SPECIES STATUS REPORT

Polar Bear

(Ursus maritimus)

Nanuq
Shih Dagaii
Ours polaire

in the Northwest Territories

NORTHWEST TERRITORIES
SPECIES AT RISK
COMMITTEE

Special Concern
December 2012

Status of Polar Bear in the NWT

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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The drafts of this report were prepared by Dan Slavik (traditional and community knowledge component) and Phillip D. McLoughlin (scientific knowledge component), prepared under contract with the Government of the Northwest Territories, and edited by Joanna Wilson and Michelle Henderson.
For additional copies contact:

Species at Risk Secretariat
c/o SC6, Department of Environment and Natural Resources
P.O. Box 1320
Yellowknife, NT X1A 2L9
Tel.: (855) 783-4301 (toll free)
Fax.: (867) 873-0293
E-mail: sara@gov.nt.ca
www.nwtspeciesatrisk.ca

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

ABOUT THIS REPORT
This species status report is a comprehensive report that compiles and analyzes the best available information on the biological status of Polar Bear in the NWT, as well as existing and potential threats and positive influences. This status report was prepared in two parts: a traditional and community knowledge component and a scientific knowledge component. Both components together form the complete status report. Full guidelines for the preparation of species status reports, including a description of the review process, may be found at www.nwtspeciesatrisk.ca.

Northwest Territories Environment and Natural Resources

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

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NORTHWEST TERRITORIES SPECIES AT RISK COMMITTEE

Assessment of Polar Bear

The Northwest Territories Species at Risk Committee met in Behchokǫ̀, Northwest Territories on December 3, 2012 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 available at www.nwtspeciesatrisk.ca.

Status: Special Concern in the Northwest Territories

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 fits criteria (b) and (c) for Special Concern

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

(c) – The species almost qualifies for Threatened status (under Threatened (d))

- There are approximately 1500-2000 Polar Bears in the Northwest Territories (with 930-1240 mature individuals). This may be considered less than 1000 mature individuals (the threshold for 'Threatened' status), but there is no estimate of numbers for the Arctic Basin subpopulation that would contribute to the total for the Northwest Territories.
- Survival and reproduction are influenced by ice conditions; ice conditions are changing, which influences their ability to hunt seals.
- Climate change will affect ice conditions differently in different parts of the Arctic.
- In the short term, optimal sea-ice will be lost in some areas and gained in others.
- It is predicted that most Polar Bear subpopulations will be negatively impacted by climate change in the long term.
- Climate change, a primary threat, cannot easily be reversed nor managed effectively.
- Polar bears have a unique niche of hunting seals from a sea-ice platform.
- Polar Bears are long-lived and have low reproductive rates. They reach maturity late and do not reproduce every year.
- Polar Bears are top predators, at the top of the food chain, making them susceptible to

bioaccumulation of pollutants.

Threats to Polar Bear and its habitat are:

Cumulative effects of:

- Climate change on sea-ice causing changes to availability of food (access to and abundance of seals);
- Offshore oil and gas exploration and development and marine traffic;
- Pollution and contamination;
- Behavioural changes resulting in more bear-human conflicts; and
- Invasive research techniques.

Positive influences on Polar Bear and its habitat are:

- Harvest has been well-managed and maintained within sustainable levels as part of a quota system;
- Polar Bear quotas have never been met because sea-ice and/or socio-economic conditions have limited hunter access to bears; and
- Polar Bears exist in other jurisdictions so there is potential for dispersal into the NWT.

Recommended measures to conserve Polar Bear and its habitat are:

- Ensure that future harvest stays within sustainable levels;
- Conduct a population survey for the Arctic Basin subpopulation;
- Do not permit development until proponents have demonstrated an ability to mitigate threats to Polar Bears;
- Continue population surveys so that sustainable harvest levels can be maintained;
- Continue to study seal populations for changes in abundance and distribution;
- Monitor changes in sea-ice coverage and conditions closely;
- Identify and protect Polar Bear denning areas from disturbance;
- Increase studies on emerging threats (such as diseases and oil and gas exploration and development); and

- Continue studies of contaminants and bioaccumulation.

Executive Summary

Traditional & Community Knowledge	Scientific Knowledge
Description	
Nannut (*plural*: polar bears, ours polaires, *Ursus maritimus*) are large marine mammals that live on the sea-ice and along the coastline throughout the circumpolar regions. Polar bears are greatly respected and are a culturally, spiritually, and economically important species to the Inuvialuit. As a result, the Inuvialuit have in-depth traditional and community 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, Polar bear is considered to be a terrestrial mammal in Canada
Distribution	
The polar bears of the Northwest Territories (NWT), Canada 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 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. There are four scientifically classified subpopulations of polar bears in the NWT, however Inuvialuit feel that the Northern and Southern Beaufort Sea subpopulations are really a single	Polar bears are distributed throughout the circumpolar Arctic where at least annual ice is known to occur, and rely on sea-ice as their primary habitat. 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 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 includes four subpopulations: the 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

subpopulation as polar bears frequently move between both areas. 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 further inland than in the past. Inuvialuit observe polar bears on the ice, on the land, and near their communities. The range of these observations, as illustrated by hunting range or "search effort", includes (but is not limited to) the coastline and sea-ice accessible by snowmobile or dog sled. Recently, the polar bear hunting range has shrunk due to inaccessible or unsafe ice conditions, and hunting effort has declined as a result of the shift from full-time to part-time harvesting and other socio-economic limitations.	another, 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).
Traditional & Community Knowledge	**Scientific Knowledge**
Habitat	
Polar bears' key habitat requirement is sea-ice from which they hunt seals. Ideal habitat for hunting seals includes pressure ridges, open leads and young or annual ice. The dynamic sea-ice is influenced by wind, currents and, over the last several decades, changes in the climate. Numerous changes in the sea-ice associated with climate change are being	Polar bear habitat is closely linked to the physical attributes of sea-ice (type and distribution) and the density and distribution of ice-dependent seals, especially ringed seals (*Pusa hispida*). Polar bears of the Southern 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

observed, and the impact of this on bears is being amplified by additional activity (such as oil and gas and marine traffic) in the region.

People 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. It is anticipated that under current estimates of climate change, multi-year ice and summer ice will decline in the next few decades. Annual ice will still form in the winter months, and some solid (multi-year) ice will remain in the high Arctic. As ice is disappearing, polar bears are adjusting their range and migrations due to more open water. If ice conditions are not suitable for hunting seals, polar bears will move to where they can find seals or other food. The effect of climate change on sea-ice has had a noticeable effect on seals and their distribution therefore changing the feeding behaviour of the polar bear. Ice conditions that are not suitable for seals will also not be suitable for polar bears.

