with a long history" (JS 2017: 33). In 2017, the Joint Secretariat and its co-management partners finalized the *Inuvialuit Settlement Region Polar Bear Joint Management Plan* (2017). This plan defines the management goals and objectives for polar bears in the entire region, including the NWT and Yukon. This plan was developed to "meet the requirements of a management plan under the territorial *Species at Risk (NWT) Act*, and the ISR regional component of the national management plan

[310] "We don't call them "traditional laws" right now, we call them "by-laws". In each community we have by-laws. We do have by-laws and each community is somewhat different. It depends on which community you go to. And we do have by-laws in place that was set up through the HTCs and agreed by them: You're not allowed to harvest bears with cubs or bears that are denning… If you harvest you have to have [physical possession] of a tag in order to harvest a polar bear. And we have bylaws where you have to bring evidence of the sex - what kind of sex it is, otherwise you can get a penalty. So we have bylaws in place that we share with not only the youth, but also with our hunters." (F. Pokiak [Tuktoyaktuk] *in* Slavik *et al*. 2009: 20)

[311] "[One year] they did a study here and the population was real healthy… We had a chance to increase our quota for the Southern Beaufort, but we decided not to do it for another year… The next year they came back…and couldn't find next to nothing." (F. Pokiak [Tuktoyaktuk] *in* Slavik *et al.* 2009: 20)

[312] "Our bear season here used to begin November 1st, but we changed that a few years back to December 1st. I guess they wanted to give the females a better chance with their one- or two-year-old cubs… That just goes to show how our community has tried to help with the bears by doing that. Now we have a whole extra month that we have to wait." (J. Pokiak [Tuktoyaktuk] *in* Slavik *et al*. 2009: 20)

[313] For further analysis of "conservation hunting" and quota systems, see Freeman, M. and A.L. Foote. (Eds.). Inuit, Polar bears and Sustainable Use. CCI Press, University of Alberta, Edmonton. 252 pp.

under the federal *Species at Risk Act* while respecting the joint management process legislated by the *Inuvialuit Final Agreement* (IFA)" (JS 2017: 3).

Across the NWT and NU there are a number of protected areas (terrestrial and marine) and conservation areas within the range of polar bears (Figure 25; ENR 2016). At a community level, community conservation plans (CCP) have been developed and recently updated for all six ISR communities to identify critical habitat, community uses, and conservation objectives, to inform future decision making. In 2016, Fisheries and Oceans Canada designated the *Anguniaqvia niqiqyuam* Marine Protected Area in Darnley Bay. Paulatuk's 2016 CCP had identified this area as a highly productive area for a variety of species, providing important habitat for Arctic char, beluga whales, polar bears, ringed seals, and a variety of birds (Community of Paulatuk *et al.* 2016).

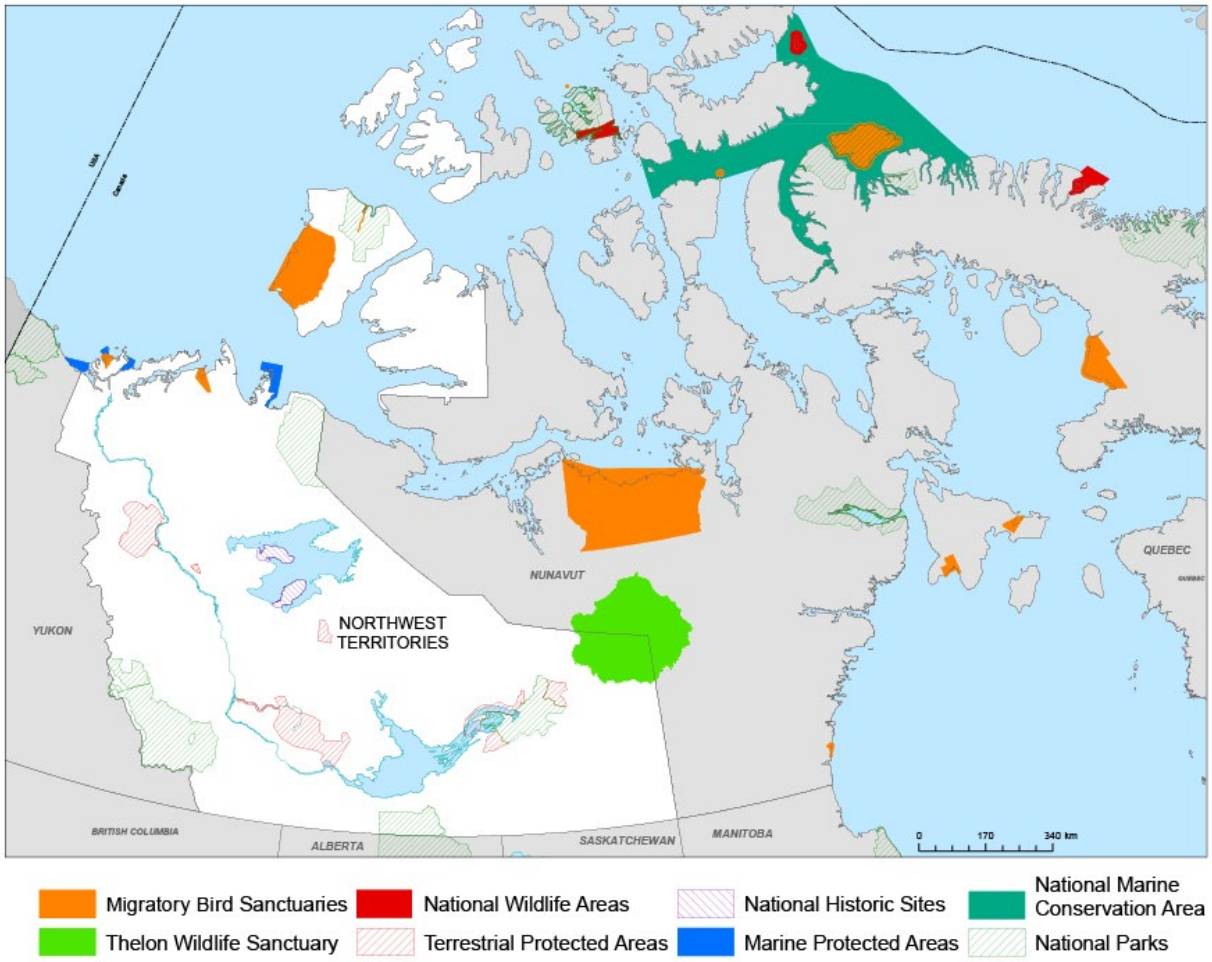

Figure 25. Protected areas in the Northwest Territories and Nunavut, Canada. Reproduced from Species at Risk in the NWT 2020 (GNWT 2020).

There are also well-established mechanisms that facilitate the coordination and collaboration of polar bear management and conservation at various levels, from a local to international level (JS 2017). The Inuvialuit have been leaders in developing landmark agreements like the 1988 Inuvialuit-Inupiat Agreement and the 2006 Kitikmeot-Inuvialuit Polar Bear Management Agreement, which promote transboundary management, knowledge sharing, and support less invasive research methods[314].

Changes in Sea Ice

Although substantial concerns have been recorded regarding changes to sea ice conditions as a result of climate change, some changes, including lack of shore-fast ice, open leads, and thin ice can also be of benefit to polar bears because these conditions prevent hunters from travelling onto the sea ice to hunt polar bears, naturally easing harvesting pressure (Reidlinger 2001; Slavik 2013; see section on *Search Effort*)[315]. Many hunters believe that an increase in the annual ice that is replacing multi-year ice will be an advantage to polar bears (CWS 2010; Slavik 2013)[316]. Annual ice is better polar bear habitat for hunting seals as the seals can make breathing holes in the thin ice (Slavik 2013; see section on *Habitat Availability*)[317].

A significant consideration and conclusion regarding Inuvialuit knowledge and polar bear management was summarized in the Joint Secretariat study (2015):

"For the Inuvialuit, the future cannot be predicted; it could be good or bad as far as polar bears are concerned. However, the consensus among the workshop participants was that polar bears are highly intelligent animals that can adapt to climate change because they have been adapting to many things for thousands of years." (p. 196)

[314] "Researchers are working hard in the region to find less invasive ways after Inuvialuit-Inupiat refused to collar any more bears after the issues with the last collars that were put out (release mechanism didn't work and people are still running into bears with old collars sometimes, awful for bears). The current population survey is genetic mark recapture using dart sampling, and lots of [research is occurring] looking into whether DNA can be captured from scat or tracks (BEARWATCH), trials from Alaska with high flying planes and multi-spectral imaging." (Nathoo pers. comm. 2020)

[315] "Ice conditions help a lot too for the polar bears. If the locals can't go out more than two miles." (W. Gully [Sachs Harbour] *in* Slavik 2013: 106)

[316] "The people I work with, the guys from doing the ice studies are telling us that…the first year ice is actually better bear habitat because it's more likely for them to get seals." (L. Carpenter [Sachs Harbour] *in* Slavik 2013: 101)

[317] "A bear likes to walk around where there's thin ice. They're always walking around, looking for seals." (R. Kuptana [Sachs Harbour] *in* Slavik 2013: 100)

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- Species at Risk Secretariat (Michelle Henderson, Claire Singer and Michele Grabke).

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BIOGRAPHY OF PREPARER

Dan Slavik is a graduate of the combined Environmental Conservation Sciences and Native Studies (B.Sc. /B.A) degree at the University of Alberta. In 2013, he completed his M.Sc. degree in Environmental Sociology in the Dept. of Rural Economy at the University of Alberta, with a thesis that explored Inuvialuit knowledge and indicators of polar bear population health. With strong, interdisciplinary training in the social and natural sciences, his research and work experience has developed his expertise in Indigenous knowledge studies and land-use mapping. His previous research examined Indigenous management of wildlife in the NWT, Canada, and southern New Zealand, exploring how traditional and contemporary Indigenous knowledge can be used to better understand and monitor changes in the environment.

Between 2007 and 2012, he was involved in several projects in the Inuvialuit region exploring Indigenous and local knowledge of polar bears and polar bear population health. These research projects have involved numerous (>100) in-depth interviews with Inuvialuit experts and knowledge holders, as well as facilitation of Indigenous knowledge workshops and training of local youth as research assistants. From 2012 to 2015, he led the Beaufort Sea program for an international environmental non-governmental organization and contributed to fieldwork and conservation programs in Alaska, Yukon, and the NWT. These experiences have given him a good working knowledge of the history, geography, and ecology of the region, as well as an understanding of local environmental processes, community concerns, and co-management initiatives.

He currently lives in Edmonton with his wife, twin daughters, and a white husky-lab named "Nanuq".

SCIENTIFIC KNOWLEDGE COMPONENT

Species Overview

Names and Classification

Scientific Name:	*Ursus maritimus* Phipps (1774), no subspecies
Common Name (English):	Polar bear
Common Name (French):	Ours polaire, ours blanc
Populations/subpopulations:	Southern Beaufort Sea, Northern Beaufort Sea, Viscount Melville Sound, Arctic Basin
Synonyms:	None
Family:	Ursidae (sub-family Ursinae)
Life Form:	Animal, vertebrate, mammal, carnivore, bear

Systematic/Taxonomic Clarifications

Phipps (1774) was first to describe the polar bear as a distinct species in the European Linnaean tradition. Following the rules of nomenclature, the appropriate authority (Wilson and Reeder 2005), and date of the specific name, *Ursus maritimus* is Phipps (1774) and not Linnaeus (1758), as is sometimes observed (Gentry 2001). Linnaeus (1758: 47) referred to the polar bear as "*Ursus* maritimus *albus-major*, *articus*"; however, in his entry he did not consider the polar bear as a distinct species from the brown bear (*Ursus arctos*). Alternative generic names have, in the past, included *Thalassarctos*, *Thalarctos*, and *Thalatarctos*; however, only the name *Ursus maritimus* is used today.

Description

Figure 26. An adult polar bear (Ursus maritimus) walking on sea ice in the NWT, Canada. Photograph courtesy of François Messier.

Polar bears are adapted to the unique niche of hunting marine mammals from a sea ice platform. The species is a large bear most comparable in size and shape to the grizzly (brown) bear, their closest relative. Morphologically, the polar bear lacks the strong digging muscles that give the brown bear its characteristic shoulder hump; it also has a larger but less dish-shaped head, a longer snout, and an elongated neck (Fig. 26). Although possessing similarly strong bite strength, the skull of the polar bear is less robust than that of the grizzly bear (Slater *et al*. 2010). Compared to grizzly bears, the grinding surfaces of the cheek teeth of polar bears are more serrated, which is an adaptation to an almost entirely carnivorous diet relative to the omnivorous diet of the grizzly bear. The claws of the polar bear are smaller and sharper than those of the grizzly bear, and the forepaws are enlarged, making them useful for swimming, hunting seals, and digging through or climbing on snow and ice. Polar bear skin is black, which enhances absorption of solar radiation. Translucent hair makes the fur appear white, especially right after moulting; however, the pelage of the polar bear may appear yellow or off-white during summer. Fur of the polar bear reflects the colours of the sky and snow, and

this may provide camouflage while hunting. Polar bears show strong sexual dimorphism. Male polar bears can weigh up to 800 kg and reach 2.8 m in length from nose to tail (DeMaster and Stirling 1981); however, females do not usually exceed 400 kg and 2.5 m in weight and length (Amstrup 2003).

Genetic studies show that polar bears and grizzly bears are sister species and have shared a complex evolutionary history (Cahill *et al.* 2013, 2015; Kumar *et al.* 2017) with divergence perhaps occurring as early as 4–5 million years ago (Miller *et al.* 2012). However, the best evidence now suggests divergence occurred within the middle Pleistocence (a period of cooling in the Arctic), from 600,000 years ago (Hailer *et al*. 2012) to as early as 350,000–500,000 years ago (Liu *et al.* 2014). Polar bears and grizzly bears were clearly established as morphologically distinct species by around 115,000 years ago (Ingólfsson and Wiig 2009; Cahill *et al*. 2013). Confusion as to the relationship between polar bears and grizzly bear bears has been complicated by recent mitochondrial evidence of past hybridization, for example with grizzly bears from the Admiralty, Baranof, and Chichagof islands of Alaska's Alexander Archipelago (Lindqvist *et al.* 2010), and with a now extinct grizzly bear in Ireland (Edwards *et al*. 2011).

More recent genomic evidence (Cahill *et al.* 2013, 2015) has shed considerable light on why such observations have been noted, with clear evidence that gene flow from polar bears into grizzly bears has occurred relatively recently (since glacial retreat) over a geographically wide area in the Pacific northwest (including both Alaskan mainland [e.g., Denali grizzly bear] and Alexander Archipelago populations of brown bears).

Instances of grizzly bear introgression into polar bear populations in the NWT have been noted, with speculation that hybridization may be something to consider as a potential risk to one or both of the species along the front of range overlap over the long term (Pongracz *et al.* 2017). However, such instances appear to be rare. Pongracz *et al.* (2017) concluded that despite observations of several hybrids occurring across Banks Island and Victoria Island (at least eight animals), all sampled hybrids were the result of a single female polar bear producing litters with two different male grizzly bears (in multiple years). Historic instances of polar bear genetic introgression into brown/grizzly bears appears to have been one-sided: there does not seem to exist any widespread historic introgression of grizzly bear genetics into polar bears (Cahill *et al.* 2015).

Distribution

Polar bears are distributed throughout the circumpolar Arctic (Fig. 27) and rely on sea ice as their primary habitat (Amstrup 2003). Polar bears generally show seasonal fidelity to local areas (Taylor and Lee 1995; Bethke *et al.* 1996; Taylor *et al*. 2001; COSEWIC 2018); however, movements by some bears can be very large (e.g., hundreds of kilometres within a single year; Messier *et al.* 2001). Wide-ranging movements and lack of evidence of evolutionary discreteness among bears within Canada led COSEWIC (2018) to consider the polar bear population as one designatable unit for status assessment at the national level. Subdivision of the population has, however, been proposed on the basis polar bear ecology including site fidelity to breeding and denning areas, the nature of sea-ice habitat availability, and fatty-acid signatures related to diet (see, e.g., Thiemann *et al.* [2008]). Early microsatellite analyses suggested that despite some indication of genetic substructure, there was little evidence that polar bears in Canada have been evolutionarily separated for significant periods of time (Paetkau *et al.* 1999). Most recently, however, Malenfant *et al.* (2016) and Jensen *et al.* (2020) both confirmed the presence of at least three genetically meaningful spatial clusters among Canadian polar bears. Jensen *et al*. (2020), using thousands of genome-wide single-nucleotide polymorphism (SNP) loci as opposed to microsatellite or mitochondrial DNA (Fig. 28), showed genetic structure closely reflective of the proposal of Thiemann *et al.* (2008).

Jensen et al. (2020) is important to the debate on population structure of polar bears, as the use of genomic tools (SNPs) have several advantages (see Zimmerman *et al.* 2020) over prior (mostly microsatellite-based) analyses, including more precise estimates of population-level diversity, higher power to identify groups in clustering methods, and the ability to consider local adaptation. All these factors are relevant to the consideration of designatable units below the species level by conservation bodies, including COSEWIC. In the case of polar bears, like Thiemann *et al.* (2008), Jensen *et al.* (2020) separated bears of the Beaufort Sea (both Southern and Northern Beaufort Sea grouping together) from bears of the Canadian Arctic Archipelago, and bears within or adjacent to Hudson Bay (including Foxe Basin) from the latter (Fig. 28). While Thiemann *et al*. (2008) did not study bears of Viscount Melville Sound, Jensen *et al.* (2020) identified polar bears of the region as being genetically related to both bears of the Beaufort Sea and the Arctic Archipelago. Similarly, Davis Strait bears showed a mixed genetic relationship between Hudson Bay and Archipelago bears, a gradation also noted in the fatty-acid signatures and ecology of Davis Strait bears by Thiemann *et al.* (2008). Grouping Viscount Melville Sound polar bears in close association with those of the Beaufort Sea is relevant to status assessment in the NWT, as it confirms the notion that all bears within the NWT likely comprise a single designatable and evolutionary significant unit.

Notwithstanding debate over the number of evolutionarily significant units of polar bears in Canada, and recent findings of authors such as Thiemann *et al.* (2008), Malenfant *et al.* (2016),

and Jensen *et al.* (2020), polar bears are currently managed according to 'subpopulations' as initially outlined by authors such as Bethke et al. (1996) and Taylor et al. (2001). Canadian subpopulations are inclusive of the 19 subpopulation units of polar bears (Fig. 27) recognized throughout the circumpolar Arctic by the International Union for the Conservation of Nature/Species Survival Commission (IUCN/SSC) Polar Bear Specialists Group (PBSG), the Canadian Polar Bear Technical Committee (PBTC), and all Canadian management jurisdictions (Joint Secretariat 2015, 2017). While 'management unit' is more correct terminology than is 'subpopulation' in this context (Vongraven and Peacock 2011; Joint Secretariat 2015, 2017), the term 'subpopulation' is used throughout this report for clarity and refers specifically to units delineated in Fig. 27.

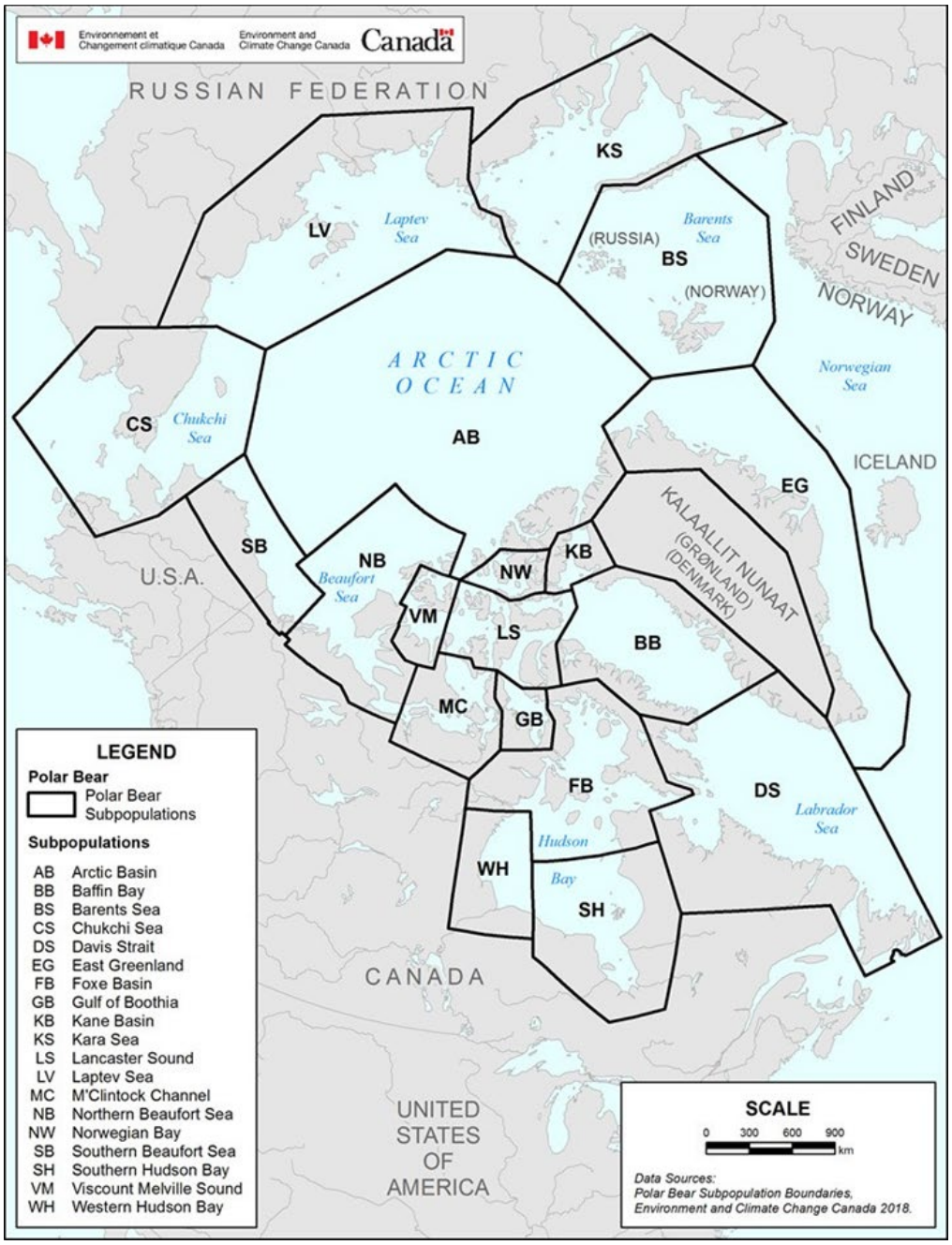

Figure 27. Circumpolar map of subpopulation boundaries of the polar bear, *Ursus maritimus*, as recognized by COSEWIC (2018). Total area covered is 24 x 107 km^2. Subpopulations are: Davis Strait (DS), Baffin Bay (BB), Kane Basin (KB), Southern Hudson Bay (SH), Western Hudson Bay (WH), Foxe Basin (FB), Gulf of Boothia (GB), Lancaster Sound (LS), Norwegian Bay (NW), M'Clintock Channel (MC), Viscount Melville Sound (VM), Northern Beaufort Sea (NB), Southern Beaufort Sea (SB), Chuchki Sea (CS), Laptev Sea (LP), Kara Sea (KS), Barents Sea (BS), East Greenland (EG), and Arctic Basin (AB). Data available at https://www.canada.ca/en/environment-climate-change/services/biodiversity/maps-sub-populations-polar-bears-protected.html (accessed January 1, 2020). Note: the boundary between the Southern and Northern Beaufort Sea was changed in 2013. At the time of the last Species at Risk Committee (SARC) report for polar bears (2012), the boundary was identified 200 km to the east (the latter boundary applied to historic population estimates for the Southern vs. Northern Beaufort Sea populations, see Fig. 29).