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, in-land in ravines or depressions, and occasionally on the sea-ice, and will spend the winter in these dens.

during summer), versus the Northern Beaufort Sea which is convergent in nature, where ice motion promotes convergence and shoreward drift of ice 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 for February 2011 being tied with February 2005 as the lowest in the satellite record (since 1978). Summer sea-ice extent was the lowest on record in September 2012. 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 Southern Beaufort Sea, especially in areas of prime polar bear habitat (shallow waters of 300m depth or less). Changes are also occurring in the Northern Beaufort Sea, 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 Beaufort Sea.

Traditional & Community Knowledge	Scientific Knowledge
Biology	
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. Ringed and bearded seals are the main prey of polar bears. Polar bears hunt seals from their breathing holes, in their dens, and while hauled up on the ice. Seal health, distribution, and abundance are determined by sea-ice, biological productivity, and their changing migration routes. In the past, seal health and numbers have been negatively impacted by oil and gas development, ocean traffic and scientific research. More recently, people have noticed that seals are affected by climate change and have observed declines in seal numbers and body condition. The impacts of development and climate change on seals will be felt by polar bears. If polar bears cannot hunt seals due to changes in sea-ice, it will be difficult for polar bears to adapt to hunting different prey. However, many harvesters and elders believe that polar bears will adapt over time. Polar bears have been observed on occasion hunting other species, both on land and in the water, and will often scavenge on	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 approximately 12 years. Survival and reproduction are known to be influenced by ice conditions.

beached whales or other carcasses.	
Traditional & Community Knowledge	**Scientific Knowledge**
Population	
Polar bears migrate, especially during the spring as they hunt and mate. In recent years, changes in polar bear migration patterns are being observed. Polar bear movements and migrations cover huge distances, and can even span continents, as bears move from one area to another hunting seals. As a result, assessing abundance using community knowledge is challenging, as a regional decline in population does not necessarily infer an overall population decline. Traditional and community knowledge indicate that polar bear abundance in certain areas changes from year to year, and there have been population ups and downs in the past. Recently, some hunters in Tuktoyaktuk and Paulatuk have observed fewer polar bears compared to the past. Residents of Paulatuk are also observing a decline in body condition. In Sachs Harbour, there is no consensus on whether or not polar bear numbers or body condition is changing. Olokhaktokmiut[1] recently stated they are seeing more polar bears than in the past and that the population is stable. Olokhaktokmiut believe that the Viscount-Melville subpopulation of polar bears has increased.	Published estimates of population size include 1526 polar bears in the Southern Beaufort Subpopulation (2006 estimate, shared by NWT, Yukon, and Alaska), 1202 in the Northern Beaufort Sea subpopulation (2011 estimate, shared by Nunavut), and 161 in the Viscount Melville Sound (1992 estimate, shared by Nunavut). The number of polar bears inhabiting the Arctic Basin subpopulation is currently unknown. All subpopulations of polar bears in the NWT are shared with other jurisdictions as noted above; within the borders of the NWT the number of polar bears is likely to only be somewhere around 1500–2000 bears. Assuming 62% of these individuals are aged 5+ (from age-sex ratios for the Southern Beaufort Sea), it is estimated that 930–1240 mature individuals live, at any given time, in the NWT. It is difficult to identify exact numbers of individuals occurring within NWT borders as population inventories are conducted across international and territorial boundaries. For polar bears of the Southern Beaufort Sea, recent climate-change related losses in sea-ice over the continental shelf have been associated with declines in survival and reproduction, and it appears that polar bears of this region are under increasing nutritional stress in relation to

	habitat loss. 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 a decline has likely occurred in the overall abundance of polar bears in the Southern Beaufort Sea, with a small decline forecasted to likely continue for this subpopulation over the short term (i.e., 10 years). However, over longer periods of time (e.g., 100 years), a published population viability analysis suggests a strong likelihood of extinction of this subpopulation in concert with projected declines in annual sea-ice in the region. The polar bear subpopulation in the Northern Beaufort Sea is thought to be stable or possibly increasing at the present time. Under the current harvest regime the subpopulation in the Viscount Melville Sound should be increasing. Data on this subpopulation is dated (by almost 20 years) and a subpopulation survey is currently underway (commenced in spring 2012). Over the short term (i.e., 10 years), changes in conditions of sea-ice in the Northern Beaufort Sea, Viscount Melville Sound, and Arctic Basin may be beneficial; however, continued projected losses in summer sea-ice extent in the NWT over the longer term (e.g., 100 years) do not bode well for any polar bear subpopulation that ranges into the NWT.

Traditional & Community Knowledge	Scientific Knowledge
Threats and limiting factors	
Several threats to polar bears and their habitat in the NWT have been identified through traditional and community knowledge. The most serious and immediate threats to polar bears are the cumulative effects of climate change on sea-ice and the arctic ecosystem. Offshore oil and gas exploration and development, and marine traffic are also important threats and can be compounded by climate change. The combined effects of climate change with rapidly increasing development and activity in the Arctic are cause for high uncertainty and immense concern about impacts on polar bears and their habitat. Other threats that are less significant in their potential impact and scope include invasive research techniques used on bears and behavioural changes caused by disturbances or nutritional stress. Pollution and contamination, disturbances from aircraft and snowmobiles, and competition for food from foxes, grizzly bears and other new species entering the polar bears' range have also been identified as possible threats. Inuvialuit point out that natural mortality is also common for polar bears. Hunting is not believed to be a threat or cause for concern at this time, although communities have seen an	The main limiting factor affecting polar bear distribution and numbers in the NWT is availability of food (access to and abundance of seals). Direct human-caused mortality (almost exclusively from hunting) is also a limiting factor; however, harvest is relatively light and has consistently been below allowable quota for the past 20 years in all NWT subpopulations. Reproduction is limited by food availability, which in turn is limited by ice conditions. Declines in reproduction have been noted for the Southern Beaufort Sea in connection with deteriorating ice conditions. Threats to polar bears may also include pollution, especially in association with offshore development of hydrocarbon reserves and increased ship traffic, and the accumulation of environmental contaminants (mainly organochlorines) in tissues of polar bears. Climate change is likely to influence all of the factors above and should thus be treated as the ultimate limiting factor to polar bears in the NWT.

increase in subsistence hunting due to increased demand of polar bear hides over the past 3 years.	
Traditional & Community Knowledge	**Scientific Knowledge**
Positive Influences	
Inuvialuit have "been managing polar bears for generations" and have taken leadership roles to ensure harvesting practices are sustainable. The development of collaborative management regimes has been a positive influence on polar bears in the NWT. Quotas, Hunter and Trappers Committee (HTC) bylaws and precautionary decision-making help ensure that polar bear harvesting is sustainable. 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.	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) and the Inupiat in Alaska or the Inuit in Nunavut. Recent harvest levels are lower than allowed by quota, which is likely to reduce the effects of harvest on polar bear productivity. The Wildlife Management Advisory Councils (Northwest Territories) and (North Slope) collaborate on management and research of shared interest and concern related to the South Beaufort Sea subpopulation.

Technical Summary

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Population trends		
Generation time (*average age of parents in the population***) (indicate years, months, days, etc.)**	Information not available in sources.	12 years
Number of mature individuals in the NWT (or give a range of estimates)	Estimates of numbers are not available in sources.	930–1240 mature individuals (bears aged 5+) within NWT borders. Assumes 1500–2000 bears occurring within NWT borders from shared subpopulations that sum to approximately 3000 bears, and 62% of the total population being aged 5+ (from age-sex ratios for the Southern Beaufort Sea).
Amount of change in numbers in the recent past; *Percent change in total number of mature individuals over the last 10 years or 3 generations, whichever is longer*	A decline in polar bear numbers has been observed in or around Tuktoyaktuk and Paulatuk. Olokhaktokmiut are seeing more polar bears than in the past and believe that the population is stable. Olokhaktokmiut believe that the Viscount-Melville subpopulation of polar bears has increased.	Likely decline in Southern Beaufort Sea; stability or possible increase in the Northern Beaufort Sea and likely increase in the Viscount Melville Sound). Projections over 36 years or 3 generations (12 years per generation) not available.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
	There is no consensus on whether or not polar bear numbers are changing in or around Sachs Harbour. Polar bears move around and a regional decline does not necessarily infer an overall decline.	
Amount of change in numbers predicted in the near future; *Percent change in total number of mature individuals over the next 10 years or 3 generations, whichever is longer*	Habitat change is expected to continue. A decrease in numbers is anticipated if degradation of habitat and other threats continue and amplify. Polar bears' ability to adapt to new ranges would require the availability of prey species. There would likely be a decline in population before sufficient adaptation to new ranges could be made.	No formal simulations available, except for polar bears of the Southern Beaufort Sea. Best available evidence suggests that there will be continued and likely exacerbated decline in the Southern Beaufort Sea; stability with possible increase in the Northern Beaufort Sea and Viscount Melville Sound. Projections over 36 years or 3 generations not available; however, published projections for polar bears of the Southern Beaufort Sea subpopulation which ranges into Alaska, Yukon and NWT indicate a 0.80–0.94 probability of extinction due to loss of sea-ice by 2100.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Amount of change happening now; *Percent change in total number of mature individuals over any 10 year or 3 generation period which includes both the past and the future*	Information not available in sources.	Overall stability considering only five years on either side of present day, but this is speculative as recent trend data for Northern Beaufort Sea and Viscount Melville Sound are not available. Decline in the Southern Beaufort Sea.
If there is a decline (*in the number of mature individuals*), **is the decline likely to continue if nothing is done?**	Yes, although many Inuvialuit believe that some polar bears will eventually adapt to climate change.	Likely declining for polar bears of the Southern Beaufort Sea over the short and long term.
If there is a decline, are the causes of the decline reversible?	Current trends in climate change and its impacts on sea-ice are largely irreversible. Other threats such as oil and gas development and marine traffic may be more easily influenced.	The decline would be very difficult to reverse, as it is principally related to climate change and loss of sea-ice; direct mortality due to human activities may be more easily reduced and managed.
If there is a decline, are the causes of the decline clearly understood?	Threats are identified and well understood, but cumulative impacts of multiple threats are not well understood.	Yes
If there is a decline, have the causes of the decline been removed?	No. Climate change, development and human activity are expected to be compounding and accelerating.	No

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Are there extreme fluctuations in the number of mature individuals?	Polar bear numbers do go up and down in certain areas. When numbers fluctuate, it is hard to tell whether there are fewer bears overall or if they have just gone somewhere else. This is because polar bear movements cause numbers in certain areas to fluctuate.	No
Distribution Trends		
Where is the species found in the NWT?; *Estimated extent of occurrence in the NWT (in km^2)*	The polar bears of the NWT live pre-dominantly on the sea-ice of the Arctic Ocean and Beaufort Sea. Seasonally, bears will be found along the northern coastline of the NWT and Arctic Islands, and may occasionally be found inland.	1,467,985 km^2
How much of its range is suitable habitat?; *Index of area of occupancy (IAO) in the NWT (in km^2; based on 2km × 2km grid)*	Polar bears are adapted to surviving on ice. Suitable habitat is where ice conditions are favourable for hunting seals. Females require suitable habitat to den along the banks of the coastline, in-land (in depressions and ravines), and occasionally on the sea-ice.	1,454,148 km^2 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.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
How many populations are there? To what degree would the different populations be likely to be impacted by a single threat?; *Number of extant locations in the NWT*	Of the four recognized subpopulations (S. Beaufort, N. Beaufort, Viscount-Melville, and Arctic Basin), Inuvialuit argue that the North and South Beaufort should be considered one subpopulation as there is travelling and intermixing between the two. Polar bear movements and migrations cover huge distances.	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 the distribution, habitat or habitat quality showing a decline that is likely to continue if nothing is done?; *Is there a continuing decline in area, extent and/or quality of habitat?*	Inuvialuit have noticed changes in the climate and sea-ice over the last twenty years, which have negatively impacted the quality of habitat in some areas. Bears are adjusting their range further north and further out on the multi-year ice in response to changes in temperature, ice conditions and distribution of seals. Changes are expected to continue and intensify. Many Inuvialuit believe bears will adapt their distribution by moving further north or eventually adapting to life on land. Replacement of multi-year ice with annual ice could also benefit some bears.	Yes, for quality of habitat especially in the Southern Beaufort Sea.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Is the number of populations or amount of occupied area showing a decline that is likely to continue if nothing is done?; *Is there a continuing decline in number of locations, number of populations, extent of occupancy and/or IAO?*	Unclear as several communities along the Beaufort coast are noticing a decline in abundance of bears in their region, however one community is noticing an increase in bears, and harvesters believe polar bears are adjusting their range further north.	Not yet
Are there extreme fluctuations in the range or the number of populations?; *Are there extreme fluctuations (>1 order of magnitude) in number of locations, extent of occupancy and/or IAO?*	Fluctuations in numbers have been observed in some areas in the past (attributed to sea-ice conditions and availability of seals), but available evidence does not support 'extreme'.	No
Are most individuals found within small and isolated populations?; *Is the total population severely fragmented (most individuals found within small and isolated populations)?*	No	No
Immigration from populations elsewhere		
Does the species exist elsewhere?	Yes, polar bears exist throughout the Arctic circumpolar regions.	Yes