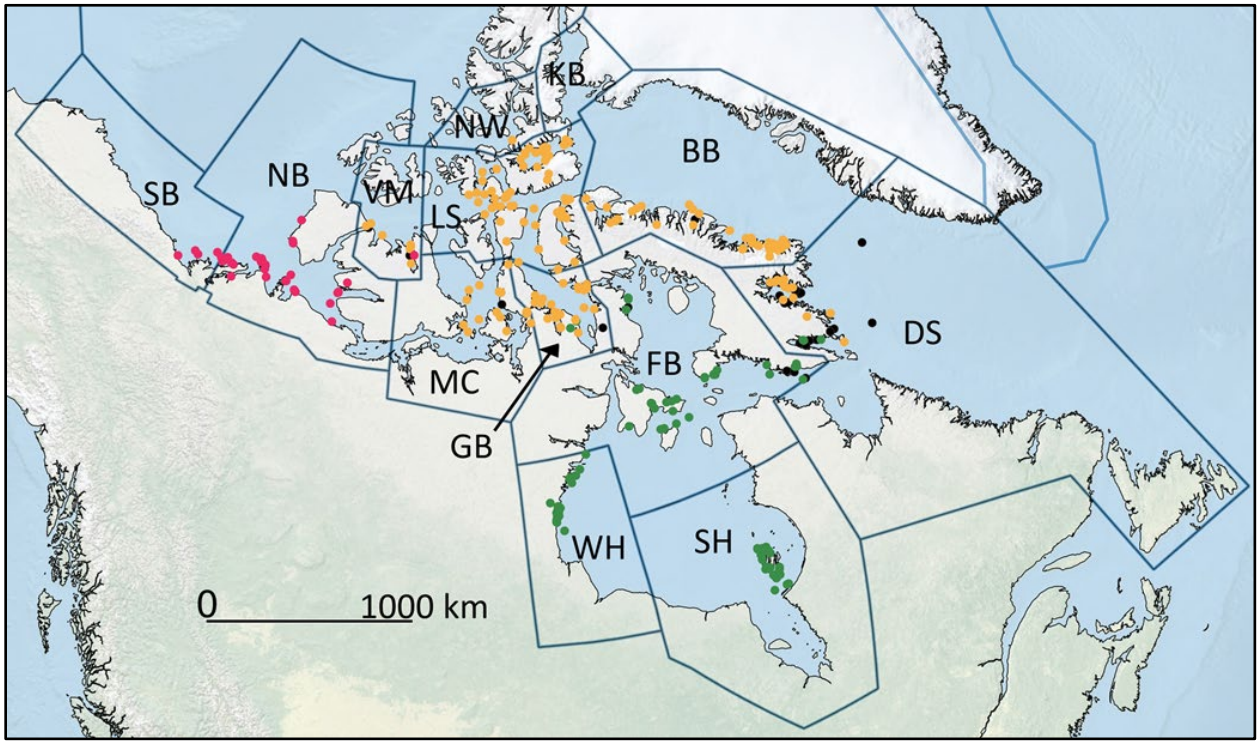

Figure 28. Current understanding of genetic substructure of Canadian polar bear subpopulations. Subpopulations are: Davis Strait (DS), Baffin Bay (BB), Kane Basin (KB), Southern Hudson Bay (SH), Western Hudson Bay (WH), Foxe Basin (FB), Gulf of Boothia (GB), Lancaster Sound (LS), Norwegian Bay (NW), M'Clintock Channel (MC), Viscount Melville Sound (VM), Northern Beaufort Sea (NB), and Southern Beaufort Sea (SB). Colored points correspond to the sampling location and genetic cluster that the individual has majority assignment to, based on the SNP dataset and STRUCTURE analysis by Jensen et al. (2020): pink = Polar Basin, orange = Arctic Archipelago, green = Hudson Complex, while individuals with membership of <0.7 to a cluster are represented as black dots. Data available at *https://doi.org/10.1002/ece3.6159*. Data are for 358 individual polar bears with samples meeting genotype depth and missing data filters, plus 16 technical replicates, genotyped at 13,488 loci. Reprinted from Jensen et al. (2020) under Creative Commons Attribution.

Continental Distribution

Of the 19 recognized subpopulations of polar bears across their circumpolar distribution, 14 (including bears of the Arctic Basin) range into or are entirely contained within Canada (Fig. 27). The distribution of the polar bear extends from the North Pole to include sea ice and coastal areas of Greenland, the Canadian Arctic Archipelago, east to the Labrador coast, south to James Bay, and west to the Bering Sea. A few polar bears regularly appear as far south as the island of Newfoundland. Bears have occasionally been noted in the Gulf of St. Lawrence in years when heavy pack ice drifts farther south than normal (COSEWIC 2018). The current south-east extent of the continental range of polar bears is considered to be the southern border of the subpopulation in Davis Strait at 47° N (Vongraven and Peacock 2011). In the south-west (i.e., Pacific Arctic), polar bears had recently been known to walk the beaches as far south as St. Matthew's Island in the Bering Sea, although now they are generally not observed south of Savoonga, Alaska (Vongraven and Peacock 2011). The southernmost observation of denning polar bears comes from James Bay, including bears at the south end of Akimiski Island ~52° 35' N (Obbard *in* SARC 2012: 56). In North America, polar bears are considered resident species in Alaska, Yukon, NWT, Nunavut, Manitoba, Ontario, Québec, Newfoundland and Labrador, and Greenland.

NWT Distribution

Polar bears occur throughout all parts of the Arctic Ocean in the NWT (Urquhart and Schweinsburg 1984; Fig 29) and are rarely found inland on the NWT mainland (SARC 2012). The estimated extent of occurrence of the polar bear in the NWT – the area contained within the shortest continuous boundary drawn to encompass all the known, inferred, or projected sites of present occurrence of the species (excluding cases of vagrancy) – is 1,467,985 km^2 (area computation provided by R. Gau, Government of the Northwest Territories [GNWT]).

The area of occupancy is defined as the area within the extent of occurrence that is occupied by the species, excluding cases of vagrancy. For polar bears in the NWT, the estimated area of occupancy is very close to that of the extent of occurrence, with only a minor adjustment for the distribution contour presented by the coast of mainland NWT (Fig. 29). The index of area of occupancy (IAO) is a measure that aims to provide an estimate of area of occupancy that is not dependent on scale and, therefore, that can be compared across taxonomic groups and against SARC's assessment criteria. The IAO is measured as the surface area of 2 × 2-km grid cells that intersect the actual area occupied by the wildlife species (i.e., the biological area of occupancy). For polar bears in the NWT, this area is 1,454,148 km^2 (Fig. 29; map and area computation provided by R. Gau, GNWT).

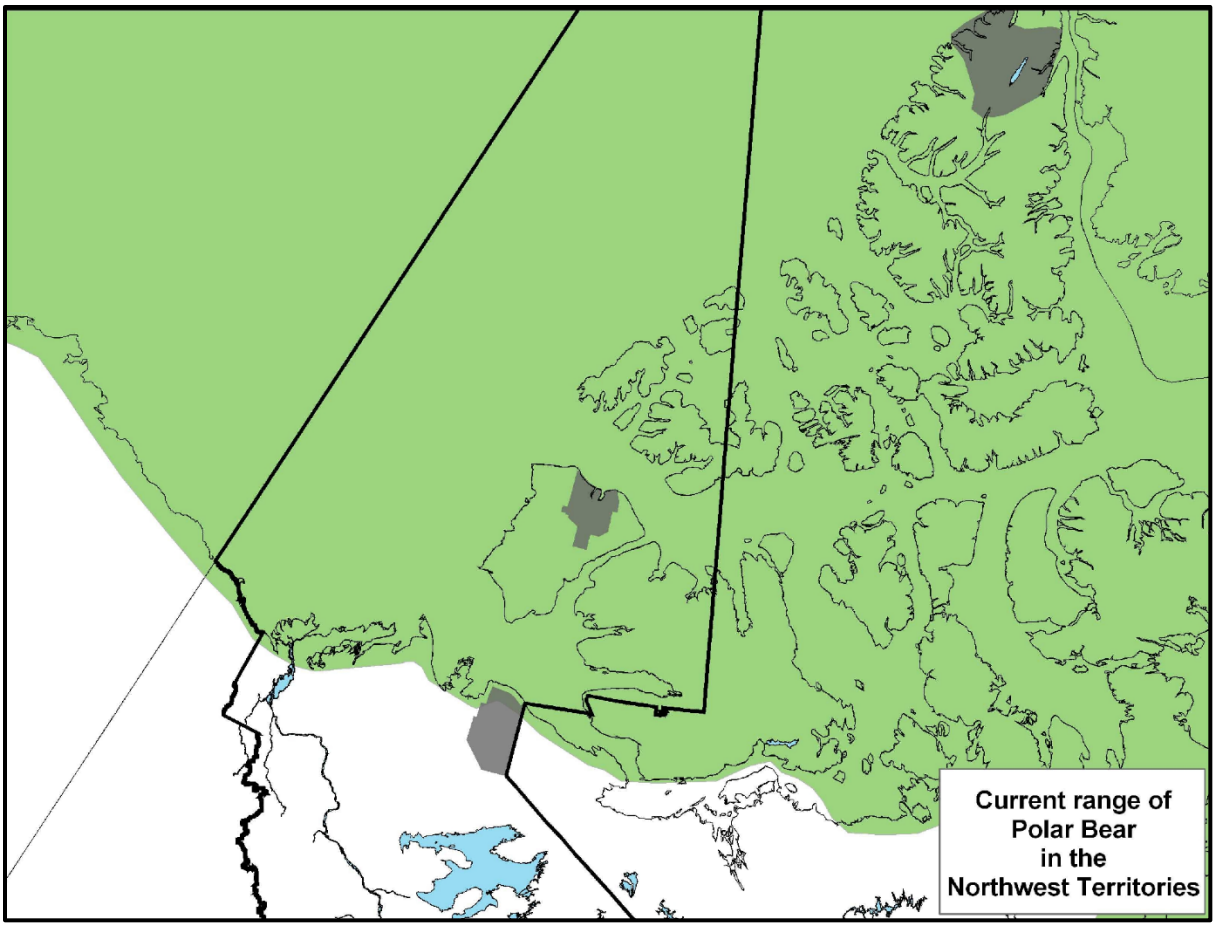

Figure 29. Distribution of the polar bear, Ursus maritimus, in the NWT, Canada. The area contained within the shortest continuous boundary drawn to encompass all the known, inferred, or projected sites of present occurrence of the species is the extent of occurrence (1,467,985 km^2). The area within the extent of occurrence that is occupied by the species, excluding cases of vagrancy (index of area of occupancy) is the green shaded region (1,454,148 km^2) contained within the territorial bounds of the NWT. Note: the NWT boundary considered by SARC extends to the North Pole (Northwest Territories Act 1985). Map and area calculations provided by R. Gau, GNWT.

The distribution of polar bears where they occur in the NWT is continuous (Fig. 29). Four recognized subpopulations occur within the territory (Fig. 30), including bears of the Southern Beaufort Sea, Northern Beaufort Sea, Viscount Melville Sound, and the Arctic Basin subpopulation units (Fig. 28). The Southern Beaufort Sea includes the coastline of northern Alaska, Yukon, and the NWT. The subpopulation is shared by all three jurisdictions. The Northern Beaufort Sea and Viscount Melville Sound subpopulations are shared with Nunavut.

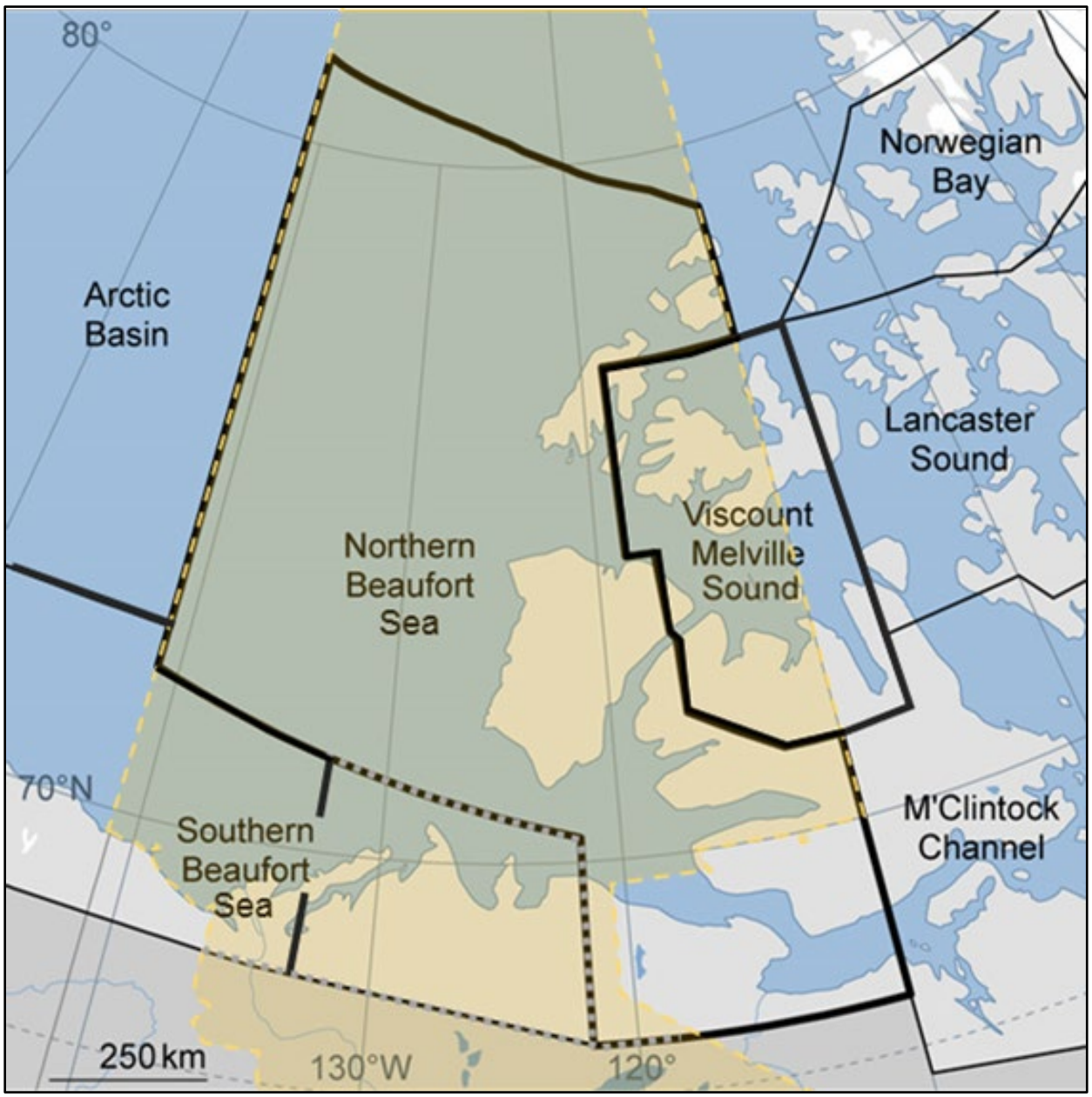

Figure 30. Polar bear subpopulations of the Western Arctic overlapping with the territorial boundary of the NWT (border in dashed gold, NWT interior in gold shade). This figure is based on Figs. 26 and 28, and data available at *https://www.canada.ca/en/environment-climate-change/services/biodiversity/maps-sub-populations-polar-bears-protected.html* (accessed January 1, 2020). Note: the boundary between the Southern and Northern Beaufort Sea was, at the time of the 2012 SARC report for polar bear, located east (dashed line) of the current boundary, which now is located at 133° longitude (with other modifications indicated as dashed grey lines). Map produced by P.D. McLoughlin.

There are no NWT subpopulations of polar bears considered to be particularly isolated from each other, and historic subpopulation boundaries (2014) between major NWT divisions, like the Southern and Northern Beaufort Sea subpopulations, contained extensive overlap of individuals. Satellite telemetry of female bears and probabilistic modelling indicates that, rather than exhibiting distinct boundaries, there are areas of overlap between the Southern and Northern Beaufort Sea subpopulations (Amstrup *et al.* 2004a, b). To address this issue, user groups, scientists, and managers, in 2013, shifted the boundaries of the Southern and Northern Beaufort Sea subpopulations to the west to 133° longitude following the process outlined in the National Polar Bear Conservation Strategy for Canada (Fig. 30; review *in* Durner *et al*. 2018; COSEWIC 2018; National Polar Bear Conservation Strategy for Canada 2011).

The Arctic Basin subpopulation was delineated to account for polar bears that may be resident in areas of the circumpolar Arctic that are not clearly part of other subpopulations (COSEWIC 2018; Durner *et al.* 2018). Polar bears (including females with cubs) are assumed to occur at very low densities in the Arctic Basin and it is known that bears from other subpopulations sometimes use the region (Durner and Amstrup 1995; Messier *et al.* 2001; Durner *et al*. 2018). Polar bears occupying the Arctic Basin can be considered resident in the NWT where they occur within the NWT boundary.

Search Effort

Research on the species in the NWT has been carried out for many decades. The distribution of polar bears in the NWT is estimated from capture locations, telemetry studies, and observations as reported in the published and unpublished literature (e.g., Messier *et al.* 2001; Amstrup *et al*. 2004a, b; COSEWIC 2018; Durner *et al.* 2018l; Jensen *et al.* 2020). Tracking data and personal observations indicate that polar bears sometimes do venture as far as the North Pole (Durner and Amstrup 1995, Messier *et al*. 2001) or as far east as the Chukchi Sea (Johnson *et al.* 2017), but rarely move south from the mainland coast of the NWT (although such occurrences do happen on occasion). Long-term study of the movements of collared polar bears in combination with genetic sampling of individuals (Jensen *et al.* 2020) and local knowledge of the species suggest that, while some regions have experienced delays in publishing research (e.g., Viscount Melville Sound), there are no major gaps in our understanding of where polar bears occur in the NWT. In this respect, search effort for this species is complete.

Biology and Behaviour

Habitat Requirements

Polar bears are dependent on sea ice as a hunting and denning platform, and the physical attributes of sea ice and ocean depth are the primary determinants of the quality of polar bear

habitat. Changes in sea ice and associated snow cover affect light transmission and thermodynamic processes important to lower trophic levels of the arctic marine ecosystem (Welch *et al.* 1992; Barber *et al.* 1995). These, in turn, combined with ocean depth and characteristics of sea ice (e.g., annual or multi-year; topography features like pressure ridges), influence the distribution of important food species such as ringed (*Pusa hispida*) and bearded (*Erignathus barbatus*) seals (Stirling and Lunn 1997; Barber and Iacozza 2004; Stern and Laidre 2016; Durner *et al*. 2018). Prey species diversity was noted by Hamilton and Derocher (2019) as being a significant predictor of polar bear density across polar bear subpopulations. Where conditions for using sea ice to hunt seals are poor (e.g., off the coast of Newfoundland, or over the deep-water polar basin, or in areas of thick, multi-year ice [Taylor *et al.* 2002]), we find few polar bears; where conditions are favourable for ice-dependent seals, the species is more likely to occur (e.g., throughout much of the shallow-water, circumpolar Arctic; Fig. 27, also see Hamilton and Derocher 2019).

Regehr *et al.* (2016), COSEWIC (2018), and Durner *et al.* (2009, 2018) present comprehensive reviews of the features of sea ice and ocean depths preferred by polar bears during different times of the year. In brief, in the NWT and throughout the Canadian Arctic Archipelago, polar bear habitat is closely associated with that of the ringed seal (Stirling *et al.* 1982; Stirling and Øritsland 1995; Harwood *et al.* 2012; Galicia *et al*. 2019) and so includes areas of shallow water with consolidated pack ice, areas immediately adjacent to pressure ridges, between multi-year and first-year ice floes, and at the floe edge between marginal and shore-fast sea ice (Kingsley *et al.* 1985; Stirling and Derocher 1993; Ferguson *et al*. 2000a)(See *Indigenous and Community Knowledge Component: Habitat Requirements* for definitions of the types of ice). Polar bears are most abundant where currents and ocean upwellings increase marine productivity and serve to keep the ice cover from becoming too consolidated in winter, including active areas consisting of openings between the shore-fast ice and drifting pack ice, polynyas (year-round openings), and leads where open water meets sea ice (Amstrup and DeMaster 1988; Stirling *et al.* 1993; Stirling and Øritsland 1995; Stirling 1997; Amstrup *et al*. 2000; review *in* Durner *et al.* 2018). Ocean depth is also important. Durner *et al.* (2009) demonstrated that polar bears prefer sea ice concentrations (percent of ocean surface area covered by ice) greater than 50 percent in waters at 300 m or less.

Based on telemetry data from females, polar bears of the low-latitude Beaufort Sea prefer sea ice situated over shallow waters of the continental shelf (Durner *et al*. 2009). This is likely due to higher biological productivity in these areas (Dunton *et al.* 2005), and greater accessibility to ringed and bearded seals in near-shore shear zones and polynyas compared to deep-water regions in the central polar basin (Stirling and Archibald 1977; Bentzen *et al.* 2007). In the low-latitudes of the Beaufort Sea, pack ice is the primary summer habitat for polar bears (Durner *et al*. 2004). During the open-water period in the Northern Beaufort Sea subpopulation (Fig. 30),

some sea ice remains in most years over the continental shelf along the west coast of Banks and Prince Patrick Islands and M'Clure Strait, and occasionally some ice remains in western Amundsen Gulf, south of Banks Island (Stirling *et al.* 2011). Thus, in most years, polar bears in the Northern Beaufort Sea subpopulation continue to have access to ice over the continental shelf through much of the year, where seals are more abundant than they are over the deep polar basin (Stirling *et al.* 1982, 2011); however, in the southwest region of the Northern Beaufort Sea subpopulation, bears are likely to have increasingly less access to ice year-round. Increased time spent onshore fasting has been observed for polar bears of the NWT over the past several decades, which is related to changing ice conditions in the Beaufort Sea due to climate change (see *Habitat Availability and Trends*).

Polar bears depend on sea ice not only for feeding but also for seeking mates, breeding, travel, and in some cases for denning. For example, Amstrup and Gardner (1994) observed that in the Beaufort Sea, maternal dens on drifting pack ice were common; however, elsewhere in the Arctic this may not be the case. For example, all dens on sea ice in the Canadian Arctic Archipelago observed by Messier *et al*. (1994) and Ferguson *et al*. (2000b) were classified as temporary shelter dens rather than maternity dens. Polar bears must move throughout the year to adjust to the changing distribution of sea ice and seals (Stirling 1988a; USFWS 2010). Mauritzen *et al.* (2003) showed that habitat use by polar bears is seasonal and may involve a trade-off between selecting habitats with abundant prey availability versus other factors such as energetic costs or risk.

Throughout the Arctic in the fall and early winter period, pregnant females will seek out areas in which to excavate dens, mainly on land, except where noted on sea ice (Harington 1968; Lentfer *et al.* 1980; Ramsay and Stirling 1990; Amstrup and Gardner 1994). Dens are generally excavated in snow, and then covered and closed by snowdrifts. Dens are mostly found where landscape features allow wind-blown snow to accumulate. Snow depth is generally less than that required for maternal dens across most of the Alaska coastal plain (Benson 1982) and because of this polar bear maternal dens mostly occur next to river and coastal banks and bluffs, steep lakeshores, and other abrupt changes in tundra topography >1.3 m in height (Durner *et al.* 2003). They are frequently located on islands or land in close proximity to the coast and adjacent to areas with high seal densities in spring (Harington 1968; Brice-Bennett 1977; Stirling and Andriashek 1992; Messier *et al*. 1994; Kalxdorff 1997, Ferguson *et al.* 2000b; Van de Velde *et al.* 2003; Lewis *et al*. 2006). Access to terrestrial denning sites, where most polar bears den, is dependent upon the location of sea ice, amount of stable ice, ice consolidation, and the length of the melt season during the summer and fall (Fischbach *et al.* 2007). Polar bear dens on land for the Alaskan portion of the Southern Beaufort Sea subpopulation largely occur relatively near the coast along the coastal hills and river banks of the mainland and barrier islands (Amstrup and Gardner 1994; Amstrup 2003; Durner *et al.*

2020). For polar bears of the Beaufort Sea in the NWT (Stirling and Andriashak 1992), maternity denning occurs annually on the west and south coasts of Banks Island, and has been recorded less frequently along the mainland coast of the southern Beaufort Sea (e.g., Tuktoyaktuk Peninsula, coastal Yukon, and Herschel Island). Little is known about the habitat requirements of Viscount Melville Sound and Arctic Basin polar bears from scientific studies.

Movements

Polar bears travel over exceedingly large areas relative to other terrestrial mammals (Ferguson *et al.* 1999), and the only practical means by which to track their movements is via remote satellite telemetry (see Messier *et al*. 2001). Radios are generally fitted using collars only on adult females given practical difficulties in securely attaching transmitters to males (necks of males are often of wider circumference than their heads); hence, movement patterns of male polar bears are not well known. Female polar bears including those of the NWT possess large annual home ranges, varying from 940 km² to 540,700 km² ($\bar{x}$ = 125,500 km², SD = 113,795, n = 93; Ferguson *et al*. 1999). Home ranges of polar bears vary with several factors, including the location of key habitat features such as polynyas (Ferguson *et al*. 1999; Messier *et al.* 2001). The ratio of land to sea within a given home range and seasonal variation in ice cover have been shown to explain up to 66% of the variation in home range size (Ferguson *et al.* 1999). Bears using land during the ice-free season have larger home ranges than those with year-round access to ice, as do bears that possess home ranges with greater seasonal variation in type of ice cover (Ferguson *et al.* 1999).

Observations of movement patterns within home ranges reinforce the importance of sea ice to the ecology of polar bears. As expected from the size of home ranges, rates of movement are very high when compared to other terrestrial mammals, with most published, mean estimates of travel speeds on sea ice falling within the range of 0.5–2.1 km/h (Larsen *et al*. 1983; Durner and Amstrup 1995; Born *et al.* 1997; Amstrup *et al.* 2000; Ferguson *et al*. 2001). The highest activity is from May through June and July, depending on conditions of sea ice and coinciding with availability of newborn seal pups (Pasitschniak-Arts and Messier 1999; Amstrup 2003).

Mauritzen *et al*. (2003) showed that movement rates of polar bears increased with decreasing thickness of sea ice. In the High Arctic, activity is lowest during winter, perhaps due to inclement weather, limited accessibility to seals, and energy conservation during the coldest months (Messier *et al*. 1992, 1994). Movements of pregnant females cease after they enter maternity dens in late autumn, but non-pregnant females and males will also use snow shelters for 0.5–4 months of the winter (Harington 1968) and fast in a manner that is physiologically similar to torpor during periods of food shortages (Watts and Hansen 1987). However, use of shelter dens varies with conditions of sea ice and latitude and is more common in the High Arctic (Ferguson *et al*. 2000b).

Annual movements associated with the distribution of sea ice have been well documented for NWT polar bears of the Southern and Northern Beaufort Sea subpopulations. For example, Amstrup *et al*. (2000) fitted 173 satellite radio collars to 121 adult female polar bears in the Beaufort Sea and relocated the bears 44,736 times between 1985 and 1995. Maximum movement rates occurred in winter and early summer. Durner *et al.* (2004, 2009) hypothesized that seasonality in movements of bears in the Beaufort Sea were in response to the waxing and waning of annual ice. In the Northern Beaufort Sea subpopulation, bears moved north in June and south in March and September. For both regions, total annual movements ranged from 1,406 to 6,203 km. Mean total distances moved each month ranged from 79 to 420 km. There is evidence from bears of the south Beaufort Sea that the frequency of long-distance swims may be increasing, leading to concerns about the effects of this behaviour on body condition and survival (e.g., Durner *et al*. 2011; Pagano *et al*. 2012). More recently, Pongracz and Derocher (2017) tracked 67 polar bears from 2007–2011 in the south Beaufort Sea (spanning the Southern and Northern Beaufort Sea subppulations with captures occurring offshore and within NWT-maritime borders). They found that 73% of the bears still remained on sea ice throughout the summer, mostly along the edge of the pack ice west of Banks Island.

Dispersal in polar bears is poorly understood largely because subadult bears have rarely been tracked using radio-collars. Subadults, though marked when captured, are not usually collared as these bears can quickly outgrow fitted collars. Dispersal events have, however, been recorded using genetic analyses (Crompton 2004; Saunders 2005), perhaps the most notable being that of Kutschera *et al.* (2016) who documented the dispersal of two bears sampled in Iceland that were most genetically similar to individuals from Alaska.

Delineation of subpopulations in the NWT and Canada (Figs. 27, 30) has largely been based on hierarchical cluster analyses of movements of radio-collared females (Bethke *et al.* 1996; Taylor *et al*. 2001; Amstrup *et al*. 2004a), with additional genetic analyses being used to support or suggest alternatives (e.g., Paetkau *et al.* 1999; Malenfant *et al.* 2016; Jensen *et al.* 2020). Increasingly, it is apparent that genetics data indicate that gene flow across the Canadian population is restricted despite the long-distance seasonal movements undertaken by some polar bears. Early analyses of genetic distances between sampled individuals using microsatellites suggested the possibility of subclustering (Paetkau *et al.* 1999), with revisions proposed based on increasing sample sizes and types of analyses. Relevant to NWT status, the most recent microsatellite work by Malenfant *et al.* (2016) and genome-wide analysis of Jensen *et al.* (2020) show that bears in the NWT from the Southern and Northern Beaufort subpopulations comprise a single genetic subcluster. Jensen *et al.* (2020) also showed that bears of Viscount Melville Sound were not greatly distinguished from bears of the Beaufort Sea (Fig. 28). Genetic relatedness is likely high amongst most bears found within the borders of the territory.

Life Cycle and Reproduction

Age at first reproduction of female polar bears may be as early as 4 years, with most polar bears throughout the NWT producing litters at relatively high rates by age 6 (Table 3). Females enter estrus in March, which lasts until June and peaks in late April and early May (Palmer *et al.* 1988; Amstrup 2003). Ovulation is thought to be induced by coitus (Wimsatt 1963), and implantation is delayed until October (Palmer *et al*. 1988). Pregnancy rates of female polar bears appear to vary markedly among polar bear subpopulations, with as many as high as 100% (Taylor *et al.* 2005) to as few as 50% of adult females (>5 years) available to mate (i.e., having no cubs or cubs that are about to be weaned) producing cubs the following year (e.g., Kane Basin; Taylor *et al.* 2007). Litter sizes are generally 1–2 bears, with triplet litters being rare except under very good conditions. Offspring are born in maternity dens generally between November and early January (Harington 1968; Derocher *et al.* 1992). Cubs are nursed inside the den until sometime between mid-March and the middle of April (Amstrup and Gardner 1994; Ferguson *et al*. 2000b; Smith *et al*. 2007; Derocher *et al*. 2011), with later den emergence at higher latitudes (review *in* COSEWIC 2008). By this time, cubs weigh 10–12 kg as compared to 0.6 kg at birth (Ramsay and Stirling 1988; Derocher and Stirling 1995). The mean time between successful litters (interbirth interval) was estimated by Lentfer *et al*. (1980) and Taylor *et al.* (1987) to be approximately 3–4 years (young dispersing from mothers at 2–3 years).

Male polar bears become physiologically mature at 5–6 years of age. Fully formed spermatozoa appear only in low concentrations in testes of bears aged 2–4 years; concentrations peak at 5.8 years of age (Rosing-Asvid *et al.* 2002). Most males, however, do not enter the reproductive segment of the population until they are 8–10 years old (Ramsay and Stirling 1988; Derocher and Stirling 1998; Saunders 2005). Richardson *et al.* (2020) clearly demonstrated that older adult male bears sire a disproportionate number of cubs compared to their representation in the population. Using the pedigree developed by Malenfant *et al.* (2016) containing genetic and field data from 4156 individual bears (from six generations, 1966–2011), Richardson *et al.* (2020) showed that age-specific reproductive success for 369 males (≥2 years was biased toward bears aged 11–17 years. Mating success ranged from 0–10 mates per male (siring 0–14 cubs), with 43% of the males not being known to reproduce (Richardson *et al.* 2020).

In the context of life cycle, polar bears experience relatively high natural survival rates, and survival can often be distinguished based on age or stage of life history. Generally, researchers assess survival rates separately for cubs-of-the-year (COYs), yearlings and sub adults (ages 1–4), prime-age adults (ages 5–20), and senescent adults (ages 21+). Polar bears do not usually live beyond 25 years; maximum age is often considered to be 30 years for bears in the wild,

although lifespans longer than this are purported to be common in captivity (COSEWIC 2008). The general pattern is for COYs and yearlings to exhibit survival rates that are lower than sub adults and prime adults, and senescent adults have lower survival rates than prime adults. The details of survival (and mortality) of polar bears in the NWT are discussed in the section on *Population* and under *Threats and Limiting Factors*.

Table 3. Estimated means (standard errors) of post-den emergence litter size and age-specific probabilities of litter production (LPR) and litter sex ratio for available females (i.e., females without cubs or 2-year-old cubs in the year previous) for subpopulations of polar bears of the NWT. Source: IUCN/SSC Polar Bear Specialist Group (PBSG 2010). Estimates included data collected to 2006 for the Southern Beaufort Sea, 2005 for the Northern Beaufort Sea, and 1992 for Viscount Melville Sound. No more recent data are available for these calculations.

Subpopulation	Cub (age 0) litter size	Age 4 LPR	Age 5 LPR	Age 6 LPR	Age 7 LPR	Prop. male cubs/litter
Southern Beaufort Sea[1]	1.724 (0.170)	0.000 (0)	0.437 (0.060)	0.437 (0.060)	0.437 (0.060)	0.520 (0.040)
Northern Beaufort Sea[2]	1.756 (0.166)	0.118 (0.183)	0.283 (0.515)	0.883 (0.622)	0.883 (0.622)	0.502 (0.035)
Viscount Melville Sound[3]	1.640 (0.125)	0.000 (0)	0.623 (0.414)	0.872 (0.712)	0.872 (0.712)	0.535 (0.118)

[1]Cub litter size was calculated from Hunter *et al*. (2007). Litter production rate is the time-invariant estimate for females available to breed (stage 4) in Regehr *et al*. (2010). Standard errors were approximated from bootstrap confidence intervals. Proportion of male cubs is from Regehr *et al.* (2006).
[2]Data originally presented in COSEWIC (2008) and PBSG (2010).
[3]Data presented in Taylor *et al*. (2002).

COSEWIC (2018) identifies generation length as: "the average age of parents of a cohort (i.e. newborn individuals in the population)," which is also the criterion used by SARC. Recently, Regehr *et al*. (2016) conducted a comprehensive analysis of polar bear subpopulation dynamics across the Arctic and computed a mean subpopulation-specific estimate of generation length (using COSEWIC criteria) of 11.5 years (95% CI, 9.8–13.6 years) from 3,374 observed reproductive events. The number was recently supported by Biddlecombe *et al*.'s (2019) analysis of the characteristics of mating polar bears in the Beaufort Sea (1970–2014, 135 breeding pairs), which showed that the mean age of paired females (i.e., parents of the next year) was 9.7 years, with paired males being 11.5 years old, on average. This estimated generation length of 11.5 years is now used by COSEWIC (2018) and updates the previous generation length (12 years) adopted by COSEWIC (2008) and SARC (2012), and Stirling's (2002) COSEWIC report (citing 10–15 years as generation length).

Physiology and Adaptability

The most notable aspect of polar bear physiology, in the context of assigning status to the species, relates to the ability of polar bears to fast for long periods of time spent on land during the ice-free season, i.e., without access to seals (as is the case for 50–60% of bears in Canada; COSEWIC 2008). While a seasonal land-based adaptive strategy is increasingly the case for bears of the Southern Beaufort Sea (Rode *et al.* 2018), it is generally not the case for bears in the higher latitude Northern Beaufort Sea and Viscount Melville Sound subpopulations (although pers. comm. [ENR 2012] in the Viscount Melville Sound suggested some bears there have moved to land during periods of no or limited ice). Further, the majority (73%) of the 67 polar bears tracked by Pongracz and Derocher (2017) from 2007–2011 (almost all captured on sea ice in the NWT between Herschel Island and the Tuktoyaktuk Peninsula) remained on sea ice during summer and used the edge of the pack ice (most notably west of Banks Island). More recent data on changing percentages in numbers of bears seeking summer refugia offshore within NWT waters are not available.

While on land, little food is often available, so polar bears must primarily rely on stored energy reserves until the sea ice forms again in late autumn (Ramsay and Hobson 1991; Derocher *et al.* 1993; Atkinson and Ramsay 1995; Rode *et al.* 2015a, b). Pregnant females in western Hudson Bay must wait until young are born and old enough to be moved from the den before ending their fast; in doing so, pregnant females may not eat for up to 8 months, while having to meet the energetic demands of gestation and lactation (Atkinson and Ramsay 1995). Adult polar bears lose approximately 1 kg of body mass per day during fasts (Derocher and Stirling 1995; Polischuk *et al*. 2002), and pregnant females may lose as much as 43% of their body mass (Atkinson and Ramsay 1995). Because offspring body mass is closely tied to the amount of body fat carried by females (Atkinson and Ramsay 1995), reproductive success likely depends on how heavy females are when they begin, or more importantly end, periods of fasting.

While much of our knowledge of seasonal changes in body condition and fasting physiology for polar bears has been obtained from the well-studied Western Hudson Bay subpopulation, increasingly, data from other subpopulations (where ice conditions are different) is becoming available. Galicia *et al*. (2019) recently studied seasonal changes in body condition in polar bears across five subpopulations of Nunavut (Baffin Bay, Davis Strait, Foxe Basin, Gulf of Boothia, Lancaster Sound), all of which experienced a period of fasting between ice break-up and freeze- up, but not to the extent observed in the Western Hudson Bay or the Southern Beaufort Sea subpopulations. Galicia *et al.* (2019) observed similar seasonal patterns in body condition change across the subpopulations studied, with bears at their lowest condition in the spring, followed by fat accumulation past break-up date and subsequent peak body condition in autumn – indicating that in these regions bears were actively foraging in late spring and early summer, and hence not necessarily fasting beyond break-up. Insight into populations like

these may have relevance to predicting NWT-polar bear responses in the high-latitude Beaufort Sea and Viscount Melville Sound regions to changing sea ice conditions, as ice conditions and duration of the ice-free season in these areas are quite different from that in the low-latitude Beaufort Sea and western Hudson Bay (Fig. 33).

In addition to being physiologically adapted to survive long periods without food, polar bears exhibit behavioural adaptations that allow them to survive in extreme or variable environments. Polar bears are known to use garbage and may habituate to the presence of humans, even in the presence of disruptive activities (e.g., hazing) if food rewards can still be obtained (e.g., Dyck 2006). Polar bears are also attracted to and may consume foreign substances (e.g., petroleum products or ethylene glycol [antifreeze]) that can be harmful or cause death (Stirling 1988b; Amstrup *et al.* 1989; Derocher and Stirling 1991). Inuit observations of polar bears eating plastic bags and engine oil apparently increased through the 1990s (McDonald *et al*. 1997). Polar bears are also known to access natural sources of food outside of their regular diet; Inuit observations of polar bears in the Baffin Bay area report an expansion in the types of foods eaten by bears in recent years (Dowsley 2005), including eggs of sea birds and Inuit meat caches. As described under *Interactions*, the diet of polar bears can extend to several species of mammals and birds, meat caches, and vegetation including berries. However, several studies show that terrestrial feeding contributes little to offset mass loss experienced by bears when on shore (Hobson *et al*. 2009; Rode *et al*. 2010b, 2015a, b; Pilfold *et al.* 2016).

Interactions

Polar bears are carnivores that occupy the highest trophic level in the Arctic, and so almost all ecological interactions involving polar bears are related to their role as an apex marine predator. Hypercarnivory is reflected in the polar bear genome: natural selection has shaped patterns of gene-copy variation in response to a rapid transition from an omnivorous diet during their recent divergence from grizzly bears (Rinket *et al*. 2019). In the NWT, the polar bear is particularly noted as a predator of ringed seals and bearded seals, species upon which they are highly dependent for food—accounting for almost 75% of the diet of polar bears in the Inuvialuit Settlement Region (ISR) (Florko *et al.* 2020). In other parts of the Arctic diet can be more varied, including harp seals (*Pagophilus groenlandica*), spotted seals (*Pusa largha*), hooded seals (*Cystophora cristata*), walrus (*Odobenus rosmarus*), beluga whales (*Delphinapterus leucas*), and narwhal (*Monodon monoceros*) (Stirling and Archibald 1977; Kiliaan *et al*. 1978; Fay 1982; Lowry *et al*. 1987; Calvert and Stirling 1990; Smith and Sjare 1990; Derocher *et al*. 2002; Florko 2018; Boucher *et al*. 2019). Bowhead whale carcasses can also be an important source of food for polar bears in the NWT, especially along the coast of the Beaufort Sea (Kalxdorff 1997; Perham 2005; Rogers *et al.* 2015; Atwood *et al.* 2016; Pongracz and Derocher 2017). The mean (± SE) diet composition of all polar bears harvested in the Beaufort Sea was 15.1 ± 0.9%

bearded seal, 17.8 ± 0.8% beluga whale, 10.0 ± 0.4% bowhead whale, and 57.1 ± 0.9% ringed seal (Florko *et al.* 2020).

Ringed seals, which live exclusively in association with sea ice for at least part of the year (as do bearded and harp seals), have apparently been the principal prey of polar bears for much of their co-evolutionary history, and many ringed seal behaviours appear to be adaptations to avoid predation by polar bears (Stirling 1977; Amstrup 2003). Changes in populations of ringed seals, in particular, are certain to impact the distribution of polar bears, as nutritional stress in polar bears is linked to reduced numbers of ringed seal pups (Stirling and Derocher 1993; Barber and Iacozza 2004; Derocher *et al.* 2004; Pongracz and Derocher 2017). Pagano *et al.* (2018) showed that the high energy demands of polar bears requires consumption of high-fat prey, such as seals, which are easy to come by on sea ice but nearly unavailable in ice-free conditions. Harwood *et al.* (2020) reviewed the links between ringed seals to arctic oceanography, productivity, and sea ice through seal responses in body condition and reproduction to environmental variation (see *Threats and Limiting Factors*, Fig. 35).

In some areas where all (e.g., northeast Manitoba [Derocher *et al.* 1993]) or some bears (e.g., low-latitude Beaufort Sea [Schliebe *et al*. 2008]) spend time on land in summer, polar bears may feed on terrestrial species, including vegetation such as blueberries (*Vaccinium uliginosum*) and crowberries (*Empetrum nigrum*). Polar bears may also depredate nests of waterfowl (e.g., Smith and Hill 1996) and have been observed to kill caribou (e.g., Derocher *et al.* 2000; Brook and Richardson 2002). In Labrador, feeding on salmon by polar bears has also been observed (Brazil and Goudie 2006).

Polar bears, as top-level carnivores, have little to fear in the way of natural predators. Grizzly bears have been noted to kill polar bear cubs on rare occasions (e.g., Doupé *et al.* 2007), and it has been hypothesized that grizzly bears may be more effective predators of polar bears than vice versa (Slater *et al.* 2010). Like all bears, polar bears will kill and eat members of their own species, as well as grizzly and black bears (Taylor 1994, 1995). Disease and parasitism have not been noted as important limiting effects in any polar bear population (COSEWIC 2019); however, an increased prevalence in disease has been projected for polar bears and marine mammals, in general, as a consequence of climate change and a northward expansion of pathogens (Burek *et al*. 2008). Atwood *et al.* (2017), working in Alaska (coastal Beaufort Sea), found that seroprevalence of *Brucella* spp. and *Toxoplasma gondii* antibodies likely increased through time with changing ice conditions from 2007–2014, and reported literature-first records of polar bear exposure to *Coxiella burnetii* (a bacterium) and *Neospora caninum* (a protozoan) known to cause disease in humans and domestic animals, and *Francisella tularensis*, the bacterium causative to tularemia.

Further to being an apex predator in the Arctic, polar bears also compete with other marine and terrestrial predators. Of note, grizzly bear populations appear to be expanding in range

throughout the western the Arctic (Doupé et al. 2007). While there is yet no evidence to suggest that hybridization between polar bears and grizzly bears is a threat to the existence of either species (Pongracz et al. 2017; see *Description*), what may be of concern to the status of polar bear in the NWT is the greater competitive ability of the grizzly bear when the species come into contact with one another (Slater *et al.* 2010). Grizzly bears appear to be socially dominant during interspecific competition with polar bears for marine mammal carcasses, e.g., along the north shore of Alaska (Miller *et al.* 2015). Although there is no evidence that grizzly bears are playing a significant role in displacing polar bears within the species' current area of occupancy, the more generalist feeding strategy of grizzly bears (Gau *et al.* 2002) might potentially provide this species with a competitive foothold on Victoria Island or on other Arctic islands. At present, while we can acknowledge competition as an ecological interaction between polar bears and grizzly bears, it is not likely to be a threat to either species' occurrence.