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Status of the outside population(s)	Information not available in sources.	The entire species in Canada is listed as Special Concern (2012) as assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2008). 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 is likely declining there. Polar bear is listed as Threatened in Manitoba (2008) and Ontario (2009) and as vulnerable in Quebec (2009 and in Newfoundland and Labrador (2008). The Arctic Basin subpopulation outside Canada is also of unknown status.
Is immigration known or possible?	Yes	Yes
Would immigrants be adapted to survive and reproduce in the NWT?	Information not available in sources.	Yes

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Is there enough good habitat for immigrants in the NWT?	Information not available in sources.	Yes, but in the near future changes to sea-ice in the Southern Beaufort Sea will result in reduced amounts of good habitat for potential immigrants in that region. Over the longer term, reduced habitat for immigrants is also expected in the Northern 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?	Information not available in sources.	Yes (can be self-sustaining, although no subpopulation is identified as occurring solely within NWT borders).
Threats and limiting factors		
Briefly summarize the threats and limiting factors. For each one, indicate how imminent it is and what the degree/scale of the impact is (*imminence and magnitude*).	The most serious and imminent threats are the changes to sea-ice habitat due to the cumulative impacts of climate change, offshore oil and gas exploration and development, and increased marine traffic.	The main limiting factor affecting polar bear distribution and numbers in the NWT is loss of habitat (sea-ice) leading to changes in availability of food (access to and abundance of seals). Direct human-caused mortality is also a limiting factor, however harvest is relatively light in the NWT and most polar bears die from other causes.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
	Other threats that are less significant in their potential impact and scope include invasive research techniques used on bears and behavioural changes caused by disturbances or nutritional stress. For example, satellite collars can hinder bears' hunting efforts and possibly lead to cuts, contusions, and infections. Pollution and contamination, disturbances from aircraft and snowmobiles, and competition for food from other predators were also mentioned.	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. Over the long-term (100 years), losses in annual sea-ice have been projected to cause the likely extirpation of the Southern Beaufort Sea Subpopulation. Changes over shorter time periods (10 years) are less dramatic, with continued slight declines in the Southern Beaufort Sea subpopulation and stability or increases in the Northern Beaufort Sea and Viscount Melville Sound subpopulations. 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, despite potential short-term increases in habitat quality for areas like the Viscount Melville Sound.

Question **TK/CK;** *Science*	Traditional & Community Knowledge	Scientific Knowledge
Positive Influences		
Briefly summarize the positive influences. For each one, indicate how imminent it is and what the degree/scale of the impact is (*imminence and magnitude*).	Inuvialuit leadership, collaborative management regimes and harvest regulations ensure that the polar bear harvest is sustainable. Changes in the sea-ice (from multi-year to annual ice) may yield better ice conditions for hunting seals. Unsafe and impassable ice conditions could restrict hunting range and lead to decreased harvesting pressure. User-to-user agreements have been signed between the Inuvialuit (who have exclusive rights to harvest polar bears in the NWT) and the Inupiat in Alaska or the Inuit in Nunavut.	Positive influences on polar bear numbers in recent years stem largely from coordinated management of shared populations with adjacent jurisdictions. Recent harvest levels are lower than allowed by quota, which is likely to benefit polar bear productivity.

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Traditional and Community Knowledge component

Names and classification

Inuvialuktun

Nanuq (S,U) – a (one) polar bear (Lowe 2001; MPEG 2006)

Nannuk (S,U) – two polar bears (MPEG 2006)

Nannut (S), *Nannuit* (U) – three or more polar bears (MPEG 2006)

Nanuaraaluk – polar bear cub (Lowe 2001)

Nanuaq – young polar bear (Lowe 2001)

*(Siglitun (S), Uummarmiut (U), Inuinnaqtun (I))[2]

Gwich'in

Chehzhìi' (GSCI 2012)
Chehzhyèe' (GSCI 2012)

English

Polar bear

French

ours polaire

Scientific

Ursus maritimus

Life form

A large, white bear.

Figure 1. A polar bear (Nanuq). J. Lee, (c) GNWT.

Description

Polar bears are large marine mammals that live on the sea-ice and along the coastline throughout the circumpolar regions. As the largest of the bear family (Ursidae), polar bears can grow up to 14-16 feet tall according to oral history and hunters' records (P. Ekpakohak and D. Nasogaluak in Slavik *et al*. 2009).

Polar bears are opportunistic predators and their diet consists mainly of ringed (*natchiit*[3]) and bearded (*ugyuit*[4]) seals. They live mostly on the sea-ice and in marine environments but will den, travel and occasionally feed on land.

Nannut are greatly respected by Inuvialuit hunters as the most intelligent animal in the Arctic[5]. 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.

Distribution

The Inuvialuit Settlement Region includes the coastal regions of the mainland and Arctic Islands in the Northwest Territories (NWT). The main range and habitat of polar bears in the NWT are in these areas. Information on the geographic range of polar bears in the NWT 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 (Figure 2).

Figure 2. An Inuvialuit hunter observes a polar bear on land. Photo R. Hamburg © GNWT.

NWT distribution

The polar bears of the NWT live mostly on the sea-ice (*siku*[6]) 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 400km inland from the Beaufort coast. 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 in Slavik *et al.* 2009)[7]. As solitary animals, polar bears generally live at very low densities but are known to congregate occasionally when feeding or mating (Slavik 2011):

> *"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 in Slavik et al. 2009).*

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 cant 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" (J.M. Kudlak in Slavik et al. 2009).*

Traditional and community knowledge suggest 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 bears and mothers and cubs like to wander around close to shore and on land-fast ice where they find certain places where they could hunt by themselves (F. Wolki in Slavik *et al.* 2009)[8]. The general belief is that "healthy" bears will stay further away from land and settlements (Slavik 2011).

> *"… [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 in Slavik et al. 2009).*

Traditional and community knowledge of the best hunting places for bears can be used to infer where the best habitat could be found. Some of these locations include Nelson Head (*Imnaqyuak*[9]) (Stefansson 1914; M. Memarak in Berger 1976e)[10], Baillie Island (*Utqaluk*) (B. Pokiak in Berger 1976h)[11], and the west coast of Banks Island (D. Nasogaluak in Slavik *et al.* 2009)[12].

To categorically examine community knowledge of NWT polar bear distribution, information and observations are grouped into five geographic regions: North Beaufort (Banks Island), Amundsen Gulf (Cape Parry and Pierce Point), Viscount-Melville (Parry Islands, Prince of Wales Strait, and McClure Channel), Cape Bathurst, and South Beaufort (North Slope, Mackenzie Bay and Tuktoyaktuk Peninsula). The regional boundaries used in these descriptions do not correspond to polar bear subpopulation boundaries used for management. More detailed information on seasonal ranges is also provided where available.

North Beaufort Area

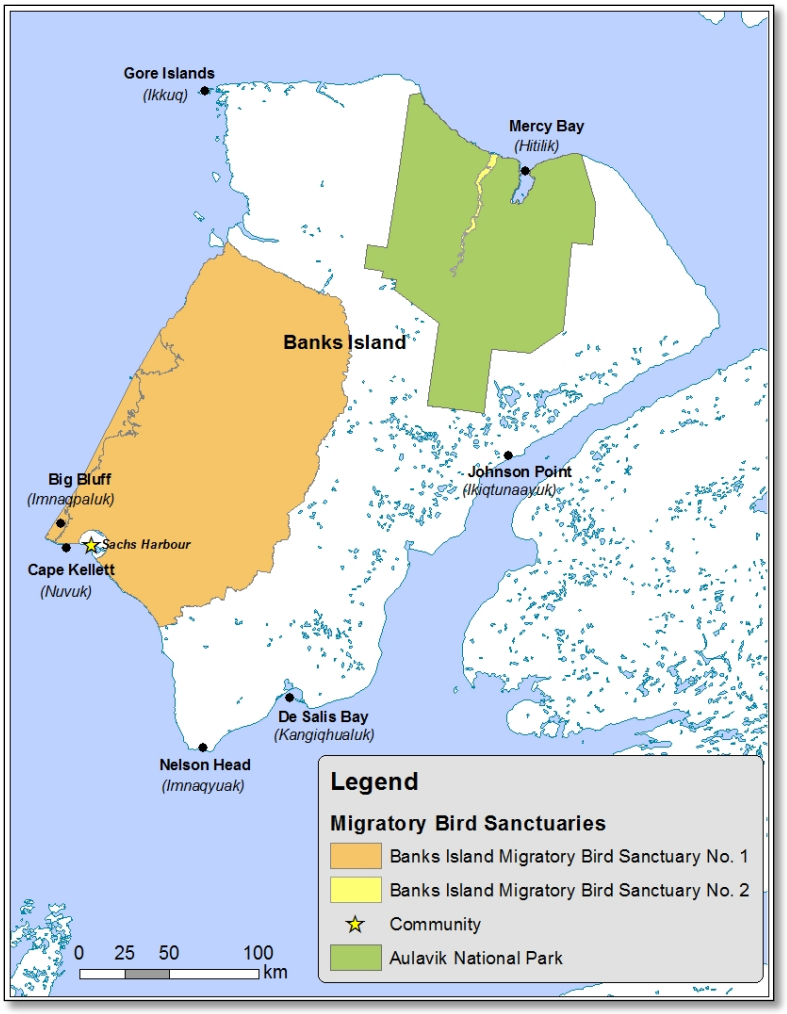

Figure 3. Map of North Beaufort area, including traditional place names.

Historical reports on the distribution of polar bears throughout the North Beaufort area 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). From McClure's notes while stranded in Mercy Bay (*Hitilik*[13]) 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 "*Kanhiryuarmiut*". Polar bear was an integral part of the diet for the *Kanhiryuarmiut* 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*[14]), and Cape Baring on the southwestern point of Victoria Island (Stefansson 1914).

Several key habitat areas for polar bears were identified more recently, specifically, offshore lead systems from De Salis Bay to Robilliard island (SHCCP 1992); and the Northern, Southern, and West coasts of Banks Island (SHCCP 1992; Barr 1996; D. Nasogaluak in Slavik *et al.* 2009)[15,16]. Areas frequented by Sachs Harbour residents for hunting polar bears include Nelson Head, DeSalis Bay and the west coast of Banks Island from Cape Kellet north to Gore Islands (Slavik 2011).

Seasonal ranges - North Beaufort area

In the summer, polar bears are found along the southwest, west, and north coasts of Banks Island (SHCCP 1992). During the late-summer or fall, bears can occasionally be seen around the middle of the island (F. Lennie in Slavik 2011). Prior to freeze-up in the early fall (October to November), polar bears can be found along the coast of Banksland, or occasionally near the community (F. Lennie in Slavik 2011). Some elders recall that in the early days "there was a lot of polar bears" at Sachs Harbour (*Ikahuuk*) in the fall (P. Gruben in Berger 1976h)[17].

From October-November to March, females den (*apitchiivik*[18]) in the vicinity of Cape Lambton, Norway Island, Nelson Head, and generally the entire coastal area of Banksland (SHCCP 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 2011). Specific denning areas identified by community members in Slavik (2011) include: Bernard Island; Blue Fox Harbour; Big Bluff (*Imnaqpaluk*); Cape Kellet (*Nuvuk*[19]); DeSalis Bay (*Kangiqhualuk*); Gore Islands (*Ikkuq*[20]); Nelson Head[21]; Norway Island; Sachs River; Siksik Island; Terror Island; and Thesiger Bay.

In the spring (*upinraksaq*[22]), bears are in healthy condition, highly active, and ready to begin breeding. 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 in Slavik 2011). In the spring they migrate south along the west coast of Banksland (P. Raddi in Slavik 2011; G. Wolki in Slavik 2011). Bears commonly travel through and around Cape Kellet, southwest of Sachs Harbour (SHCCP 1992). There are so many tracks around Cape Kellet in spring, it looks like a "polar bear highway" (F. Lennie in Slavik 2011; L. Carpenter in Slavik 2011).

Amundsen Gulf Area

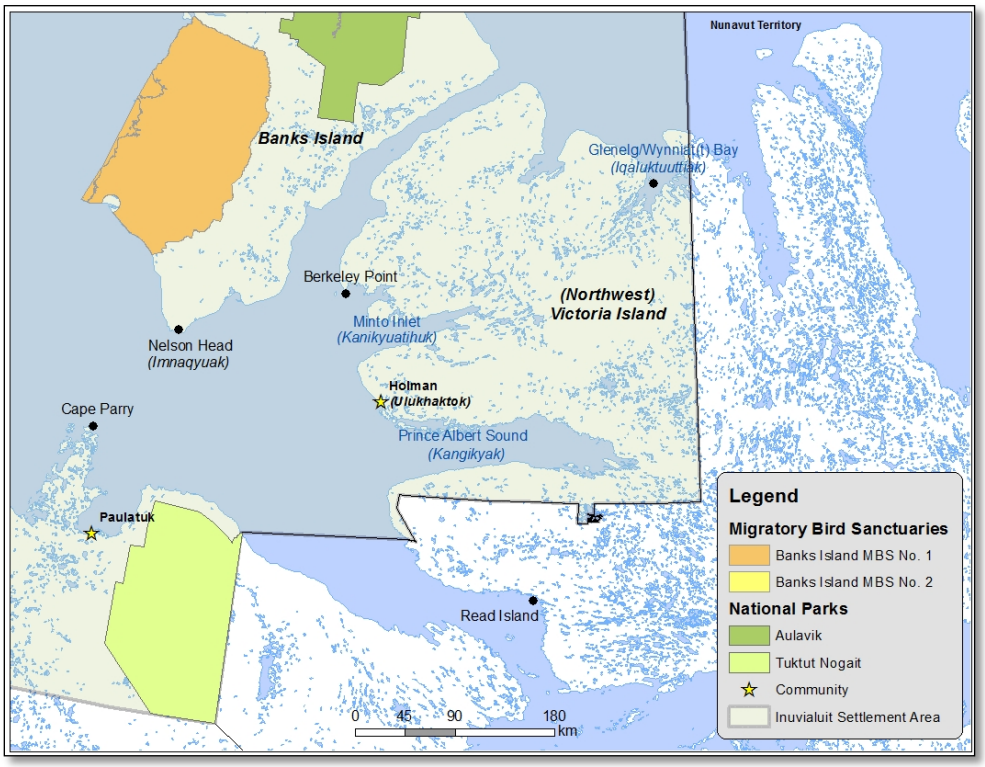

Figure 4. Map of Amundsen Gulf area, including traditional place names.