STATE AND TRENDS

Population

Because all NWT subpopulations of polar bears are shared, either internationally or with Yukon and Nunavut (Figs. 26–29), and each subpopulation is largely managed independently, it is difficult to meaningfully discuss dynamics of a single 'NWT population' of polar bears. Further, there is much debate about the appropriateness of methods to estimate subpopulation size(s) with the best available data, all of which are now dated (to 2010, 2006, and 1992 for bears of the Southern Beaufort Sea in the NWT, Northern Beaufort Sea, and Viscount Melville Sound, respectively). The discussion below presents relevant information on the structure, rates, movements, status, and viability of the three main subpopulations that overlap with the borders of the NWT (i.e., the Southern Beaufort Sea, Northern Beaufort Sea, and Viscount Melville Sound subpopulations); however, rates are all dated due to lack of new demographic information for these subpopulations since SARC (2012). This means that quantitative assessment of projected trends is not possible, especially in consideration of the major changes in sea ice conditions that have occurred in the NWT over the past decade. Some discussion of the relevant rates from prior research is presented for context, but they should not be relied on as characterizing any NWT subpopulation or the overall NWT population today. Further, little information continues to exist for polar bears living in the Arctic Basin where this 'catch-all' subpopulation overlaps with the NWT (Fig. 26); hence, the subpopulation is not discussed to any great extent here, other than to note its existence. The Arctic Basin (subpopulation) was delineated by groups such as the IUCN/SSC Polar Bear Specialists Group to account for polar bears that may be resident in areas of the circumpolar Arctic that are not clearly part of other subpopulations (Durner *et al*. 2018). Polar bears are known to occur in the

Arctic Basin and it is known that bears from other subpopulations sometimes use the region (e.g., see movements of females from Viscount Melville Sound to the Arctic Basin in Messier *et al*. 2001)

Abundance

The most recent estimate of the global size of the world's polar bear population is around 25,000 animals (26,000, with 95% CI = 22,000–31,000 [Regehr *et al.* 2016]; 23,315 with range 15,972–31,212 [Hamilton and Derocher 2019]). Within Canada, there may be around 16,000 bears, with the number of mature individuals likely above 10,000 animals; the estimate being based on the sum of various subpopulation inventories and expert opinion, as detailed in COSEWIC (2018) and PBTC (2019).

Tables 4 and 5 present estimates of the total number of individuals of all ages in subpopulations of polar bears shared by the NWT. Each table relies slightly differently on available data sources. Table 4 presents estimates and interpretations from the Canadian Polar Bear Technical Committee (PBCT), which use Stirling *et al.*'s (2011) estimates for the Northern Beaufort Sea subpopulation and Regehr *et al.*'s (2006) study of the Southern Beaufort Sea subpopulation, with a reanalysis applied by Griswold *et al.* (2017) to accommodate the recent boundary change between the Southern Beaufort Sea and Northern Beaufort Sea subpopulations (i.e., reallocating some Southern Beaufort Sea bears to the Northern Beaufort Sea, based on the westward shift in boundary that enlarged the Northern Beaufort Sea subpopulation and shrank that of the Southern Beaufort Sea). Table 5 presents the consensus estimates proposed by the IUCN/SSC Polar Bear Specialists Group (PBSG), whom rely on Bromaghin *et al.*'s (2015) capture-mark-recapture study from 2000–2010 for the Southern Beaufort Sea subpopulation and Stirling *et al.*'s (2011) study of eastern and northern Beaufort Sea bears (with data collected up until 2006). Both tables use the Taylor *et al.*'s (1998) study for the Viscount Melville Sound subpopulation; while neither contains estimates for the Arctic Basin subpopulation.

All NWT-Beaufort Sea estimates derive from the same data, with different analyses concluding different population sizes that are also a function of unit boundaries. Since there is no scientific information on abundance for more than a full generation of polar bears in the NWT, at writing, all data on abundance are historical. A re-assessment of population inventory is being conducted by NWT personnel and collaborators for the Southern and Northern Beaufort Sea subpopulations with field work that commenced in 2019. New field work on the Viscount Melville Sound subpopulation was conducted from 2012–2014; however, at writing, data are currently being analyzed. The below describes details on the latest available population estimates of NWT polar bears, with Tables 4 and 5 reproducing historic assessments of population size presented by PBTC (2019) and PBSG (2019), respectively.

Both Table 4 and Table 5 are useful for summing historic estimates of the size of polar bear subpopulations overlapping with the border of the NWT (Figs. 27–30). That is, totaling the number of bears living in subpopulations of the Southern Beaufort Sea (shared by NWT with Alaska and Yukon), Northern Beaufort Sea (shared with Nunavut), and Viscount Melville Sound (shared with Nunavut), exclusive of the (likely) small number of bears that may range north of the Northern Beaufort Sea subpopulation within the Arctic Basin to the North Pole. To be clear, it is not possible, at this time, to definitively identify either a total number of bears that would, in any given year or season, fall within the territorial borders of the NWT. However, we can apply the data of Tables 4 and 5 and that of recent and relevant literature (e.g., Atwood *et al.* 2020) to propose a likely maximum number of polars bears located within the territorial borders of the NWT.

Scenario A. Table 4, based on PBTC (2019), can be used to sum estimates for the Southern Beaufort Sea and Northern Beaufort Sea subpopulations from 2006, with the Viscount Melville Sound estimate from 1992, presenting a rough, historic estimate of 2667 bears for these three subpopulations combined circa early 2000. The latter assumes no population decrease or increase from 1992 to the early 2000s for bears of Viscount Melville Sound. Extrapolation beyond 2006 becomes more difficult due to lack of data. However, Bromaghin *et al.* (2015) and Atwood *et al.* (2020) showed that the Southern Beaufort Sea subpopulation experienced a stepped decline of 25–50% abundance to 2008–2009, after which the population roughly stabilized in trend through to 2015 (according to data from bears captured in Alaska; Fig. 28). The part of the Southern Beaufort Sea subpopulation off the Alaska coast is a large subset of the entire subpopulation shared with the NWT (60.5 to 77.8%, depending on boundary change), and it is logical to assume that estimates of demographic parameters based on U.S. Geological Survey (USGS) Alaska data are informative with respect to the entire subpopulation (Atwood *et al.* 2020). No other historic trend data is available for any NWT-ranging subpopulation at time of writing.

Assuming that subpopulations of the Northern Beaufort Sea and Viscount Melville Sound remained stable since data collection through today (no change from Table 4 over roughly one and two generations, respectively), but accounting for a stepped decline in the Southern Beaufort Sea subpoupation from the 2000s to the beginning of the last decade (i.e., applying Bromaghin et al.'s [2015] and Atwood et al.'s [2020] range of decline [25–50%] to the Southern Beaufort Sea subpopulation without recovery [stability thereafter]), suggests 304–608 less bears in the three subpopulations (combined) today compared to when data on the Southern Beaufort Sea subpopulation was collected in Table 4. The result is a rough, recent estimate of 2059–2363 bears in the combined Southern Beaufort Sea, Northern Beaufort Sea, and Viscount Melville Sound subpopulations, exclusive of an unknown number of bears living in the Arctic Basin. Extrapolations based on assumptions of multigenerational stability in size of the

Viscount Melville Sound and Northern Beaufort Sea subpopulations (due to lack of data), when it is clear that one subpopulation (Southern Beaufort Sea) declined significantly at least once since 2006, may not be realistic nor precautionary. However, if we do assume the above, we can identify what might be the number of bears present in these subpopulations today, and from there within the territorial boundaries of the NWT.

Assuming 62% of the 2059–2363 bears composite PBTC population (Table 4) are mature (computations of Southern Beaufort Sea polar bears, presented in SARC 2012), we can expect a range of 1277–1465 mature bears living in the combined subpopulations sharing a border with the NWT, excluding bears of the Arctic Basin. The true estimate of NWT bears must be less than this, depending on how many bears of each subpopulation one can assign to another territorial jurisdiction or Alaska. Atwood *et al.* (2020) recently computed an abundance estimate for the Alaska part of the Southern Beaufort Sea using data (to 2015) of 565 bears, or 350 mature bears (data collected after the stepped decline from 2006–2008). If we expect a range of 1277–1465 mature bears in the multi-jurisdictional region, but subtract the point estimate of Alaskan bears of the Southern Beaufort Sea subpopulation, the range above is reduced to 927–1115 mature bears contained in the NWT. From this estimate, however, we also need to subtract the Nunavut component of bears of the Viscount Melville Sound subpopulation (est. at around 30 mature bears as ~70% of Viscount Melville Sound polar bears sampled in Taylor *et al.* [1992] were captured in Nunavut), reducing this range to 897–1085 bears. While we might add in the few bears that periodically occupy the Arctic Basin in NWT territorial waters, we also must subtract the (unknown) number of mature bears of the Northern Beaufort Sea subpopulation crossing inhabiting Nunavut (e.g., southeast Amundsen Gulf and Dolphin and Union Strait). Estimated bears within the territorial bounds of the NWT are also expected to be less in autumn compared to other seasons, when polar bears will move or den on shore in Yukon. Considering the above, and the tentative assumption of no change in any NWT-overlapping polar bear subpopulation over the past generation (or more), using PBTC (2019) data it would be optimistic to conclude that the NWT contains more than 1000 mature bears within its territorial borders at any given time. The midpoint of the range estimate (897–1085) suggests 991 mature bears, with the bounds of the range defined by acknowledging a decline of either 50% (lower bound) or 25% (upper bound) having occurred in the Southern Beaufort Sea subpopulation from 2006–2008, and population stability thereafter (Bromaghin *et al.* 2015; Atwood *et al.* 2020).

Scenario B. If we use the interpretations of data by the IUCN/SSC Polar Bear Specialists Group (Table 5) to derive an NWT-specific population size under the same assumptions regarding population stability, above, the conclusion is that of a recent estimate of 2048 bears for the Southern and Northern Beaufort Sea and Viscount Melville Sound subpopulations, combined, or 1269 mature bears. This aligns best with the lower bound of the PBTC (2019) combined

estimate, and reflects the direct incorporation of the evidence of Bromaghin *et al.* (2015) that a severe population decline was experienced by the Southern Beaufort Sea subpopulation from 2006–2008. The latter has been supported by the analysis of Atwood *et al.* (2020). Subtracting from this measure the point estimate of Southern Beaufort Sea abundance assigned to Alaska by Atwood *et al.* (2020), i.e., 565 bears (350 mature) bears, and 30 mature bears of the Viscount Melville Sound that are resident in Nunavut, the conclusion is that 889 mature polar bears might live within the NWT (1269 – 350 – 30 = 889 mature bears). Again, we might add to this an unknown number of bears present in the NWT portion of the Arctic Basin, but also subtract any bears of the southeast Amundsen Gulf and Dolphin and Union Strait of the Northern Beaufort Sea subpopulation that should be assigned to Nunavut.

Scenario C. Perhaps the easiest method to extrapolate a current population size for polar bears of the NWT is to accept that there has been no change in any subpopulation other than the Southern Beaufort Sea since the early 2000s, and use the Alaskan-only mark-recapture dataset (i.e., Atwood *et al.* 2020) to proportionately identify the number of polar bears of the Southern Beaufort Sea living in the NWT. According to the current spatial extent of the Southern Beaufort Sea subpopulation boundary, 77.8% the unit occurs in Alaska. Adopting the multiannual average estimate of Atwood *et al.* (2020) from 2006–2015 for Alaska-only polar bears of the Southern Beaufort Sea (565 bears, 95% CI: 340–920 bears, Fig. 29), this would then suggest there presently exists 161 (range 97–263) Southern Beaufort Sea polar bears living in Canada (i.e., in NWT and Yukon, inhabiting land and near-shore ice from 133° longtitude east to the Alaskan border, Fig. 30). Using PBTC data (Table 4), adding 161 bears to the estimated number of animals of the Northern Beaufort Sea and Viscount Melville Sound (less 30 Nunvavut bears assigned to the latter) subpopulations, suggests a contemporary estimate of 1583 bears (range 1519–1685) or 981 mature bears (range 942–1045) within the borders of the NWT. The above ignores any Northern Beaufort Sea bears that should be assigned to Nunavut, and any Arctic Basin bears that may be resident within the territorial bounds of the NWT.

Irrespective of how populations sizes have been computed, the best available evidence, at writing, suggests that the NWT currently supports no more and likely less than 1000 mature polar bears within its territorial borders, at any given time.

Table 4. Historic estimates of polar bears, *Ursus maritimus*, within or shared by the NWT, to 2006. Data reproduced from PBTC (2019). The estimates for the Southern and Northern Beaufort Sea are based on the new subpopulation boundaries for these units and suggestions of changes to abundance estimates based on this (Griswold *et al.* 2017) as presented in Fig. 30.

Subpopulation	**Southern Beaufort Sea (Alaska, Yukon and NWT)**	**Northern Beaufort Sea (NWT only)**	**Viscount Melville Sound (NWT and Nunavut)**
Estimate	1,215[1]	1,291[2]	161[3]
Method and type of evidence	Physical C-R, with 311 bears subtracted based on Griswold *et al.* (2017)	Physical C-R, with 311 bears added based on Griswold *et al.* (2017)	Physical C-R
Year of last data	2006	2006	1992

[1]Regehr *et al.* (2006) estimate (1,526) adjusted for new boundary at 133°W (Tuktoyaktuk) following Griswold *et al.* (2017), which indicated 311 bears would shift from the Southern Beaufort Sea to the Northern Beaufort Sea subpopulation unit under the aforementioned boundary shift.
[2]Based on adding 311 bears to the 2006 estimate (980 bears) of Stirling *et al.* (2011), following Griswold *et al.* (2017).
[3]Taylor *et al.* (2002). Simulation using these data showed that to 1999 the population could have grown to 215 bears (SE 57.4) based on the 1992 survival rates, but this was a projection only.

Table 5. Historic estimates of polar bears, *Ursus maritimus*, within or shared by the NWT to 2006. Data reproduced from PBSG (2019), based on its newest criteria for status assessments at the IUCN/SSC Polar Bear Specialists Group. Data available at: http://pbsg.npolar.no/en/status/status-table.html (accessed February 26, 2021). Data and rationale presented in detail in Durner *et al.* (2018) and PBSG (2019). Based on data used for physical capture-mark-recapture (C-R) in Bromaghin *et al.* (2015)[1] and Stirling *et al.* (2011)[2], the estimates for the Southern and Northern Beaufort Sea subpopulations are not inconsistent with the new subpopulation boundaries for these units, as presented in Fig. 30.

Subpopulation	**Southern Beaufort Sea (Alaska, Yukon + NWT)**	**Northern Beaufort Sea (NWT only)**	**Viscount Melville Sound (NWT + Nunavut)**
Estimate and uncertainty (94% CI)	907[1] (548-1,270)	980[2] (825-1,135)	161[3] (93-229)
Method and type of evidence	Physical C-R	Physical C-R	Physical C-R
Year of last data	2010	2006	1992

[1]Bromaghin *et al.* (2015)
[2]Stirling *et al.* (2011)
[3]Taylor *et al.* (2002)

Fluctuations and Trends

It is suspected that the NWT population of polar bears is now lower than in the past because of declines in numbers of bears proximal to the south coast of the Beaufort Sea (see *Abundance*, Fig. 31). There is no quantitative, direct data from western science to inform us about declines over the past generation(s) in other subpopulations which overlap with the NWT border (i.e., no abundance estimates to compare today with that obtained from the 2000s for the Beaufort Sea and early 1990s for the Viscount Melville Sound). Nonetheless, and restricting quantitative analysis to only the declines noted to have occurred in the Southern Beaufort Sea subpopulation, the best available evidence suggests that over the past three generations (roughly 34.5 years) there are now fewer polar bears in the NWT than previously.

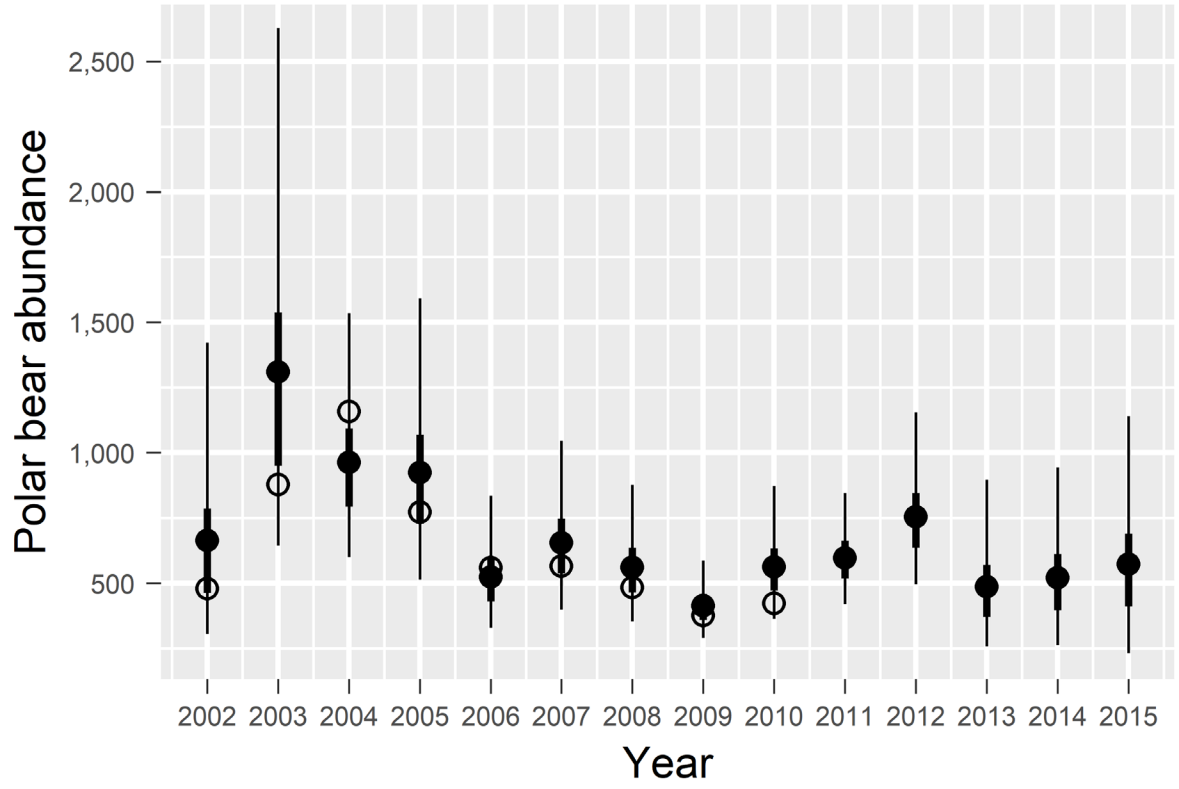

Figure 31. Estimates of the abundance of polar bears in the Alaska-only part of the southern Beaufort Sea subpopulation. The black symbol is the mean, the heavy black line is the 50-percent credible interval (CI), and the thin black line is the 95-percent CI, all based on 20,000 samples from the posterior distribution of abundance in each year. The circles are the point estimates reported by Bromaghin *et al.* (2015). Note, as pointed out by Atwood et al. (2020) the 2002 abundance estimate is known to be biased low (Bromaghin *et al.* 2015) because no capture effort was based out of Utqiaġvik in 2001, and 2002 was the first year that marked bears were released in all parts of the Alaskan study area. Reproduced from Atwood et al. (2020) with permission.

Notwithstanding that western science has been unable to assess historic trend due to lack of data for the majority of the NWT polar bear population over the past generation—or longer in places like Viscount Melville Sound—the negative association between increasing length of the ice-free season in the Beaufort Sea and polar bear survival and reproduction and its potential to generate population decline (see *Population Dynamics* and *Habitat Availability and Trends*) does not suggest the polar bear population will increase over the next three generations. While the impact of changing sea ice dynamics on bears in the higher latitude Beaufort Sea, Viscount Melville subpopulation and Arctic Basin subpopulation is uncertain, and it is possible that habitat for polar bears may improve for a period of time, if climate change is unmitigated, continuing sea ice declines will most likely negatively impact polar bears. Indeed, the balance of evidence strongly suggests that the projected trend of the NWT polar bear population over the next three generations (34.5 years), i.e., to the year 2050, will be one of decline, and not stability.

The evidence for the statement above comes from the increasingly strong links being identified between lengthening of the ice-free season on the Beaufort Sea and polar bear survival and reproduction (see *Population Dynamics* and *Habitat Availability and Trends*), and sustained declines in body condition (blubber depth) of ringed seals—a critical food component of NWT polar bears—of the Amundsen Gulf that has not reversed (from 1992–2019, Fig. 35; see *Threats and Limiting Factors*). While the latter has yet to be studied in relation to polar bear population trends in the region it is widely accepted that nutritional stress in polar bears is linked to reduced numbers of ringed seal pups, for which ovulation failure in the Beaufort Sea has been associated with sequential years of negative residual mean blubber depth (Harwood *et al.* 2020). Ringed seal pups are critical to the diet of pregnant female polar bears (Stirling and Øritsland 1995; Stirling 2002; Stirling *et al.* 2008; Rode *et al.* 2018). For the polar bear population of the NWT to not decline further from where it is now, at an est. ≲1000 mature bears, it must be assumed that until 2050: 1) climatic linkages known to negatively influence Southern Beaufort Sea polar bears will not lead to further declines in bears of that or any other regional subpopulation; 2) sustained declines in the blubber depth of ringed seals of Amundsen Gulf will not lead to declines in Northern Beaufort Sea polar bears; or 3) that polar bear habitat and food resources will improve in other parts of the NWT range, or human-caused mortality modified, to offset any declines in abundance experienced elsewhere.

Possibility of Rescue

Genetic relatedness is likely high amongst most bears. COSEWIC (2018) reported that polar bears do exhibit evidence of genetic distinctiveness (Paetkau et al. 1999; Malenfant et al. 2016) consistent with the ecoregion differences in habitat identified in Fig. 33. However, because the genetic differences among groups are small relative to other carnivores, and the species maintains a continuous distribution across its historical Canadian range, COSEWIC therefore

concluded that these genetic units do not meet the criteria for significance of a Designatable Unit (DU). Polar bears across Canada (and hence within the NWT) are thus considered to comprise a single conservation unit or DU by COSEWIC (2018).

Rescue effects for NWT polar bears occur through natural movements of bears from other jurisdictions, individuals of which are expected to be adapted to the conditions that currently exist in the NWT. Although there is enough good habitat in the NWT, future expected changes to sea ice in the southern latitudes of the Beaufort Sea will result in reduced amounts of sea ice habitat for polar bears in the southern Beaufort Sea. Over the longer term, reduced habitat for immigrants is also expected in the higher latitudes of the Beaufort Sea. Trends of available habitat for immigrant polar bears in the Viscount Melville Sound have not been assessed. There is natural movement of polar bears across their range, however in areas where habitat loss due to ice melt becomes a limiting factor then rescue effect is not possible in that area.