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). 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 district when "big ice [came] from the North" [Amundsen Gulf], but rare or entirely absent in years that the ice did not arrive (Gavin 1954 in Harington 1968: 11).

Cape Parry was a good area to hunt for polar bears, seals, and foxes, and that encouraged settlement in this area (T. Green in Parks Canada 2004)[23]. 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 (D. Nasogaluak and P. Ekpakohak in Slavik *et al.* 2009) [24, 25].

Prince Albert Sound and Minto Inlet (*Kanikyuatihuk*[26]) were frequented for polar bear hunting in the past, including hunting bears in their dens at Mount Fair (R. Inuktalik and C. Kilolaitak in Berger 1976e)[27,28]. 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" (R. Goose in Berger 1976e)[29]. This suggests a high concentration of polar bears in the area. Explorer Robert Mc'Clure 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)[30]. Recently, 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" (P. Ekpakohak in Slavik *et al.* 2009)[31].

Viscount-Melville Area

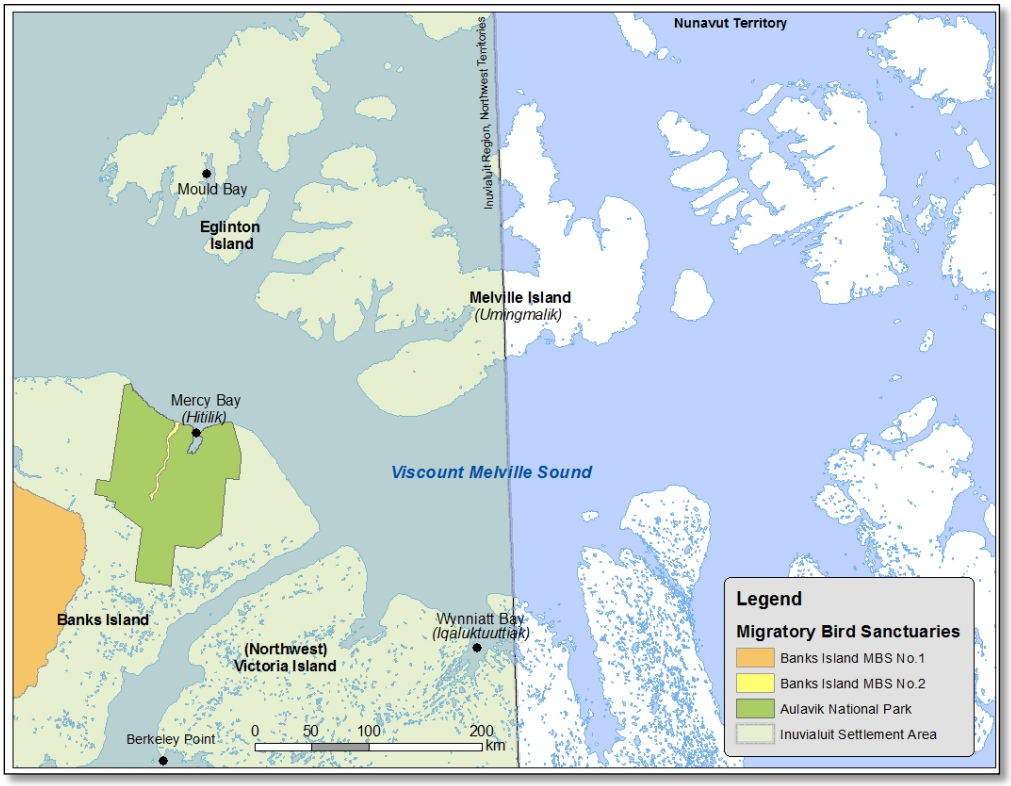

Figure 5. Map of Viscount-Melville Area, including traditional place names.

While hunters travel to Melville Island (*Umingmalik*[32]) infrequently, of the hunters who do make the trip, one hunter commented several times on the abundance of bears in the region (P. Ekpakohak in Slavik *et al.* 2009)[33]. Olokhaktokmiut believe that the Viscount-Melville subpopulation has increased since the moratorium on hunting in this area (CWS 2010: 88) and that this subpopulation needs to be re-surveyed (CWS 2010: 10). Pat Ekpakohak shared a story from his four trips to Melville Island:

> *"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 in Slavik et al. 2009).*

South Beaufort Area

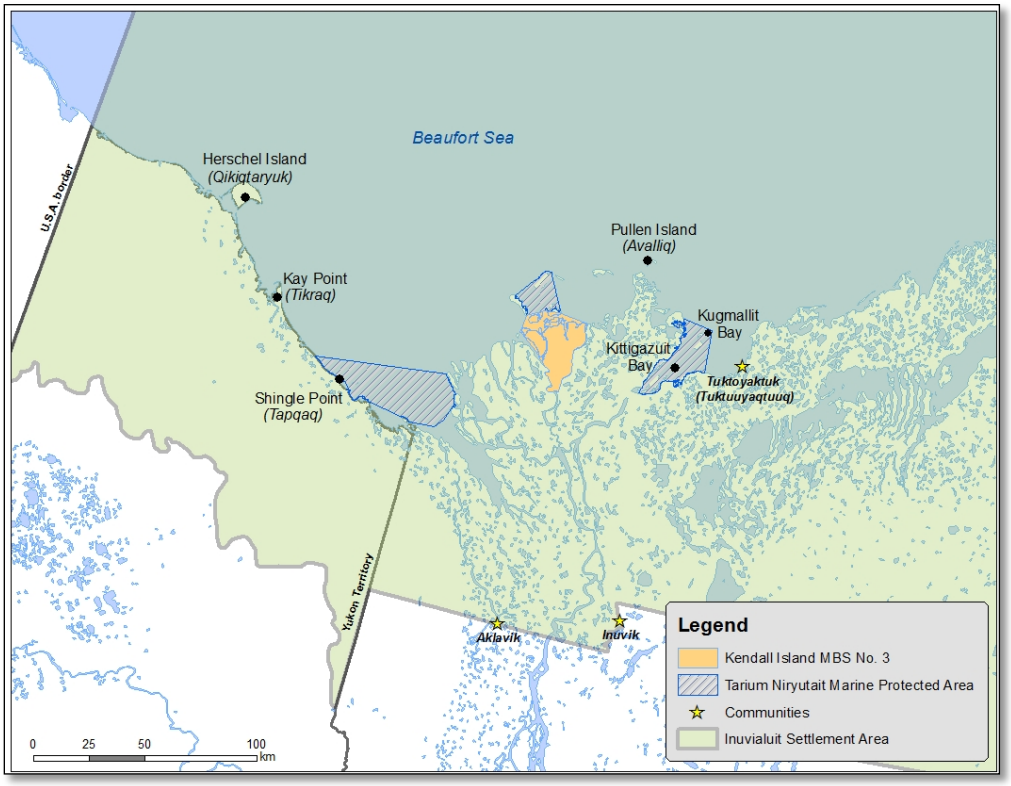

Figure 6. Map of South Beaufort area, including traditional place names.

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)[34]. However, it was later noted, once the whalers began to winter on the Beaufort coast, that a "substantial number of bears" frequent the mainland coast during the winter (Barr 1996: 186)[35].

Early harvest records from Tuktoyaktuk (*Tuktuuyaqtuuq*[36]) identify 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)[37]. To the west of Tuktoyaktuk, people would trap and hunt for bears and seals around Pullen Island (*Avalliq/Avallialuk*[38]) (N. Felix in Cockney 1997)[39]. Today, the hunting range for polar bears in the Tuktoyaktuk area extends from outside Pullen Island to the mouth of the Horton River (*Kuuk*[40]) (J. Pokiak in Slavik *et al.* 2009).

Seasonal Ranges – South Beaufort Area

In an effort to avoid the disturbance of denning female bears as a result of oil and gas development in the Mackenzie Delta, Environment Canada initiated a 4-year research program to examine the distribution of polar bear dens and polar bear denning habitat. Integrating scientific data (denning surveys and satellite telemetry) as well as traditional knowledge (47 local knowledge interviews in the communities of Inuvik, Aklavik, and Tuktoyaktuk), Environment Canada identified important maternity denning areas within the Mackenzie Delta and southern Beaufort Sea (Richardson pers. comm. 2011). 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*[41]) along the Yukon coast to Shallow Water Bay; the outer Mackenzie Delta (including Richards Island, Pelly Island (*Igluligyuaq*[42]), Hooper Island (*Kamikgik*[43]), Pullen Island (*Avalliq*) and Garry Island (*Ualligyuaq*[44]); the Tuktoyaktuk Peninsula from Atkinson Point (*Nuvuraq*[45]) to Cape Dalhousie (*Nuvuk*[46]); and the area around Baillie Islands (*Utqaluk*[47]), including a significant portion of Cape Bathurst (Richardson pers. comm. 2011).

Denning areas were also identified during a community workshop on traditional knowledge of polar bears sponsored by the Wildlife Management Advisory Council (NWT) (Slavik *et al.* 2009). These denning areas include: Garry Island, Kendall Island (*Ukivik*[48]), Hooper Island, Richards Island, Pullen Island, the outer delta area of Shallow Bay[49], and Mason and Old Horton (*Kangiqluk*[50]) Rivers on Bathurst Peninsula[51] (Slavik *et al.* 2009). Dens are also observed along east banks, high up on banks (*imnaqpak*[52]), and inland in ravines or riverbeds.

Cape Bathurst Area

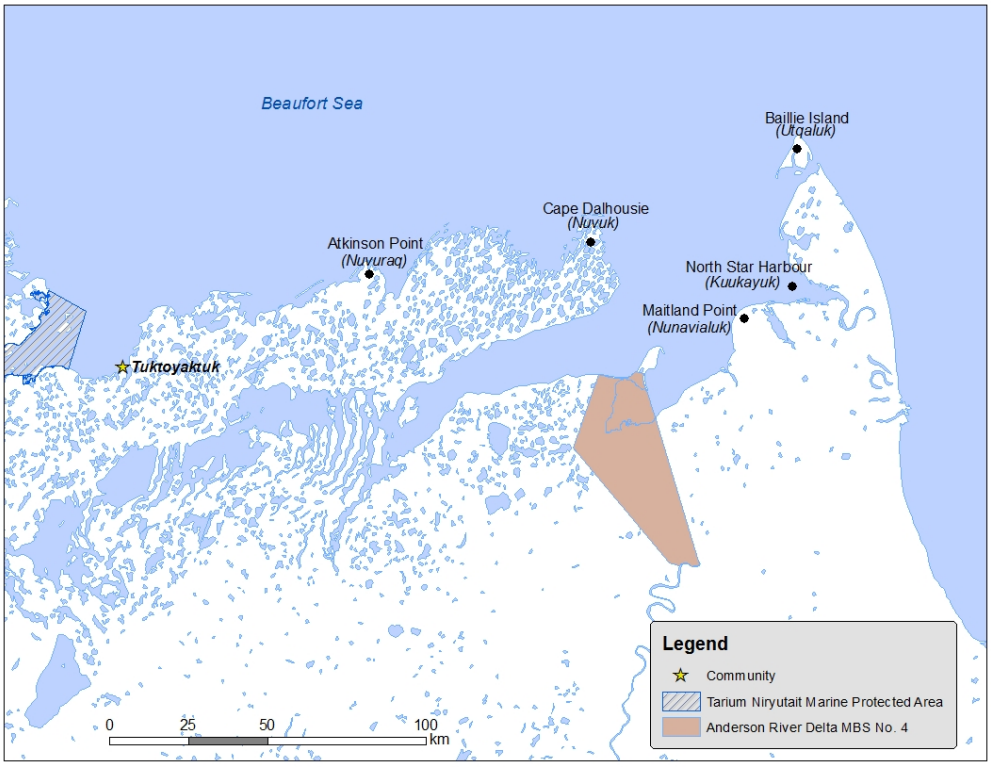

Figure 7. Map of Cape Bathurst area, including traditional place names.

Numerous stories exist about polar bear hunting at Cape Bathurst, as the Cape Bathurst polynya (*uiniq*[53]) was an important place for both seal and bear hunting (Hart and Amos 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*[54]) and Baillie Island (*Utqaluk*[55]). 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*[56]) on Cape Bathurst (F. Wolki and J. Pokiak in Slavik *et al.* 2009)[57,58]. 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 in Slavik *et al.*

2009)[59]. Jim Wolki (in Hart and Amos 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 3 miles) around Baillie Island, and open water around Observation Point (*Nuvuk*) meant, "if you go out to the edge you're going to see a bear!" (C. Gruben in Slavik *et al.* 2009)[60]. Bears would be frequently around Maitland Point (*Nunavialuk*[61]) when a west wind (*ungalaq*[62]) would open up water (J. Nasogaluak in Hart and Amos 2004)[63]. 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 and Amos 2004: 72).*

Bears were known to "portage" or travel overland across Cape Bathurst and often would den inland in the fall at Old Horton River and Mason River (F. Wolki in Slavik *et al.* 2009)[64,65].