Population Dynamics

True standing age distributions (age structures) of polar bear subpopulations are not well known. This is because the sampling of polar bear subpopulations cannot easily be conducted in a non-biased manner (e.g., during a capture-recapture program). For example, females with cubs may be more likely to be observed from a capture helicopter than are lone females (e.g., Taylor *et al*. 2002, 2005; Stirling *et al.* 2011). However, by controlling for bias, age- and sex-structures can still be estimated. For example, Hunter *et al.* (2007) presented a partial age structure (proportions of the population) for non-cub or non-yearling female polar bears of the Southern Beaufort Sea subpopulation, including: 0.106 for newly independent two-year-old females; 0.068 for females of age 3; 0.106 for females aged 4; 0.461 for adult females without cubs; 0.151 for adult females with new litters; and 0.108 for adult females with yearlings. Structure was averaged over 2004–2006, as obtained from a Horvitz-Thomson estimator applied to mark-recapture data in the Southern Beaufort Sea subpopulation using recapture probabilities from Regehr *et al.* (2006).

The estimated numbers of cubs or yearlings can also be obtained given the ratios of one- and two-cub litters reported by Hunter *et al*. (2007), i.e., 0.276 and 0.724, respectively. Considering a sample of 1,000 adult females partitioned according to the age-reproductive structuring indicated above, and assuming a 50:50 sex ratio in litters and that cub and yearling litter sizes are structured in the same manner, we can anticipate adding 130 female cubs and yearlings to this total (i.e., 151/2 cubs plus 108/2 yearlings). With these ratios applied to the female component of the population only, the proportion of females that are mature (aged 5+) in the Southern Beaufort Sea subpopulation (old boundaries) would have been 63.7%, as at 2006.

Little information has been presented in the published and unpublished literature on sex structure for polar bear populations of the NWT to update these numbers; however, data

suggest that both the Southern Beaufort and Northern Beaufort Sea subpopulations are female-biased with respect to adult age structure. Stirling *et al*. (2011) show that the sex ratio of all adult bears (≥5 years old) captured in the Northern Beaufort Sea from 2003–2006 was 42.1:57.9 (189 males, 260 females), which represents a significant departure from an even sex ratio in favour of females ($\chi 2 = 11.27$, P = 0.001; Stirling *et al.* 2006, 2011). Assuming these sex ratios are true standing age distributions for the non-cub component of the Beaufort Sea, for presenting status-relevant numbers we can apply 62.2% of the population (all NWT bears) as being either a mature female or a mature male.

Sighting-related biases in capture-recapture programs can also be accounted for in demographic modelling, e.g., by including covariates of re-sight probabilities (for the NWT see Taylor *et al*. 2002; Regehr *et al*. 2006; 2010; Stirling *et al.* 2011); with shortfalls countered by innovative techniques such as integrated population modelling (Regehr *et al.* 2018). Hence, although the sex-age structure of polar bear subpopulations might only be simulated (e.g., as the stable age distribution), it is still often possible to compute age- and sex-specific structures of survival and reproduction.

In long-lived species like bears, the sensitivity and elasticity of population growth rate to model parameters is likely to be greatest for adult survival rates (e.g., Heppell *et al*. 2000). Hunter *et al.* (2007) show that this is true for polar bears in the Southern Beaufort Sea subpopulation. That is, in terms of relative absolute (sensitivity) and proportional (elasticity) changes in survival, the population growth rate of a polar bear population is expected to respond greatest to changes in the fates of adult females compared to all other age and sex classes. Earlier analyses suggest that total adult female survival rate in the higher-latitude Beaufort Sea was naturally quite high at 0.920 (Stirling *et al.* 2011). Total adult female survival rate in the Viscount Melville Sound was last assessed in 1992 as 0.905 (Taylor *et al.* 2002). Regehr *et al*. (2010) showed that from 2001-2003, the ice-free period in the low-latitude Beaufort Sea (Southern Beaufort Sea subpopulation) was relatively short (mean 101 days) and adult female survival was very high (0.96-0.99, depending on reproductive state); however, in 2004 and 2005, the ice-free period was longer (mean 135 days) and adult female survival declined precipitously (0.73-0.79, depending on reproductive state).

Recent reanalyses of the Southern Beaufort Sea subpopulation data (using the US Geological Survey data set [2001-2010]) aimed to determine if the low survival rates from 2004–2005 reported by Regehr *et al*. (2010) persisted. Bromaghin *et al.* (2015) found remarkably reduced survival and abundance from 2004–2007, with improvements in adult and cub survival from very low levels (<0.80 and <0.20, respectively), and abundance, for the period 2007–2010 (with survival >0.9 for adults and cubs by 2010). Atwood *et al.* (2020) found that for Alaskan Southern Beaufort Sea polar bears, survival rates were high for 2009–2015, with the exception of 2012, which had low survival estimates. Overall, the modelling of Bromaghin *et al*. (2015)

suggested a decline of some 25–50% in population abundance from 2001-2010, but with wide confidence intervals around survival (especially late-decade rates). The observed trend was most likely due to declines in juvenile survival (with especially low cub survival in the period 2004–2006) and adult female survival rates dropping below 0.90 (a rate consistent with a growing population, see Regehr *et al.* 2018), despite the apparent recovery of adult survival toward the end of the decade. Atwood *et al.* (2020) updates Bromaghin *et al.* (2015) and provides support for their findings of a decline in abundance and survival probabilities in the mid-2000s, with a recovery in survival and stable abundance to 2015.

There is a paucity of more recent data on survival and reproduction estimates for NWT bears. Past rates are not likely to be applicable in 2020, particularly given the known changes that have been occurring in sea ice conditions since last estimation of parameters.

Habitat

Habitat Availability and Trends

Trends in habitat for polar bears are strongly associated with climate change-induced reductions in sea ice, including replacement of multi-year ice with annual ice, and increases in length of the ice-free season (reviews *in* Post *et al.* 2014; COSEWIC 2018; Durner *et al.* 2018). The Intergovernmental Panel on Climate Change's 2019 special report on the ocean and cryosphere (IPCC 2019) documents how summer upper-mixed layer temperatures increased at around 0.5°C per decade during 1982–2017 for much of the seasonally ice-free Arctic. This was primarily associated with increased absorbed solar radiation accompanying sea ice loss (decreased albedo [sun reflectance off snow]) and increased inflow of ocean heat from lower latitudes since the 2000s.

Of relevance to the status of NWT polar bears, deteriorating ice conditions since the 2012 SARC report have been noted for the Beaufort Sea, which has been impacted (by some metrics) more than any other region of the Arctic. For example, decreased albedo has been strongest in the Beaufort and Chukchi Seas compared to anywhere else in the circumpolar region over the past 30 years (decline in the albedo trend of −2.7% per decade [Peng *et al.* 2019]), with increasing impacts evident through time. There is complexity in interpreting these indicators, which is discussed later in *Habitat Availability and Trends*. The US National Snow and Ice Data Center (University of Colorado Boulder) compiles monthly reports and graphs on temperatures and ice conditions. The retreat of sea ice in summer to low levels, prior to reforming in late September and October, is clearly exacerbating in terms of extent throughout much of the Arctic (Fig. 32), but this is especially evident in the Beaufort Sea. A period of low ice conditions in the region in 2008 was eclipsed by the September 2012 occurrence of <15% ice coverage, which was the first time the Beaufort Sea was considered to be 'ice-free' (Babb *et al.* 2019). Such low levels of ice coverage again appeared in fall of 2016

(Babb *et al.* 2019), with similarly low summer ice-levels prevailing in 2019 and 2020 (Figs. 32, 33). Average Arctic sea ice extent for September 2020 was 3.92 million square kilometers, the second lowest in the 42-year satellite record, behind only September 2012 (Figs. 32, 33).

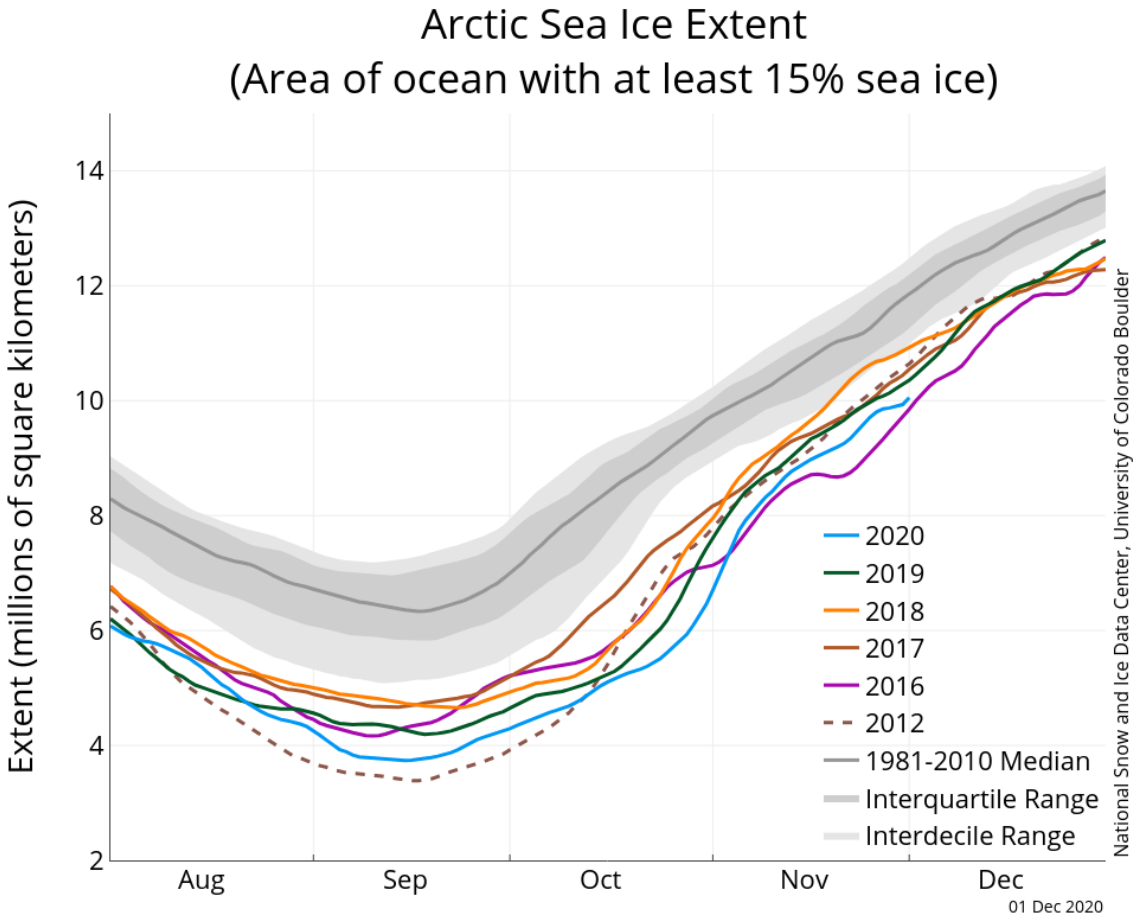

Figure 32. Arctic sea ice extent in fall has declined throughout the circumpolar Arctic since the 2012 SARC report on polar bears. Data are current as of December 1, 2020, along with daily ice extent data for five previous years and the record low year. The 1981– 2010 median is in dark gray. The gray areas around the median line show the interquartile and interdecile ranges of the data. Credit: US National Snow and Ice Data Center, University of Colorado Boulder. Available at: *http://nsidc.org/arcticseaicenews/2020/*. Data accessed February 27, 2021.

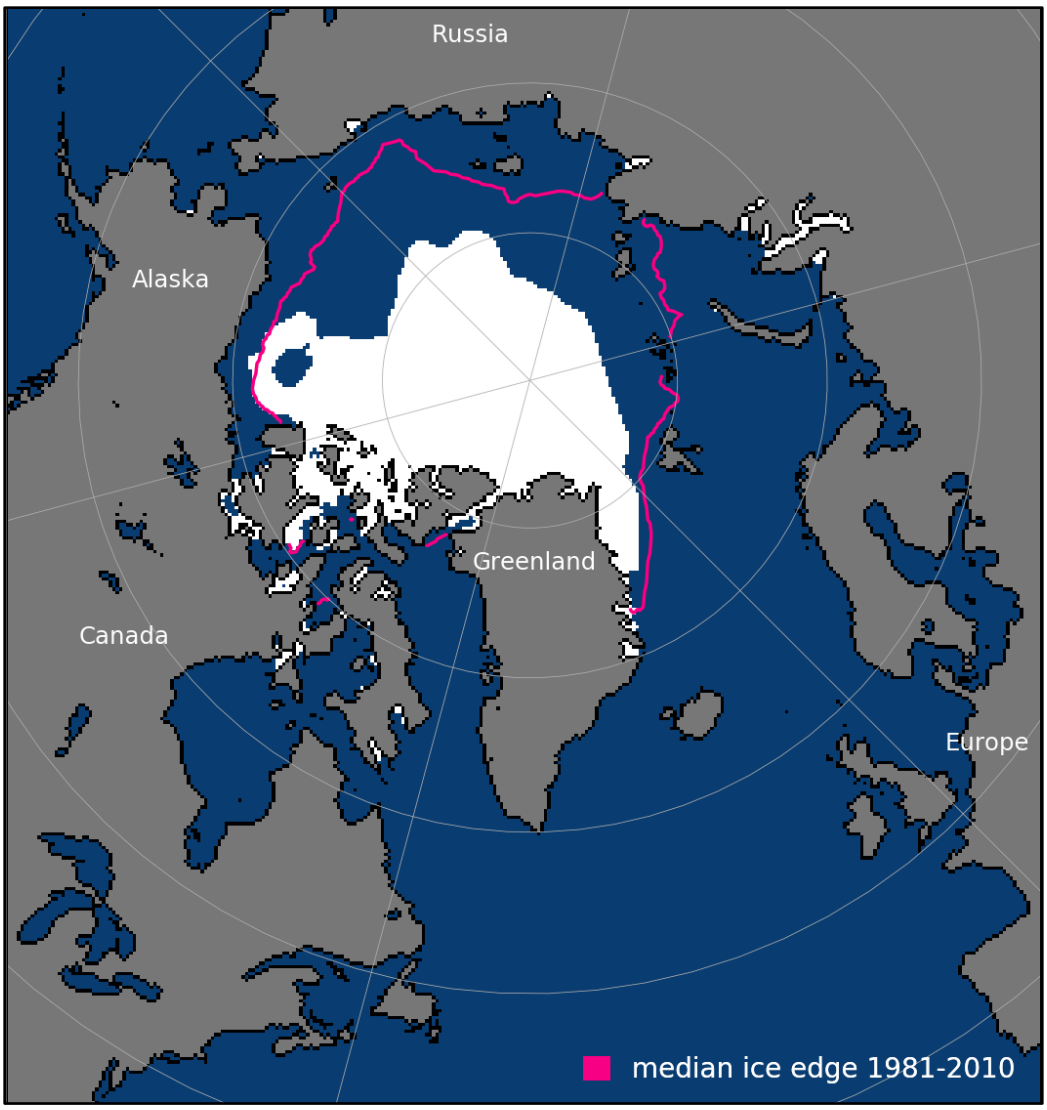

Figure 33. Arctic sea ice extent for September 2020 (white) was 3.92 million km^2, the second lowest in the 42-year satellite record, behind only September 2012. The magenta line shows the 1981 to 2010 average extent for that month. Credit: US National Snow and Ice Data Center, University of Colorado Boulder. Available at: *http://nsidc.org/arcticseaicenews/2020/*. Data accessed February 27, 2021.

Habitat (sea ice) conditions for polar bears in the Beaufort Sea are changing, with polar bears responding in turn on several levels. Atwood *et al.* (2016) observed that the percentage of radio-tracked adult females of the Southern Beaufort Sea subpopulation (marked just west of the NWT's maritime border) adopting an on-shore summer strategy vs. staying on ice year-round tripled over the 15-year period since 1990 (with the average percentage of bears staying on shore [>21 days] increasing from 5.8% during 1986–1999 to 20% during 2000–2014, reaching a high of 37% in 2013); the duration of time spent by bears onshore increased by over a month. This has resulted in more physiological signals indicative of increased rates of fasting (Rode *et al.* 2018), shifting diets as reflected in stable isotopes of carbon δC^{13} (Boucher *et al.* 2019), and even changing composition of the gut microbiome of bears (Watson *et al.* 2019) for

this subpopulation. However, use of habitat and ice features in relation to changing habitat availability has not appeared to result in marked changes in larger-scale patterns of habitat preference (Wilson *et al.* 2016), i.e., a functional response to habitat selection (Mysterud and Ims 1998) has not been observed with declining sea ice conditions. Polar bears of the Beaufort Sea are still seeking habitat that they prefer where they can find it, even as habitat availability is changing.

The logical consequence of the above is increased competition (van Beest *et al.* 2014), something that should be—and is—reflected in declining body condition and reproduction of female polar bears in the Southern Beaufort Sea of Alaska (Rode *et al*. 2010a, 2014). Following Eberhardt's (1977) postulated principles for large mammals (originally proposed for marine mammals), with increasing competition is an expected pattern of increasing offspring and juvenile mortality initially, followed by changes in age of first reproduction and then changes in reproductive rates of adult females. The fourth and last stage, as individuals experience greatest food competition, is assumed to involve changes in adult survival (with adults trading-off reproduction to maintain survival earlier on the reproduction curve). While Eberhardt's (1977) model was originally based on what we might expect for an increasing population as it moves towards food carrying capacity, the same would apply if the ceiling of carrying capacity is lowered onto a population. Reduced availability of year-round hunting habitat for polar bears as a result of deteriorating ice conditions caused by climate change is analogous to this.

Observed trends in reproduction and survival for polar bears of the low-latitude Beaufort Sea (Rode *et al*. 2010a; Regehr *et al.* 2010; Bromaghin *et al.* 2015) can help us consider if the above prediction is occuring for NWT bears. Recent sea ice loss over the continental shelf has been associated with declining survival (Regehr *et al*. 2010), especially for subadults (Bromaghin *et al.* 2015). However, cub survival was very low from 2004 through 2006 (<0.20), before beginning to improve near the end of the study, while adult survival also showed a dip to exceptionally low levels (e.g., adult female survival using US and Canadian data was estimated at less than 0.60 in 2006, meaning only 40% of adult females in the population that were modelled survived the interval). Atwood *et al.* (2020) updated Bromaghin *et al.*'s (2015) analysis for Alaskan (Southern Beaufort Sea) bears only, finding that survival was high, and remained relatively stable from 2009–2015. The Southern Beaufort Sea subpopulation, however, has not recovered from the observed decline in abundance since 2006 (Fig. 30).

Lack of recent demographic data on NWT polar bears makes it difficult to model survival at this time (see *Population*). Nonetheless, it is clear that polar bears of the low-latitude Beaufort Sea are under increasing nutritional stress in association with this loss of sea ice (Rose *et al.* 2010a). From 1982–2006, body size and body condition for most sex and age classes were positively correlated with the availability of sea ice habitat, and showed a statistically significant decline during this period (Regehr *et al.* 2010; PBSG 2010). Rode *et al.* (2010a) found

that cub litter mass and the number of yearlings per female also declined following years with lower availability of sea ice habitat in the low-latitude Beaufort Sea. Although captures in the latter study were focused on polar bears of Alaska, the bears captured in the study are from a subpopulation shared with the NWT. Additionally, through the use of serum biomarkers, Cherry *et al*. (2009) found a higher proportion of polar bears through the NWT Beaufort Sea (from the Alaska border to north of Banks Island, i.e., both the Southern and Northern Beaufort Sea subpopulations) were fasting in the springs of 2005 and 2006 (21.4% and 29.3%, years following large sea ice retreats compared to 1985-1986 (9.6% and 10.5%). This is notable because 2006 corresponded with Bromaghin *et al*.'s (2015) documented interval of lowest adult male and adult female survival (both <0.80), and exceptionally low cub survival rates (<0.20): rates of survival that are exceptionally poor for a large mammal like a polar bear. More recent data supports these findings: fasting periods onshore have been estimated to be increasing for bears of the low-latitude Beaufort Sea (Rode *et al.* 2015a; Atwood *et al.* 2016), where bears also appear to be responding to changing ice conditions by increasing diet breadth (Rogers *et al.* 2015; Boucher *et al*. 2019). The best scientific evidence suggests that in years of low ice coverage, polar bears of the Beaufort Sea are expected to experience low survival and recruitment, compared to years of high ice coverage, due to impacts of longer periods onshore. Further discussion of the fasting response and foraging plasticity of polar bears is presented in *Physiology and Adaptability*.

In contrast to conditions of the Beaufort Sea (especially trends in shore ice availability along the mainland), year-round availability of sea ice among NWT islands in the Arctic Archipelago appears to be somewhat less impacted by recent climatic trends. However, even Viscount Melville Sound has begun to experience unusual periods of low sea ice in September, a phenomenon noted first in summer 2011 (USFWS 2012; Comiso 2012) and 2012 (Williams pers. comm. *in* SARC 2012). The type of ice present in Viscount Melville Sound (multi-annual vs. annual) may also be changing (Comiso 2012), although ice coverage can still remain high even if reduced in the nearby Beaufort Sea (Fig. 32).

Scientific observations of changes in sea ice in the Arctic have been summarized by numerous authors, with recent polar bear-specific reviews appearing in Durner *et al*. (2018) and COSEWIC (2018). The Intergovernmental Panel on Climate Change (IPCC) recently released a comprehensive report on changing ice conditions with chapters specific to the Arctic (IPCC Special Report on the Ocean and Cryosphere in a Changing Climate) in 2019 (IPCC 2019). Higher temperatures and loss of sea ice in the Arctic does not bode well for the long-term future of polar bears (Amstrup *et al.* 2008). In the previous SARC report for polar bears (SARC 2012), the effects of changes in sea ice habitat to polar bears in the NWT were forecasted to be most severe in the Southern Beaufort Sea subpopulation compared to elsewhere; this has proven to be true.

Longer periods of open water and increased ice roughness in recent years, caused by the action of winter storms on thinner ice, may reduce foraging success and increase the energetic costs of locomotion in polar bears (Derocher *et al*. 2004; Sahanatien and Derocher 2012; Pongracz and Derocher 2017). The recent losses of annual sea ice in the south Beaufort Sea have also been associated with reports of what the IUCN/SSC Polar Bear Specialists Group has called 'inefficient foraging behaviours by polar bears', including observations in Alaska of cannibalism (Amstrup *et al.* 2006) and apparent starvation (Regehr *et al.* 2006) in Southern Beaufort Sea subpopulation bears. Increased ice roughness has also been linked to observations of inefficient foraging behaviours during spring in the eastern Beaufort (Stirling *et al.* 2008). However, it remains unclear how polar bears, in general, may respond demographically to changes in local ice conditions. We know that metrics of body condition in polar bears will depend on the availability of food and will vary seasonally and markedly in space (Galicia *et al*. 2019), but these metrics can still remain high even with substantial declines in annual sea ice. For example, despite also experiencing declines in ice conditions over the past several decades (including a -26% change in summer sea ice area per decade from 1979–2018), polar bears of the Chukchi-Bering seas, compared to the Beaufort Sea, remained larger and in considerably better condition than low-latitude Beaufort Sea bears (Rode *et al*. 2014), as apparently reflected in demographic rates consistent with a productive and stable population (Regehr *et al*. 2018; Durner *et al*. 2018). Rode *et al.* (2014) speculate that this may be because of higher productivity and prey availability in the Chukchi-Bering Sea regions compared to the Beaufort Sea, and a shorter recent history of reduced sea ice habitat.

It is important to note that the types and conditions of sea ice in the NWT vary substantially among the polar bear subpopulations, which may account for the relatively dire forecasts of habitat trends for polar bears in the lower-latitude Beaufort Sea. Polar bears of the Chukchi and low-latitude Beaufort Sea live in what is called a divergent sea ice zone (called 'ecoregion' in Amstrup *et al.* 2008; Fig. 33), where ice is generally carried by currents offshore and melts away from shore during summer, versus the greater part of the high-latitude Beaufort Sea, which is convergent in nature, where ice motion promotes convergence and shoreward drift of ice (e.g., toward northern Banks Island) year round (Durner *et al.* 2009). As noted above, it is polar bears of the low-latitude Beaufort Sea, where divergent sea ice conditions exist, which appear to be most at risk from periods of low ice coverage.

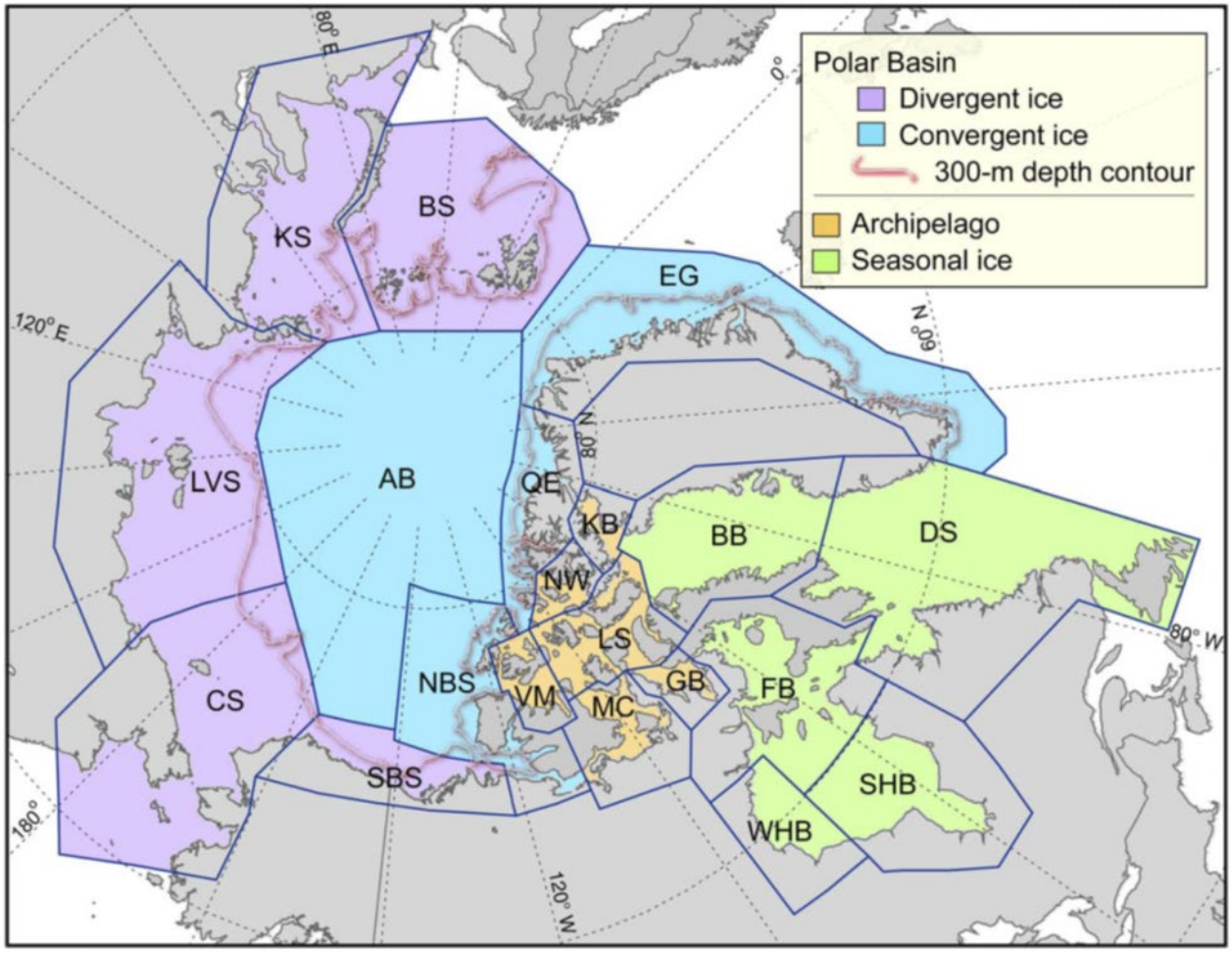

Figure 34. The polar basin study area of Durner et al. (2009), defined by a composite of IUCN/SSC polar bear subpopulation units (note the use of the older Southern Beaufort Sea [SBS]/Northern Beaufort Sea [NBS] boundary, compare with Fig. 30) located in the Arctic Ocean and peripheral seas (pelagic region). Subpopulation units are colour-shaded to distinguish membership within two groups based on general sea ice dynamics: 'divergent' (purple) where ice is generally carried by currents offshore (and melts away from shore during summer) and 'convergent' (blue) where ice motion promotes convergence and shoreward drift year-round. Subpopulation abbreviations are as in Fig. 27. Polar bear populations that range into the NWT include the Southern Beaufort Sea (SBS), Northern Beaufort Sea (NBS), Viscount Melville Sound (VM), and Arctic Basin (AB). Figure legend and figure modified with permission from Durner et al. (2009).

It is also possible that changing conditions of the higher-latitude Beaufort Sea (and possibly also the Viscount Melville Sound, see discussion below) may have benefitted polar bears, which prefer less heavy sea ice than has historically occurred in these regions (for feeding on seals). Stirling *et al.* (2011) commented that although the ice conditions in the low-latitude Beaufort Sea were likely past the point at which polar bears might have benefitted from milder conditions, stability in the higher latitude Northern Beaufort Sea subpopulation of polar bears (up until 2006), suggested this was not the case in the north.

For polar bears in the Viscount Melville Sound subpopulation, seasonal sea ice profiles conform to neither those of the Southern nor Northern Beaufort Sea (Durner *et al.* 2009, 2019). Ice patterns include greater concentrations of multi-year ice that offer polar bears hunting platforms year-round (Comiso 2012). Different sea ice characteristics for archipelago ice profiles like that of the Viscount Melville Sound precluded the region from being included in the study of Durner *et al*. (2009). Polar bear density has historically been lower in the Viscount Melville Sound compared to other regions because of large expanses of heavy, multi-year ice and low densities of ringed seals (Kingsley *et al.* 1985); however, in recent years loss of multi-year ice with replacement by annual ice has been apparent (Comiso 2012) with changes in the date of spring ice retreat of –5.5 days per decade, and a relatively high 7.7 day delay in fall ice advance per decade (1979–2018; PBSG 2019). Trends in sea ice characteristics as they pertain to polar bear habitat in the Arctic Basin also show important changes, including a –7.4% decline in summer sea ice area per decade (1979–2018; PBSG 2019).

One final consideration on habitat trends is the impact of increased coastal erosion (Mars and Houseknecht 2007; Jones *et al*. 2009; Schwarz 2011; Wobus *et al*. 2011) on polar bear maternal denning habitat, in part due to increasing sea levels (T. James *cited in* ENR 2011b) and other factors such as low ice cover and increasing frequencies of storms (Kokelj *et al*. 2012). It is a potential concern for Southern Beaufort Sea polar bears because many pregnant bears may den on barrier islands and next to coastal banks where the terrain allows drifting snow to accumulate (see *Habitat Requirements*). Some coastal denning habitat may disappear in the future, and this may result in a change in denning distribution (USFWS 2012). Additionally, there are potential impacts of changing sea ice composition on maternal den distribution, as seen in the US portion of the Southern Beaufort Sea polar bear range (Fischbach *et al.* 2007).

Habitat Fragmentation

Habitat fragmentation, as it relates to polar bear habitat, was defined by Sahanatien and Derocher (2012). In the NWT, polar bear habitat is dependent on sea ice conditions. Overlap of all subpopulations in the NWT is considerable and habitat is not considered to be fragmented to the point of isolation (see *Distribution*).

Distribution Trends

Polar bears currently occupy the same overall distribution in the NWT as they have historically. However, seasonal distributions may be changing as described in *Habitat Availability and Trends*.

Threats and Limiting Factors

Limiting factors can influence survival, reproduction, or both: it is the balance (or rather imbalance) between births and deaths that determines the trajectory of a population. Limiting factors can be direct, such as what can be classified as a cause of death (e.g., starvation, death due to hunting), cause for loss of a litter (e.g., infanticide), or failure to breed (e.g., lack of males), or they can be indirect, which may include variables that underlie causes of death or impaired reproduction. For a species like the polar bear, this will include variables that relate to the functional carrying capacity of the population (e.g., availability of food or adequate habitat, see *Habitat Availability and Trends*). In this sense, as a species entirely dependent on sea ice as a platform upon which to hunt seals, conditions of sea ice can be viewed as one of the main, indirect limiting factors to polar bears.

In all parts of the NWT, the harvest of polar bears has been below the quota for many years (ENR, unpublished data). The Viscount Melville Sound subpopulation has been historically managed for population increase after overharvesting in the late 1980s and early 1990s (Taylor *et al*. 2002), but with unknown efficacy at time of writing. Polar bears living in the Arctic Basin region of the NWT are not hunted due to the distance of these bears from hunting communities. Most polar bears (all age categories) are thus dying natural deaths in the NWT, the direct nature of which is likely impossible to assess. This may include intraspecific predation, deaths due to starvation, and accidental deaths. Factors such as pollution and the accumulation of environmental contaminants (mainly organochlorines) in tissues of polar bears are not likely to be a current limiting factor for polar bear populations (review *in* COSEWIC 2008), but new studies indicate that sub-clinical impacts on the health of individuals may over time have cumulative effects on whole populations through lowered immune systems and reproduction rates (Sonne 2010).

Climate change in the Arctic now dominates the field of polar bear conservation biology. Review papers (e.g., Stirling and Derocher 1993; Barber and Iacozza 2004; Derocher *et al*. 2004; Stirling and Parkinson 2006; Post *et al.* 2013), Indigenous knowledge studies (e.g., Dowsley 2005), previous status reports (COSEWIC 2008; PBSG 2010; SARC 2012; Durner *et al.* 2018; COSEWIC 2018), and government findings (USFWS 2010) and projections (Hunter *et al*. 2010;, Regehr *et al*. 2016) offer insight into the possible impacts of past and continued climate warming on polar bears. The discussion presented in *Habitat* discusses the most relevant literature pertaining to the status of the polar bear in the NWT related to climate-mediated impacts on polar bear habitat, which is not repeated here. However, climate change will likely influence all of the direct limiting factors to polar bears listed above (and below) and may therefore be thought of as an ultimate threat to the species. The threat of anthropogenic climate change must be treated as an integral part of any discussion of the limiting factors of polar bear distribution and abundance.

For the purpose of assigning status, we can consider three main categories of direct and indirect limiting factors to population dynamics of polar bears: 1) direct human-caused mortality; 2) climate change-related impacts on natural survival and reproduction; and 3) other potential limiting factors including, for example, pollution, and environmental contamination.

Direct Human-caused Mortality

Harvest rates of polar bears in the NWT (Table 6) are all likely to be less than 5% of the territorial population. The recent average of all NWT harvesting including kills in defense of life or property (DLPs) (which includes both mature and immature bears) sums to 41 bears/year (2016–2020), which is 4.1% of the population if we assume 1,000 mature bears as occurring within the borders of the NWT, and 4.6% of the population if we assume a lower estimate of 900 mature bears in the territory. In either case, the population is being harvested at levels well below the identified possible annual quota for each subpopulation, and in general agreement with a sex bias towards males (34.4% female in the Northern Beaufort Sea, 41.1% female in the Southern Beaufort Sea). Viscount Melville Sound harvesting is low (and non-existent in some years, as the average kill has been 0.4 bears per year since 2016). Unsustainable harvesting due to quotas being set too high was, until the mid-1990s, a major concern for the Viscount Melville Sound subpopulation (Taylor *et al.* 2002). Today, substantially reduced mean rates of annual kill would be consistent with simulations to have reversed trends in these subpopulations (Taylor *et al.* 2002; COSEWIC 2008). That said, due to the long period since the latter subpopulation was last inventoried (1992, Tables 4, 5), the current status of polar bears in the Viscount Melville Sound is unknown.

For a polygynous species such as polar bear, if hunting was the only source of mortality in the population, population growth would be expected for total kill rates of <5% annually (McLoughlin *et al.* 2005); however, the best available information suggests that for subpopulations like that of the Southern Beaufort Sea, populations are not increasing but even under reduced harvest pressure are remaining stable (Bromaghin *et al.* 2015, Atwood *et al.* 2010). This tells us there is likely to be a relatively large source of mortality other than known human-caused mortality affecting population growth rate in the Southern Beaufort Sea subpopulation.

How human-caused mortality interacts with climate warming and impending changes to abundances of or access to seals is of considerable importance to the conservation of polar bears. One likely impact of climate change is an anticipated increase in bear-human conflicts, which would affect the manner in which polar bears are killed in Canada (Derocher *et al.* 2004; Stirling and Parkinson 2006; Towns *et al.* 2009; Peacock *et al.* 2010, 2011; COSEWIC 2018). Reductions in food availability (including ringed seals and the amount of blubber held by ringed seals, see Harwood et al. [2020], also Fig. 34) may result in increases in nutritionally stressed bears spending longer periods of time onshore, where humans live. Increases in bear

interactions with humans in areas most affected by climate warming have been reported in recent years, including for communities adjacent to the Alaskan southern Beaufort Sea (Schliebe *et al.* 2006; Wilson *et al*. 2016; Wilder *et al*. 2017) and western Hudson Bay (McDonald *et al.* 1997; Stirling *et al.* 1999; Stirling and Parkinson 2006; Towns *et al*. 2009). Stirling and Parkinson (2006) showed that for western Hudson Bay, the earlier the ice breaks up the more bears interacting with humans there are in a year, and vice versa (see Fig. 14 of Stirling and Parkinson [2006]).

Table 6. Historic harvest rates for polar bear subpopulations overlapping with the NWT border, including the Northern Beaufort Sea (NB), Southern Beaufort Sea (SB), and Viscount Melville Sound (VM) subpopulations (Fig. 29). Data include the total harvest for each subpopulation for the range of periods indicated, the NWT-only harvest, kills in defense of life or property (DLPs), the NWT average total number of kills per year, average number of female kills per year, and how these numbers relate to the total annual quota assigned to NWT or ISR (in the case of the Southern Beaufort Sea) and the total subpopulation quota.Data provided by NWT Environment and Natural Resources, Government of Nunavut, and United States Fish and Wildlife Service (unpublished data).

	Total Harvest	NWT Harvest	NWT DLPs	NWT Avg/year Total	NWT Avg/year Female	NWT Annual Quota	Total Annual Quota
Northern Beaufort Sea Subpopulation							
2016-2020	188 (65)[1]	186 (64)	5	37.2	12.8	71	77
2011-2020	403 (136)	390 (130)	10	39	13	59 to 71	65 to 77
2001-2010	296 (124)	273 (115)	5	27.3	11.5	59	65
Southern Beaufort Sea Subpopulation							
2016-2020	102 (20)	17 (7)	0	3.4	1.4	21	56
2011-2020	306 (123)	105 (49)	0	10.5	4.9	35 to 21	56 to 70
2001-2010	482 (207)	179 (66)	2	17.9	6.6	40 to 35	70 to 80
Viscount Melville Sound Subpopulation							
2016-2020	12 (6)	2 (2)	0	0.4	0.4	4	7
2011-2020	40 (18)	16 (10)	0	1.6	1	4	7
2001-2010	43 (13)	18 (6)	0	1.8	0.6	3 to 4	8 or 7

[1]Female harvest indicated in brackets. All kills of 'Unknown' sex are included as female.

In conclusion, unsustainable human-caused mortality is not expected to be a present cause of concern for the conservation of polar bears in the NWT. However, in the medium to long-term, with increasing pressures on polar bears due to sea ice loss and possible increased natural mortality, human-caused mortality (including harvest) could become an issue, unless adaptive management, inclusive of harvest-risk assessment that is cognizant of environmental change, is employed.

Climate Change and Effects on Natural Survival and Reproduction

Recently, researchers from Environment and Climate Change Canada and the United States Geological Survey (USGS) Alaska Science Center have been able to provide quantitative evidence for the effects of climate-related stressors on polar bear demographic rates (reviews *in* Durner *et al*. 2018; COSEWIC 2018) by establishing relationships between earlier break-up of sea ice in western Hudson Bay and the southern Beaufort Sea and decreased survival of polar bears (Regehr *et al*. 2007, 2010) particularly for juveniles. Coupled with observations that body size and condition (Stirling *et al*. 1999; Obbard *et al*. 2006; Molnár *et al.* 2010; Rode *et al.* 2014) and recruitment (e.g., numbers of yearlings per female, litter size [Rode *et al.* 2010a, 2014; Molnár *et al*. 2011]) of polar bears have declined in association with earlier break-up in spring and reduced availability of preferred sea ice habitats, the best available evidence suggests trends of decline in subpopulations at their southernmost continental ranges (e.g., Southern Beaufort Sea and western Hudson Bay) are food-related. Direct effects of lack of available food to polar bears may include increased risks of mortality due to intraspecific predation and cannibalism (Amstrup *et al*. 2006) or starvation (Regehr *et al.* 2006). As discussed above, it is also possible that due to lack of food polar bears may be more likely to interact with humans, and thus be killed in defense of life and property (e.g., Wilder *et al*. 2017; Wilson *et al*. 2017), although in the NWT, defense of life and property kills are counted under a subpopulation's quota. Retreat of sea ice and more frequent storms during the open-water season may also cause a rise in natural mortality due to drowning (Monnett and Gleason 2006).

From the perspective of status in the NWT, the most current understanding of the effects of earlier break-up of sea ice on polar bear mortality comes from research from the Southern Beaufort Sea unit. Regehr *et al.* (2010) first noted that polar bear survival declined with an increasing number of days per year that waters over the continental shelf were ice free. In 2001–2003, the ice-free period was relatively short (mean 101 days) and adult female survival was high (0.96–0.99, depending on reproductive state). In 2004 and 2005, the ice-free period was longer (mean 135 days) and adult female survival was low (0.73–0.79, depending on reproductive state), a trend that persisted for the next couple of years before recovering to above 0.80 (Bromaghin *et al.* 2015) and remained as such to 2015 for Alaska-captured Southern Beaufort Sea bears (Atwood *et al.* 2020).

Rode *et al*. (2010a) tested whether patterns in body size, condition, and cub recruitment of polar bears observed on the Alaskan side of the southern Beaufort Sea (including bears that ranged into the NWT) were related to the availability of preferred sea ice habitats and whether these measures and habitat availability exhibited trends over time, between 1982 and 2006. Rode *et al*. (2010a) found that mean skull size and body length of all polar bears over three years of age had declined over time, corresponding with long-term declines in the spatial and temporal availability of sea ice habitat. Body size of young, growing bears declined over time

and was smaller after years when sea ice availability was reduced. Reduced litter mass and numbers of yearlings per female following years with lower availability of optimal sea ice habitat suggest reduced reproductive output and juvenile survival.

Hunter *et al.* (2010) evaluated the impacts of climate change on polar bears in the southern Beaufort Sea by means of a demographic analysis, combining deterministic, stochastic, and environment-dependent matrix population models with forecasts of future sea ice conditions from Intergovernmental Panel on Climate Change (IPCC) general circulation models (GCMs). Parameter estimates were obtained from the capture-recapture study conducted from 2001 to 2006 by Regehr *et al*. (2006, 2010). Candidate statistical models allowed vital rates to vary with time and as functions of a sea ice covariate. Hunter *et al*.'s (2010) deterministic models projected population growth in years with more extensive ice coverage (2001–2003) and population decline in years with less ice coverage (2004–2005). Their stochastic model with two environmental states, good and poor sea ice conditions, projected a declining stochastic growth rate as the frequency of poor ice years increased. This stochastic model was then linked to a set of 10 GCMs compiled by the IPCC. The resulting stochastic population projections showed severe declines in the Southern Beaufort Sea polar bear subpopulation by the year 2100. Further analyses linking worldwide population projections to sea ice or habitat productivity have been produced by Regehr *et al.* (2016) and Hamilton and Derocher (2019).

All these results, based on analysis of the long-term data sets that exist primarily for the Alaskan southern Beaufort Sea (which is shared with the NWT), suggest that changing ice conditions in this region is a serious threat to polar bears, manifesting in nutritional limitations that will reduce body size, survival, and reproduction (also see *Habitat Availability and Trends*). However, there also exists strong evidence from the Northern Beaufort Sea, particularly the Amundsen Gulf, that suggests a climatic threat of direct relevance to polar bears—continued and sustained declines in the body condition (blubber depth) of their principal source of food, ringed seals. Harwood *et al.* (2002) confirmed a sustained, significant temporal declining trend in blubber depth of adult ringed seals sampled in Prince Albert Sound and the Amundsen Gulf, near Masoyak, NWT (1992–2019; Fig. 35), also associated with the winter Arctic Oscillation Index (AOI). Mean blubber depth of harvested females (aged 7–20 yrs) appears to have declined at a rate of 0.02 cm per year (SE = 0.005), which, over the 30-year period of montoring, accounts for why the time-series high for seal blubber depth in females was 2.92 ± 0.34 cm (mean ± SE) in 1992 but the low was 2.10 ± 0.41 cm in 2018, roughly a 28% decline in blubber depth. Further, ovulation failures in females in the study of Harwood *et al.* (2020) were partially explained by preceeding years of reduced blubber depth and earlier (but not later) date of annual sea ice clearance (Harwood et al. 2020), suggesting a complicated if as yet poorly understood link between changing sea ice conditions and nutritional stress in ringed seals of the area. Regardless of the manner in which climate change may be influencing the

above, it is clear that the body condition of ringed seals is clearly declining in the Northern Beaufort Sea subpopulation of polar bears. This is a threat to polar bears of the region, as it is indisputable that ringed seal pup production is influenced by female nutritional stress, and that young ringed seals are critical to the diet of all polar bears but especiallypregnant female polar bears (Stirling and Øritsland 1995; Stirling 2002; Stirling et al. 2008; Rode et al. 2018).

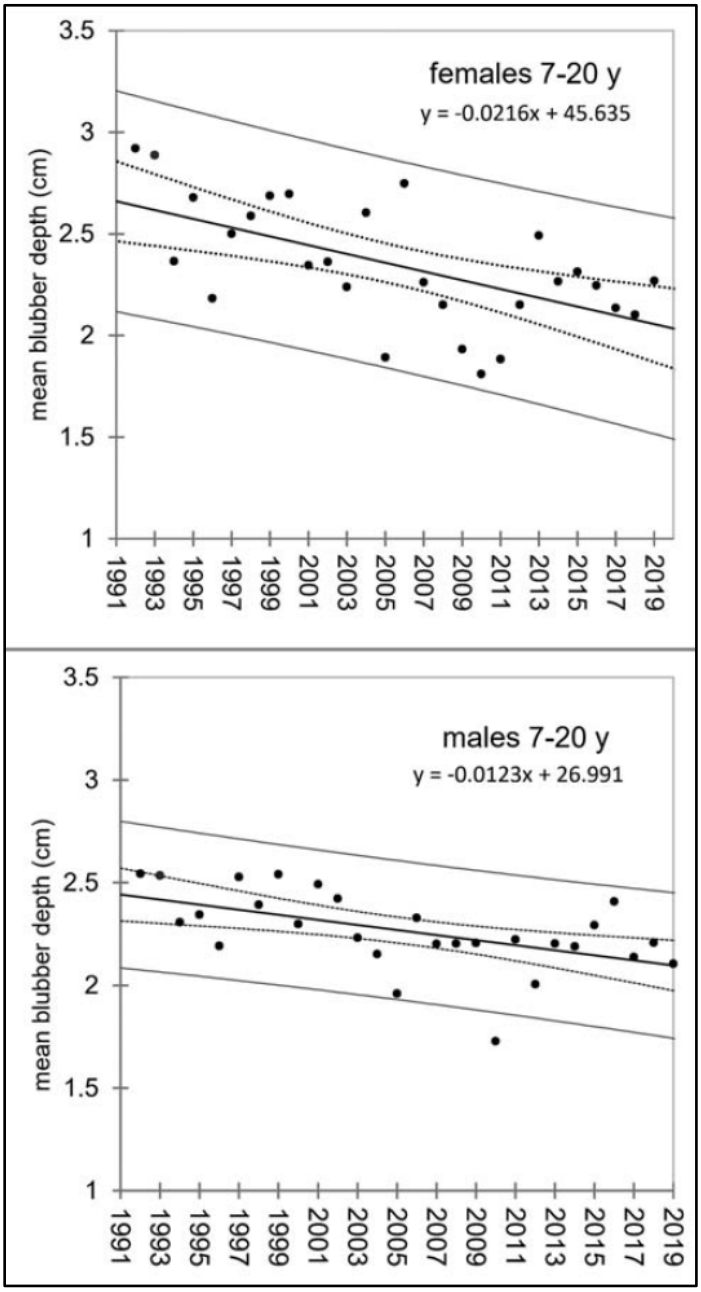

Figure 35. Mean annual blubber depth of 483 multiparous female (upper) and 793 adult male (lower) ringed seals aged 7 –20 years sampled from the subsistence harvest at Masoyak, June –July 1992 –2019 (95% confidence interval of the model dashed lines; 95% confidence interval of observations, outer lines). Data are applicable to the east Amundsen Gulf and Prince Albert Sound of the Northern Beaufort Sea subpopulation. Reprinted from Harwood et al. (2020) under Creative Commons Attribution.

Much less is understood about threats and limiting factors for polar bears that live in more northern regions, including the NWT subpopulations of the Northern Beaufort Sea, Viscount Melville Sound, and parts of the Arctic Basin. Hamilton and Derocher's (2019) worldwide assessment of subpopulation vulnerability to climate change (based on a 'vulnerability index' of subpopulation size, amount of continental shelf habitat, prey diversity, and changing ice conditions) indicates that the Southern Beaufort Sea, Northern Beaufort Sea, and Arctic Basin subpopulations appeared to be the most vulnerable, followed by the Laptev Sea and Viscount Melville Sound subpopulations. Notably, all but one of these subpopulations include the NWT polar bear population.

What may be happening to the polar bear population in Viscount Melville Sound, and areas north, remains obscure. Earlier reports of higher numbers of bears and triplets in Viscount Melville Sound suggest that loss of multi-year ice in the region, coupled with a low harvest rate (Table 4), may be benefitting polar bears of the region (Atkinson pers. comm. *in* SARC 2012; Branigan pers. comm. *in* SARC 2012: 92). Derocher *et al.* (2004) provided a synopsis of possible scenarios of changes in food availability to polar bears in the context of climate change, including the potential for climate warming to benefit some subpopulations. If climate change increases prey diversity in some areas, where it is presently low, this could be important, as the only significant variable in Hamilton and Derocher's (2019) regression of putative habitat indices and subpopulation size was marine prey-species diversity. This might apply to polar bears at the extreme northern edge of the species' range (e.g., Viscount Melville Sound and the Arctic Basin), where historically low primary productivity and heavy, multi-year sea ice limits densities of and access to ringed seals (Kingsley *et al*. 1985); but these are also small populations that are inherently vulnerable in nature (Hamilton and Derocher 2019).

Although it remains uncertain as to how polar bears of the NWT will respond to climate warming, it is logical that there must be a minimum coverage of ice for some period of time (any ice, annual or multi-year) conducive to the presence of polar bears. Only rarely have polar bears been observed to kill seals while swimming in open water (Furnell and Oolooyuk 1980, JS 2015), and killing of seals and walrus when hauled out on land will likely never replace the advantage of killing seals from sea ice (Derocher *et al*. 2004). Where climate warming eliminates annual winter sea ice or substantially increases the open water season from maximum periods associated with areas of current occupancy by polar bears, the species is not expected to persist.

Other Limiting Factors and Threats

Since the mid-1960s, exploration for energy and mineral reserves has led to an increased amount of industrial activity in the Arctic. The Mackenzie shelf has high potential for oil and gas development (Callow 2012) and other regions within NWT waters are believed to have high potential for undiscovered hydrocarbons (Gautier *et al*. 2009). Industrial activities have the

potential to alter polar bear habitat from normal exploration and development (Stirling 1990), and because of spilled oil (Amstrup *et al.* 2006), including physiologic effects on polar bears and their prey (St. Aubin 1990a, b). The primary threat to polar bears from industrial development may come from the potential for environmental contamination, especially large-scale oil spills. Oil is extremely toxic and potentially lethal to bears in even small amounts (Øritsland *et al*. 1981; Stirling 1990; Derocher and Stirling 1991). Although some oil-spill simulations (Durner *et al.* 2001) suggest that relatively few bears in Canada (Southern Beaufort Sea) would encounter oil if a major spill occurred from existing operations, as climate change increases access to the polar basin we might anticipate increased risks to bears with increased development in the Canadian Arctic Archipelago. Extensive discovered and recoverable oil and gas reserves exist in Nunavut, including the 3.3 × 106 barrel (oil) and 17.4 × 108 ft3 (gas) reserves of the Sverdrup sedimentary basin (Drummond 2006), which overlaps the subpopulations of Viscount Melville Sound and Northern Beaufort Sea. Continued development of the 1.0 × 107 barrel (oil) and 9.7 × 108 ft3 (natural gas) petroleum reserves of the Beaufort Sea/Mackenzie Delta in the NWT (Drummond 2006; JRPMGP 2009) may put additional pressure on the Southern Beaufort Sea subpopulation of polar bears. However, in 2016, Canada and the United States announced a joint moratorium on offshore oil and gas work in the Arctic. In Canada, the moratorium includes new and existing oil and gas licenses and is to be reviewed every five years; the current order extends until December 31, 2021 In the United States, the moratorium has no expiration date. The Nunavut Impact Review Board has recommended that the Canadian moratorium be extended for another ten years (Nunatsiaq News 2019; Vigliotti 2019).

The United States' Tax Cuts and Jobs Act, which was passed in 2017, mandated the US Senate to open up the 1002 lands part of the Arctic National Wildlife Refuge, to oil and gas drilling. The 1002 lands is part of the denning habitat for the Southern Beaufort Sea polar bear subpopulation. The future of oil and gas development in the 1002 lands is unclear at the time of writing, but the US Bureau of Lands Management has indicated that a lease sale for the 1002 lands will occur on January 6, 2021. A proposal for seismic exploration in the 1002 lands was also posted by the Bureau of Land Management for comment in fall 2020. Since the polar bear is a legally listed species under the Endangered Species Act, all activity in the 1002 lands is subject to incidental take permitting from the US Fish and Wildlife Service.

In recent years, significant levels of various contaminants (organochlorines and other persistent organic pollutants) have been documented in polar bear tissues or tissues of their prey, particularly adipose tissue (for recent review, see COSEWIC 2018 and Blévin *et al.* 2020). Effects of various compounds in the tissues of polar bears or of the seals they feed on remains largely unknown. Although contaminant levels in some subpopulations correlate with impaired endocrine function (Skaare *et al.* 2001; Oskam *et al.* 2004), immune function (e.g., Bernhoft *et*

al. 2000; Skaare *et al*. 2002; Lie *et al.* 2004, 2005), and potentially bone mineral composition (Sonne *et al.* 2004), there has been little demonstration of demographic effects from contaminants on polar bears (Jenssen *et al*. 2015). Nonetheless, changes in polar bear behaviour brought about by climate-induced modifications to the Arctic marine ecosystem may also alter contaminant-exposure pathways. However, as yet, we know little of these consequences to polar bears. While greater time spent on shore may expose bears to terrestrial pathogens (above), they may also reduce the risks to polar bears to some pollutants (e.g., polychlorinated biphenyls, organochlorine pesticides, polybrominated diphenyl ethers), if geographic distribution is altered from a pelagic- to a more coastal-feeding niche, thus reducing exposure to contaminant biomagnification via the marine food web. This is suggested by Blévin *et al.*'s (2020) comparison of contaminant levels in pelagic vs. coastal polar bears feeding in the Barents Sea; but also Atwood *et al*. (2017), who showed that mean plasma concentrations of an organochlorine were significantly lower for land-based (compared to bears remaining on sea ice during summer and fall) in the low-latitude Beaufort Sea.

Other contaminants, including plastics, have been reported to increasingly account for stomach content in polar bears. Stimmelmayr et al. (2019) reported that from 51 necropsied polar bears harvested or found dead in the Southern Beaufort Sea subpopulation, stomachs of polar bears routinely carried plastics (25% of bears). Plastics including bags and refuse can lad to pyloric gastric outlet obstruction (Stimmelmayr et al.2019), of which two bears in their study were diagnosed as such.

Disease is also a potential limiting factor to consider, particularly if overall carrying capacity has been reduced (competition intensified) for polar bears in some areas due to changes in sea ice, and predictions of pathogen invasion (Kutz *et al*. 2009) into the Arctic bear true. Notably, polar bears known to spend relatively more time on land in the south Beaufort Sea present as having increased exposure to several parasites (Atwood *et al*. 2017). A recent study found heightened immune system activities in Southern Beaufort subpopulation bears that spend more time on land, compared to bears spending more time on the sea ice (Whiteman *et al.* 2019). However, very little is known about the limiting effects (demographic consequences) of parasitism and disease in polar bears. Furthermore, understanding the potential impact of disease on polar bears is complex because we must consider both exposure to disease and the actual risk of clinical disease to the species or animal.

Inuit interviewed for Indigenous knowledge studies have real concerns about scientific research methods, whereby bears are immobilized using drugs, and helicopters and snowmobiles are used to capture bears, which may cause displacement of bears or result in long-term, adverse physiological effects (McDonald *et al*. 1997; Atatahak and Banci 2001; Dowsley and Taylor 2006; Dowsley 2005). However, Messier (2000), after analyzing 3,237 research handlings of polar bears for the period 1989–1997, concluded that long-term effects

on polar bears of tagging and radio-collaring are largely negligible from the perspective of population dynamics. Nonetheless, polar bears are sometimes killed by accident during the course of scientific research and these accidental deaths are taken out of the total allowable harvest. Messier (2000) reported that mortalities occurred at an average rate of 1 per 1,000 bears handled for management and population studies. Risk of mortality was higher for more complex handling protocols associated with studies of physiology (28 bears per 1,000 bears handled). In recent years in the NWT, researchers have been exploring less invasive research techniques, including scat genetics, e-DNA, aerial surveys and genetic or DNA capture-recapture methods. Researchers in the NWT are currently in the midsts of a 3-4 year field research program using the genetic mark-recapture. Although this method involves pursuing polar bears by helicopter to biopsy dart them from a distance, there is no physical handling or immobilization of the bear. In addition, there are protocols in place to avoid disturbing sows and cubs.

In all likelihood and within our lifetimes, due to changing climate patterns, the Northwest Passage will remain open for increasing periods of time, making it attractive as a major shipping route (COSEWIC 2019). Routes from Europe to the Far East are reduced by as much as 4,000 km by travel through the waterway, as compared to the route through the Panama Canal. Polar bears in the NWT and in the vicinity of this new shipping route may be exposed to traffic and levels of pollution that no subpopulation of polar bear has yet experienced (not only for commerce, but also from tourism [e.g., cruise ships]). The number of transits increased from four per year in the 1980s to 20-30 per year in 2014-2019 (ENR 2016; Figure 36). (ENR 2016). How they will respond to these cumulative effects is unknown, but increased sea traffic in NWT waters is a potential threat that could include the release of oil, introduction of invasive species, ship emissions, and noise (Niemi *et al.* 2012, COSEWIC 2018).

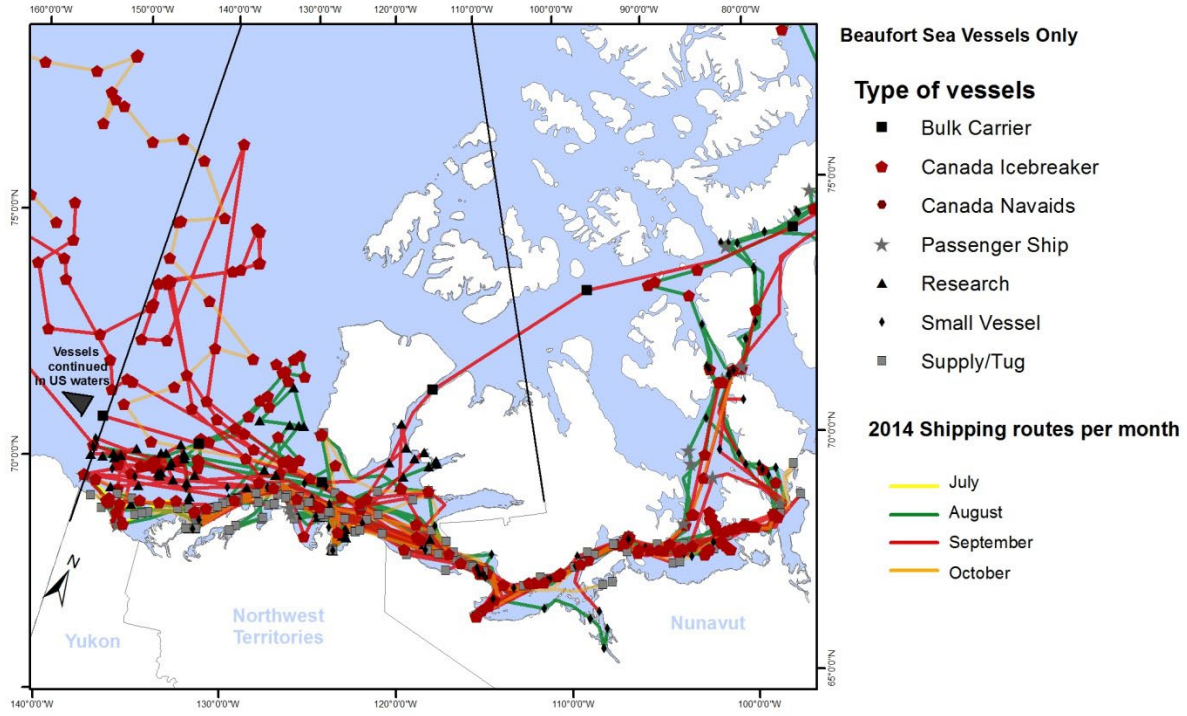

Figure 36. Vessel transit through the Beaufort Sea by type of ship and month from ENR 2016. Data derived from NORDREG 2015.

Positive Influences

Positive influences on polar bear populations in the NWT (i.e., factors that are likely to promote population growth) can be classified into two main categories:

1) protections afforded to polar bears through legislation and management planning and
2) the potential for climate change in northern parts of the species' range in the NWT to improve polar bear habitat in the short term (ice conditions amenable to seal productivity).

Of these two influences, only the former can be commented on without resorting to speculation as, apart from some analyses of Durner *et al.* (2009), thorough research on the potential effects of improved ice conditions for polar bears has not been conducted for bears of the NWT.

Protections and Management

Internationally, polar bear research and management are coordinated under the *Agreement on the Conservation of Polar Bears*, which was signed in November 1973, and came into effect on May 26, 1976 (also see Stirling 1988a; Prestrud and Stirling 1994). The signatories, collectively known as the Polar Bear Range States (Norway, Canada, Greenland, the Russian Federation

and the United States) noted that at that time the largest threat to the polar bear was over-hunting. The agreement also obliged each signatory to conduct research relating to the conservation and management of the species, the results of which are conveyed to each member nation. In the past few decades, the severity of the threat of over-harvest has decreased. In response to changing threats, the Range States developed the *Circumpolar Action Plan: Conservation Strategies for Polar Bear* (PBRS 2015) to address the growing concern over climate change and a number of other emerging issues. In the action plan the Range States agreed that the long-term conservation of polar bears depends upon successful mitigation, or lessening, of climate change with recognition that polar bears are an indicator of the biological health of the Arctic ecosystem and a significant resource that requires additional protections (PBRS 2015).

Member scientists of the IUCN/SSC Polar Bear Specialist Group meet every 3 to 4 years under the auspices of the IUCN World Conservation Union to coordinate research throughout the Arctic. Although responsibility for management of polar bears in Canada lies with the provinces, territories, and wildlife co-management boards, the federal government on behalf of all jurisdictions signed the Agreement. Under the terms of the Agreement, the taking of polar bears is restricted to 'local people' (which is interpreted in Canada to mean Indigenous people or the transfer of that right to hunters guided by Indigenous people who harvest by traditional means) and in accordance with sound conservation practices based on the best available data. This Agreement was renewed indefinitely in 1981.

The polar bear was moved into a status of 'Vulnerable' from the status of 'Lower Risk/Conservation Dependent' for the 2006 Red List of the Species Survival Commission (SSC) of the IUCN World Conservation Union, based on discussions and evidence presented at the 14th Working Meeting of the IUCN/SSC Polar Bear Specialist Group held in Seattle, Washington, USA during June 20–24, 2005 (Schliebe *et al.* 2008). This status was confirmed at subsequent meetings (Wiig *et al*. 2015), including the 18th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, held from 7–11 June 2016, in Anchorage (Durner *et al.* 2018).

Polar bears are listed under Appendix II of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora). Under CITES, any international trade of polar bears or parts thereof requires a permit. CITES export permits can be issued by Canada's CITES Management Authority only upon advice from Canada's CITES Scientific Authority, housed within Environment and Climate Change, that the trade will not be detrimental to the survival of the species. Since July 1975, a permanent record of all polar bears, hides, or any other products legally exported from or imported to Canada has been maintained by the Government of Canada.

In Canada, polar bears were listed as a species of Special Concern on Schedule 1 of the federal *Species at Risk Act* in 2011, a status that was reconfirmed by COSEWIC in 2018 (COSEWIC

2018). In accordance with SARA, a national management plan is under development (as of 2021). Within the NWT, the polar bear was listed in 2014 as a species of Special Concern under the *Species at Risk (NWT) Act*. In 2017, the *Inuvialuit Settlement Region Polar Bear Joint Management Plan* (Joint Secretariat 2017) was also approved, which describes goals and objectives for the conservation of polar bears throughout the Inuvialuit Settlement Region (i.e., NWT and Yukon).

Polar bears have been listed as a Threatened species under the United States *Endangered Species Act* (ESA) since May of 2008. At this time, it is unknown what effects of legal protections and restrictions on hide importation in the US might mean to hunting pressure on polar bears in the NWT. The US listing ruling was based primarily on findings that the polar bear is facing serious threats in the foreseeable future from the projected destruction, modification, or curtailment of its sea ice habitat or range due to global climate change and the lack of sufficient regulatory mechanisms available to alleviate this threat (USFWS 2010). Threatened species in the United States receive most of the same regulatory protections under the ESA as Endangered species, including the requirement that federal agencies ensure that their actions are not likely to jeopardize the continued existence of the species or destroy or adversely modify designated critical habitat. In addition to the ESA, the polar bear is protected by the United States *Marine Mammal Protection Act* (MMPA), which provides protections equal to and in some cases more stringent than the ESA.

In 2010, following the listing of polar bears as a Threatened species under the ESA, the USFWS designated critical habitat for polar bear populations in the United States. This included all parts of the United States that may be occupied by polar bears of the Southern Beaufort Sea subpopulation, and also where bears of the Northern Beaufort Sea wander into the 200-mile exclusive economic zone of the United States. In total, approximately 484,734 km^2 of designated critical habitat fell within the boundaries of the United States. This rule became effective on January 6, 2011. The primary regulatory effect of critical habitat designation is that, under paragraph 7(a)(2) of the ESA, federal agencies of the US must ensure "any action authorized, funded, or carried out by such agency…is not likely to jeopardize the continued existence of any endangered…or threatened species or result in the destruction or adverse modification of [designated critical] habitat…". The magnitude and effectiveness of this positive influence on polar bears in the NWT is currently unknown.

Across the NWT and NU there are a number of protected areas (terrestrial and marine) and conservation areas within the range of polar bears (see Figure 25 in *Indigenous and Community Knowledge Component*). At a community level, community conservation plans (CCP) have been developed and recently updated for all six ISR communities to identify critical habitat, community uses, and conservation objectives, to inform future decision making and to help ensure the conservation of Polar bear and other species' habitat. Conservation priorities for

local wildlife have been formalized in these plans (CSH *et al.* 1992; 2000; 2008; 2016). The 2008 and 2016 versions recommend that "all uses of the land in the Planning Area, including renewable and non-renewable resource development, must recognize conservation of the renewable resource base as the foremost priority. This applies to uses of the land by the community and by other interests" (CSH *et al.* 2008: 16; CSH *et al.* 2016: 17). This indicates community resolve for responsibly managing the local landscape with a long-term view. Polar bear specific conservation measures in 2016 included recommendations that harvesters "identify and protect important habitats from disruptive land uses" (CSH *et al.* 2008: 28; CSH *et al.* 2016: 77).

Proposals for development projects within the ISR must be screened by the Environmental Impact Screening Committee (EISC; established under the Inuvialuit Final Agreement). The screening process ensures that proposed developments in the ISR do not have significant negative impacts on the environment, wildlife, wildlife productivity and harvesting (EISC 2014). Projects are reviewed by the Sachs Harbour and Olokhaktomiut Hunters and Trappers Committees, co-management partners, public, and/or other interested organizations as part of the EISC public commenting period (EISC 2014). The Inuvialuit Land Administration (ILA) and GNWT require the screening and approvals of the HTCs before approving project proposals and permits, and may attach conditions on the projects to ensure that land and resources are not harmed (CSH et al. 2008). If projects have the potential for significant adverse environmental effects, the Environmental Impact Review Board (EIRB) conducts environmental impact reviews. The EIRB decides whether a project should proceed and, if so, under what specific terms and conditions. In making its decision, the EIRB considers the need for wildlife compensation, mitigation, and remedial measures (EISC 2014).

Harvest Protections of NWT Polar Bears Shared with Alaska, Yukon, and Nunavut

The subpopulation of polar bears inhabiting the Southern Beaufort Sea is shared between Canada (NWT and Yukon, Inuvaluit Settlement Region [ISR]) and the United States (Alaska). Polar bears in the Southern Beaufort Sea subpopulation are harvested for subsistence in the United States, and for both subsistence and Indigenous-guided hunting in Canada. Recognition that bears of the Southern Beaufort Sea subpopulation are shared by Canada and Alaska prompted the Polar Bear Management Agreement for the Southern Beaufort Sea (the Agreement). The Agreement between the Inupiat hunters of Alaska and the Inuvialuit hunters of Canada was ratified by both parties initially in 1988, with subsequent reviews and amendments (e.g., 2011). The Agreement includes provisions to protect bears in dens and females with cubs, and states that the annual sustainable harvest from the Southern Beaufort Sea is to be shared between the two jurisdictions (currently 56 bears [35 in the United States and 21 in the ISR, Table 6]). Harvest levels are reviewed annually in light of the best scientific information available (Treseder and Carpenter 1989; Nageak *et al.* 1994). In the NWT, the

Inuvialuit have exclusive rights to harvest polar bears under quotas that include all human-caused mortalities (including kills in defence of life and property), and/or transfer their right to guided hunters so it is not additive (once the tag is sold to a guided hunter, the tag cannot be reused). There is conservation value in assigning tags to licenced hunters (for Indigenous-guided hunting) who are not always successful; the subpopulation has been harvested at levels below allowable quota for more than 30 years (ENR unpublished data). Current harvest levels in the NWT are lower than allowed by quota and the current harvest ratio is 3:2 male: female, which likely benefits polar bear productivity (Table 6).

The comprehensive land claim affecting the Western Arctic Region of the Northwest Territories and the North Slope of Yukon was settled in 1984. The land claim agreement was passed into federal law and is known as the Inuvialuit Final Agreement (IFA). Under the Inuvialuit Final Agreement, both science and Inuvialuit traditional knowledge (TK) and local knowledge (LK) are considered when making management decisions. The NWT and Yukon Wildlife Acts and associated regulations enable polar bear harvest management provisions to be enforceable in the ISR. The HTC by-law regulations under the NWT *Wildlife Act* identify requirements for use of tags, harvest reporting, and sample submission. The Yukon Wildlife Act has a similar ability to establish HTC by-laws. The Canada National Parks Act applies in National Parks in the ISR.

Conservation and management of polar bears in the Northern Beaufort Sea and Viscount Melville Sound is primarily the result of discussions between the NWT and Nunavut with management responsibilities according to their respective land claim structure. There is a Polar Bear Management Agreement for the North Beaufort Sea and Viscount-Melville Sound Polar Bear Populations between the Inuvialuit and the Inuit of the Kitikmeot West Region in Nunavut (established in 2006). The polar bear quota for the Northern Beaufort Sea unit is shared between Inuvialuit in the NWT and the Inuit of Nunavut, but the subpopulation is consistently harvested below allowable quota (Table 6). In Nunavut (quota of 6/year), harvest has declined due to increasing difficulty for residents of Kugluktuk to reach areas where there are bears because of changing ice conditions (PBSG 2010).

Polar bear management discussions at the national level are facilitated by the Canadian Polar Bear Administrative Committee, with technical support from the Polar Bear Technical Committee (PBTC). The PBTC includes biologists from each jurisdiction, representatives of the Wildlife Management Advisory Councils (NWT and North Slope) and the Inuvialuit Game Council, and invited experts from user groups and other research organizations (such as universities) who have expertise with Indigenous knowledge or scientific research on polar bears. Each year, the PBTC discusses the most recent information on subpopulation trends and threats to make recommendations on research needs, coordination, and protection measures for the species to senior administrators and user groups.

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[318] Note that all authorities listed were contacted for the 2012 and 2021 status reports, with the exception of Samuel Iverson and Jodie Pongracz, who were contacted only for the 2021 status report.

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STATUS AND RANKS

Region	Coarse filter (Ranks) To prioritize[319]	Fine filter (Status) To provide advice	Legal listings (Status) To protect under species at risk legislation
Global	G3 – Vulnerable (NatureServe 2016)	A3c – Vulnerable (IUCN 2015)	Not applicable
Canada	N3 – Vulnerable (NatureServe Canada 2016) Sensitive (Canada General Status Ranking Program 2010)	Special Concern (COSEWIC 2018)	Special Concern (SARA 2011)
Northwest Territories	**Sensitive (NWT General Status Ranking Program 2020)**	**Special Concern (SARC 2012)**	**Special Concern (*Species at Risk (NWT) Act* 2013)**
Adjacent Jurisdictions			
Yukon	S1 – Critically Imperiled (NatureServe Canada 2016)		
Nunavut	S3 – Vulnerable (NatureServe Canada 2016)		
Manitoba	S2 – Imperiled (NatureServe Canada 2016)	Threatened (Endangered Species Advisory Committee – 2008)	Threatened (Manitoba Endangered Species Act – 2008)
Ontario	S3 – Vulnerable (NatureServe Canada 2016)	Threatened (COSSARO – 2009)	Threatened (Ontario Endangered Species Act – 2009)
Quebec	S3S4 – Vulnerable to Probably Secure (NatureServe Canada 2016)		Vulnérable (Loi sur les espèces menacées ou vulnérables – 2009)
Newfoundland and Labrador	S2S3 – Imperiled to Vulnerable (NatureServe Canada 2016)	Vulnerable (Species Status Advisory Committee – 2008)	Vulnerable (NL Endangered Species Act – 2008)
Saskatchewan	Vagrant (SK General Status 2010)		
Alaska	S2 – Imperiled (NatureServe 2016)	Not applicable	Threatened (US Endangered Species Act – 2008)

[319] All NatureServe codes are as defined in Definitions of NatureServe Conservation Status Ranks: http://help.natureserve.org/biotics/Content/Record_Management/Element_Files/Element_Tracking/ETRACK_Definitions_of_Heritage_Conservation_Status_Ranks.htm#NatureSe.

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APPENDIX A – ADDITIONAL INFORMATION

Threats Assessment[320]

Threats have been classified for polar bear in the NWT and adjacent jurisdictions where populations are shared or connected, insofar as those threats may be relevant to the status of the population in the NWT. The threats assessment is based on whether threats are considered to be of concern for the sustainability of the species over approximately the next 10 years.

This threats assessment was completed collaboratively by members of the NWT Species at Risk Committee, at a meeting on June 5, 2020. The threats assessment will be reviewed and revised as required when the status report is reviewed, in 10 years or at the request of a Management Authority or the Conference of Management Authorities. Parameters used to assess threats are listed in Table 7.

Table 7. Parameters used in threats assessment.

Parameter	Description	Categories
LIKELIHOOD		
Timing (i.e., immediacy)	Indicates if the threat is presently happening, expected in the short term (<10 years), expected in the long term (>10 years), or not expected to happen.	Happening now Short-term future Long-term future Not expected
Probability of event within 10 years	Indicates the likelihood of the threat to occur over the next 10 years.	High Medium Low
CAUSAL CERTAINTY		
Certainty	Indicates the confidence that the threat will have an impact on the population.	High Medium Low

[320] This approach to threats assessment represents a modification of the International Union for the Conservation of Nature's (IUCN) traditional threats calculator. It was originally modified for use in the Inuvialuit Settlement Region Polar Bear Joint Management Plan (Joint Secretariat 2017). This modified threats assessment approach was adopted as the standard threats assessment method by the Species at Risk Committee and Conference of Management Authorities in 2019.

MAGNITUDE		
Extent (scope)	Indicates the spatial extent of the threat (based on percentage of population area affected)	Widespread (>50%) Localized (<50%)
Severity of population-level effect	Indicates how severe the impact of the threat would be at a population level if it occurred.	High Medium Low Unknown
Temporality	Indicates the frequency with which the threat occurs.	Seasonal Continuous
Overall level of concern	**Indicates the overall threat to the population (considering the above).**	**High** **Medium** **Low**

Overall Level of Concern

The overall level of concern for threats to polar bear are noted below. Please note that combinations of individual threats could result in cumulative impacts to polar bears in the NWT. Details be found in the *Detailed Threats Assessment*.

Overall level of concern:

- **Threat 1 – Climate change** **Medium-High**
- **Threat 2 – Marine traffic** **Medium**
- **Threat 3 – Pollution** **Low-Medium**
- **Threat 4 – Human-bear interactions and harvesting** **Low**
- **Threat 5 – Offshore oil and gas exploration and development** **Low**
- **Threat 6 – Invasive research techniques** **Low**
- **Threat 7 – Competition** **Low**

Detailed Threats Assessment

Threat #1. Climate change	
Specific threat	Intensifying effects of climate change have been observed on the weather, sea state, sea ice, and snow since the 1980s. Changes in sea ice and associated snow cover affect light transmission and thermodynamic processes important to lower trophic levels of the arctic marine ecosystem. These, in turn, influence the distribution of important food species such as ringed and bearded seals. Observed effects of climate change include: earlier spring melt, later freeze-up, warmer winter temperatures, shrinking of multi-year ice, fewer icebergs, thinner winter sea ice, increasingly frequent and severe winter storms, more hot weather during the summer, low summer water levels, unprecedented winter thunderstorms, melting permafrost, mudslides, soil erosion, and changes to prevailing winds. There is no more multi-year ice anywhere in the southern Beaufort Sea along the coast of the Yukon and NWT, nor in Amundsen Gulf off the coast of Ulukhaktok. Knowledge holders from Tuktoyaktuk observed that multi-year ice had disappeared from the coastal area north of Tuktoyaktuk by about 2000. People from all NWT Inuvialuit communities have noticed a decline in the number and the size of pressure ridges – a key ice feature from which bears hunt seals. This is attributed to thinner ice and increased ice movement. Erosion is a potential concern for Southern Beaufort Sea polar bears because many pregnant bears may den on barrier islands and next to coastal banks where the terrain allows drifting snow to accumulate. Some coastal denning habitat may disappear in the future, and this may result in a change in denning distribution. In the southwest Northern Beaufort Sea unit, bears are likely to have increasingly less access to ice year-round. In contrast, year-round availability of sea ice among NWT islands in the Arctic Archipelago appears to be somewhat less impacted by recent climatic trends. However, even Viscount Melville Sound has begun to experience unusual periods of low sea ice in September. The type of ice present in Viscount Melville Sound (multi-year v. annual) may also be changing. Harvesters in Nunavut have also reported that there is less snow accumulation in recent memory compared to earlier times.
Stress	Polar bears in the lower latitude Beaufort Sea are currently showing signs of stress and decline, likely in response to climate change-related losses of sea ice habitat. The extended ice-free season in the lower-latitude Beaufort Sea is likely to have resulted in lower juvenile and adult survival, compared to the higher-latitude Beaufort Sea and Viscount Melville Sound areas. In the Southern Beaufort Sea subpopulation, the duration of time spent by bears onshore has also increased by over a month. While polar bears in some areas are observed to be diversifying their diet, associated with increasing time spent onshore, a few

	studies show that terrestrial foods do not appear to provide substantive nutritional resources for polar bears. While polar bears are adept at hunting and scavenging on land, there would likely be a decline in population before sufficient adaptation to new ranges/food species could be made. Reductions in habitat availability are resulting in increased competition, which may be reflected in declining body condition and reproduction of females in the southern Beaufort Sea. There is also evidence from bears in the southern Beaufort Sea that the frequency of long-distance swims may be increasing, leading to concerns about the effects of this behaviour on body condition and survival. The consensus coming out of the Joint Secretariat study (2015) is that climate change is occurring but Inuvialuit have not yet observed changes in polar bear abundance or condition and are reluctant to make predictions about the long-term effects of climate change on polar bears and their prey. Climate change is causing or compounding all major threats to polar bears and their habitat in the NWT, including changes in sea ice habitat, potential offshore oil and gas exploration and development, and increased marine traffic. However, in 2016, Canada and the United States announced a joint moratorium on offshore oil and gas work in the Arctic. In Canada, the moratorium includes new and existing oil and gas licenses and is to be reviewed every five years; the current order extends until December 31, 2021 In the United States, the moratorium has no expiration date. The combined effects of climate change with rapidly increasing development and activity in the Arctic are cause for high uncertainty and concern about cumulative impacts on polar bears and their habitat. Climate change will likely influence all of the direct limiting factors to polar bears and may therefore be thought of as an ultimate threat to the species. The best available evidence suggests that the NWT will most likely have fewer polar bears after three generations than there may exist today. However, there is no quantitative, direct data from western science to inform us about the magnitude of any potential decline. Polar bears in the low-latitude Beaufort Sea, where divergent sea ice conditions exist, appear to be most at risk from periods of low ice coverage. Where climate warming eliminates annual winter sea ice or substantially increases the open water season from maximum periods associated with areas of current occupancy by polar bears, the species is not expected to persist. It is also possible that changing conditions of the higher-latitude Beaufort Sea (and possibly also Viscount Melville Sound) may benefit polar bears, which prefer less heavy sea ice than has historically occurred in this region (for feeding on seals). Likewise, if climate change increases prey diversity in some areas, where it is presently low, this could be important. This might apply to polar bears at the extreme northern edge of the species' range, where historically low primary productivity and heavy, multi-year ice limits densities of and access to ringed seals, but these are also small populations that are inherently vulnerable in

	nature.
Extent	Widespread
Severity	Unknown-Medium (unknown for Northern Beaufort Sea, Viscount Melville Sound, and Arctic Basin subpopulations, and medium for the Southern Beaufort Sea subpopulation)
Temporality	Continuous
Timing	Happening now
Probability	High
Causal certainty	Medium
Overall level of concern	**Medium-High**

Threat #2. Marine traffic	
Specific threat	The opening of the Northwest Passage to marine traffic is seen as having the potential to be one of the most serious threats to polar bear habitat. In all likelihood and within our lifetime, due to changing climate patterns, the Northwest Passage will remain open for increasing periods of time, making it attractive as a major shipping route. The number of transits increased from four per year in the 1980s to 20-30 per year in 2014-2019.
Stress	Polar bears in the NWT and in the vicinity of this new shipping route may be exposed to traffic and levels of pollution that no subpopulation of polar bear has yet experienced. How they will respond to these cumulative effects is unknown, but increased sea traffic in NWT waters is a potential threat that could include the release of oil, introduction of invasive species, ship emissions, and noise. Marine traffic in the form of ice-breakers, submarines, cargo ships, and cruise ships could travel through open leads, preventing the leads from re-freezing properly, and by doing so, contribute to the decline in multi-year ice. In the Viscount Melville Sound and M'Clure Strait, concerns have been expressed about ship traffic affecting the fall and spring migration of polar bears between Banks, Victoria, and Melville islands. Olokhaktomiut are concerned that marine traffic in the Richardson Collinson Inlet and Glenelg Bay area will have a negative impact on polar bear denning and on a critical community harvesting area. Specifically, the community is concerned that ships will destroy polar bear dens in multi-year ice, that noise will disturb denning bears, and that ship tracks will pose dangers to hunters in the area. Paulatukmiut are concerned that shipping, along with exploration and development, will impact polar bear denning in the Parry

	Peninsula, Franklin Bay, Darnley Bay, Amundsen Gulf offshore, and offshore islands. Marine traffic could also increase the release of oil, introduction of invasive species, ship emissions, and noise.
Extent	Localized
Severity	Unknown
Temporality	Seasonal
Timing	Happening now
Probability	Medium-High
Causal certainty	Medium
Overall level of concern	**Medium**

Threat #3. Pollution	
Specific threat	Pollution and contamination are being more frequently observed, especially in the form of marine plastics. In recent years, significant levels of various contaminants (organochlorines and other persistent organic pollutants) have been documented in polar bear tissues or tissues of their prey, particularly adipose tissue. Greater time spent ashore (associated with climate change) may actually reduce the risks to polar bears of pollutants (e.g., polychlorinated biphenyls, organochlorine pesticides, polybrominated diphenyl ethers), if geographic distribution is altered from a pelagic to a more coastal feeding niche.
Stress	Pollution and the accumulation of environmental contaminants (mainly organochlorines) in tissues of polar bears are not likely to be a current limiting factor for polar bear populations, but new studies indicate that sub-clinical impacts on the health of individuals may, over time, have cumulative effects on whole populations through lowered immune systems and reproduction rates. However, effects of various compounds in the tissues of polar bears or of the seals they feed on remains largely unknown.
Extent	Widespread
Severity	Unknown
Temporality	Continuous

Timing	Happening now
Probability	High
Causal certainty	Low
Overall level of concern	**Low-Medium**

Threat #4. Human-bear interactions and harvesting	
Specific threat	In all parts of the NWT, the harvest (including defence of life and property kills) of polar bears has been below the quota for many years. Harvesting and human-caused mortality are not, at this time, considered threats to the NWT polar bear population. However, one likely impact of climate change is an anticipated increase in human-bear conflicts. Increases in bear interactions with humans in areas most affected by climate warming have been reported in recent years, including for communities adjacent to the Alaskan southern Beaufort Sea and western Hudson Bay. For Nunavut, the earlier the ice breaks up, the more bears interacting with humans there are in a year, and vice versa. However, in the NWT, defence of life and property kills are counted under a subpopulation's quota.
Stress	Reductions in food availability may result in increases in nutritionally stressed bears spending longer periods of time onshore. Signs of nutritional stress are already being observed, including consumption of the entire seal carcass (polar bears typically only eat the blubber). If bears become nutritionally stressed because of changes to their habitat and prey availability, it is likely they will become nuisance bears as they scavenge for food and become less shy of people. This could lead to an increase in defence of life and property kills.
Extent	Localized
Severity	Low
Temporality	Seasonal
Timing	Long-term future
Probability	Low-Medium
Causal certainty	Low
Overall level of concern	**Low**

Threat #5. Offshore oil and gas exploration and development	
Specific threat	Since the mid-1960s, exploration for energy and mineral reserves has led to an increased amount of industrial activity in the Arctic. The Mackenzie shelf has high potential for oil and gas development, and other regions within NWT waters are believed to have high potential for undiscovered hydrocarbons. There are extensive discovered and recoverable oil and gas reserves in Nunavut, including the Sverdrup sedimentary basin, which overlaps the subpopulations of Viscount Melville Sound and Northern Beaufort Sea. Continued development of natural gas petroleum reserves of the Beaufort Sea/Mackenzie Delta in the NWT may put additional pressure on the Southern Beaufort Sea subpopulation of polar bears. The primary threat to polar bears from industrial development may come from the potential for environmental contamination, especially large-scale oil spills. Oil is extremely toxic and potentially lethal to bears in even small amounts. As climate change increases access to the polar basin, we might anticipate increased risks to bears in the Canadian Arctic Archipelago. Knowledge holders note that an oil spill of any size would cause a chain reaction in the fragile Arctic ecosystem. There is also the potential for negative impacts to seals from seismic research and blasting. Concerns remain very high today about the current and potential impact of offshore oil and gas exploration and development on polar bears, their habitat, and their movement patterns. However, in 2016, Canada and the United Stated announced a joint moratorium on offshore oil and gas work in the Arctic. In Canada, the moratorium extends until 2021 and includes new and existing oil and gas licenses. In 2021, the moratorium will be reviewed; in the United States, the moratorium has no expiration date. The Nunavut Impact Review Board has recommended that the Canadian moratorium be extended for another ten years.
Stress	In North Star Harbour and Sachs Harbour, a decline in seal health associated with seismic research resulted in a decline in polar bear health. Industrial activity near the shoreline can interrupt bears' denning cycles or cause them to abandon their young cubs. Increased development may result in changes in the migrations of not only the polar bear but all the marine mammals along the Beaufort Sea.
Extent	Localized
Severity	Low-High
Temporality	Continuous

Timing	Long-term future
Probability	Low
Causal certainty	Medium
Overall level of concern	**Low**

Threat #6. Invasive research techniques	
Specific threat	Inuit interviewed for Indigenous knowledge studies have concerns about scientific research methods, whereby bears are immobilized using drugs, and helicopters and snowmobiles are used to capture bears, which may cause displacement of bears or result in long-term, adverse physiological effects. Inuvialuit-Inupiat refuse to collar polar bears and Inuit communities and organizations do not support invasive research techniques. Although invasive research techniques are not currently happening in Canada, they are occurring in Alaska. Researchers in the NWT are currently in the midsts of a 3-4 year field research program using the genetic mark-recapture. Although this method involves pursuing polar bears by helicopter to biopsy dart them from a distance, there is no physical handling or immobilization of the bear. In addition, there are protocols in place to avoid disturbing sows and cubs.
Stress	Invasive research techniques may hinder hunting efforts, lead to injuries, or cause disturbance, avoidance behaviour, or accidental death. Immobilizing drugs and handling may affect individual health, behaviour and survivorship in a small portion of the Southern Beaufort Sea population where collaring occurs in Alaska. In an examination of the impact of research, long-term effects on polar bears of tagging and radio-collaring are considered largely negligible from the perspective of population dynamics.
Extent	Localized
Severity	Low
Temporality	Seasonal
Timing	Happening now
Probability	Low

Causal certainty	Low
Overall level of concern	**Low**

Threat #7. Competition	
Specific threat	There is evidence of grizzly bears expanding their range in northern Canada. The greater competitive ability of the grizzly bear may be of concern when the two species come into contact with one another.
Stress	Although there is no evidence that grizzly bears are playing a significant role in displacing polar bears within the species' current area of occupancy, the more generalist feeding strategy of grizzly bears might potentially provide this species with a competitive foothold on Victoria Island or on other Arctic islands.
Extent	Localized
Severity	Unknown
Temporality	Seasonal
Timing	Happening now
Probability	Medium
Causal certainty	Low
Overall level of concern	**Low**