Polar bear subpopulations

Scientists and managers recognize four subpopulations of NWT polar bears (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 a single subpopulation, as polar bears frequently move between both areas (CWS 2010) [66, 67, 68, 69, 70]. This perception is based on observations of the intermixing of bears from Northern Beaufort and Southern Beaufort (F. Wolki in Slavik *et al.* 2009)[71] (see *Movements,* p.34) and the experience that animals will constantly be moving to where the food is [found] (J. Pokiak in Slavik *et al.* 2009; Summary of Ulukhaktok Consultation in CWS 2010)[72, 73].

Search Effort

"Search effort" is a way of describing how well people know where polar bears are. With regard to traditional 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. Hunting ranges for polar bears and other species have been mapped and qualitatively described in Freeman (1976), Usher (2002) and Slavik *et al*. (2009). A comparison of Inuvialuit land and sea use in the 1960s and 1990s is shown in Figure 8, p.16. Kill locations from the Inuvialuit Harvest Study in the 1990s give an indication of where harvesting and "search effort" are concentrated.

Historical occupation of Melville and Eglinton Island is contested in the literature reviewed for this study (Usher 1976; Haogak pers. comm. 2010)[74]. However, in the last three decades, hunters from Sachs Harbour and Holman/Ulukhaktok have traveled to Melville Island for both sports hunts and subsistence hunts, and certain hunters visit Melville Island frequently (Slavik *et al.* 2009; Slavik 2011)[75].

Harvesting effort and hence 'search effort' for polar bears have 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 (Figures 9 and 10, p.17). However, some Inuvialuit indicate that the search effort for bears may be less than in the past as the hunting range has shrunk (L. Amos and D. Haogak in Slavik 2011)[76]. The high cost of gas may also be limiting the range of some harvesters (Slavik 2011). However, the communities have seen an increase in subsistence hunting due to increased demand of polar bear hides over the past 3 years (WMAC-NWT 2012, WMAC-NS 2012)[305].

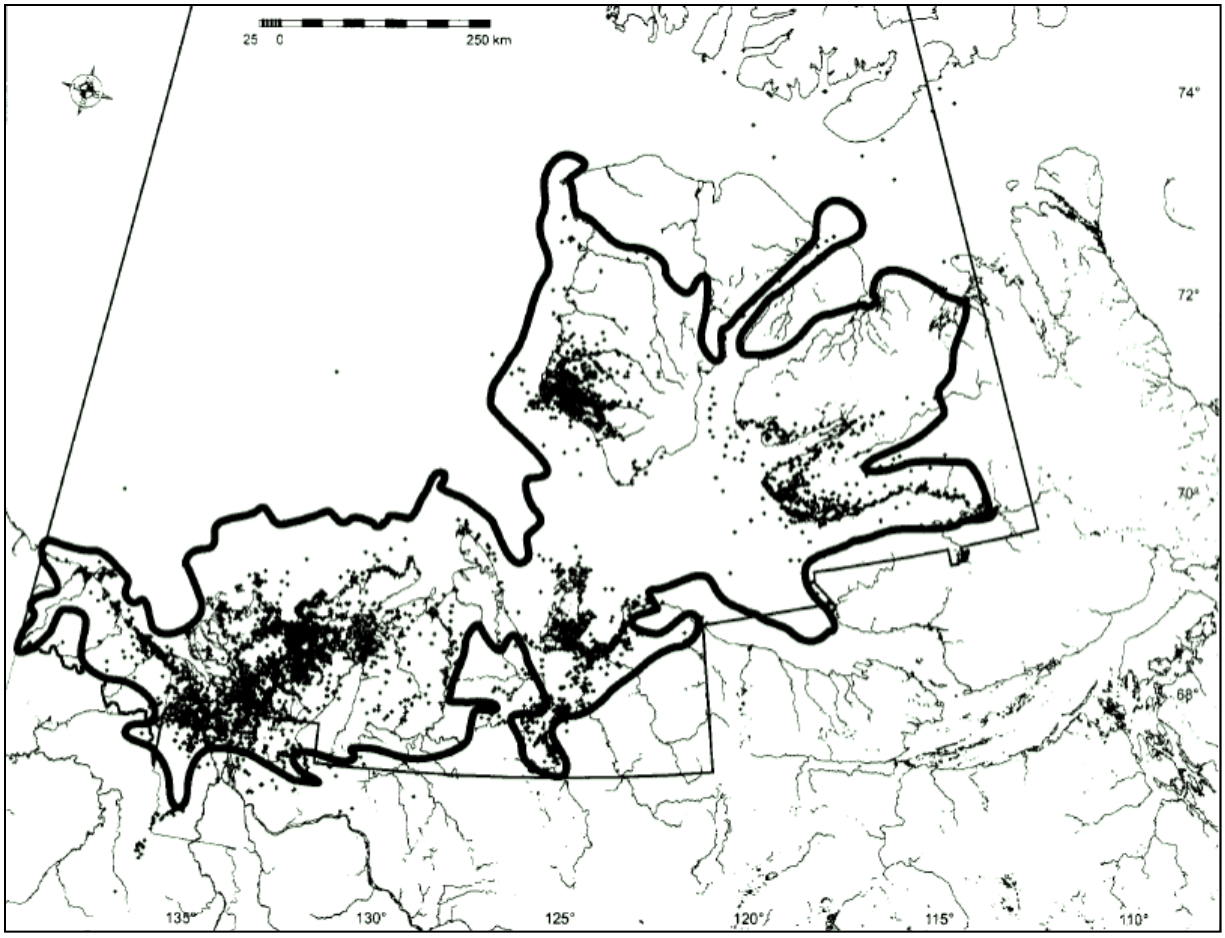

Figure 8. Inuvialuit use of land and sea in the Inuvialuit Settlement Region, 1960s and 1990s. The thick line shows land and sea use in the 1960s: it represents the outer limit of Inuvialuit harvesting from the mid-1950s to the mid-1970s, as documented by the Inuit Land Use and Occupancy project (Freeman 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 Inuvialuit Settlement Region. Reproduced from Usher (2002) with permission, © Arctic Institute of North America.

Figure 9. Approximate polar bear hunting range (prior to 1984) of 16 Inuvialuit participants in a workshop and interviews. Reproduced from Slavik *et al.* (2009) with permission.

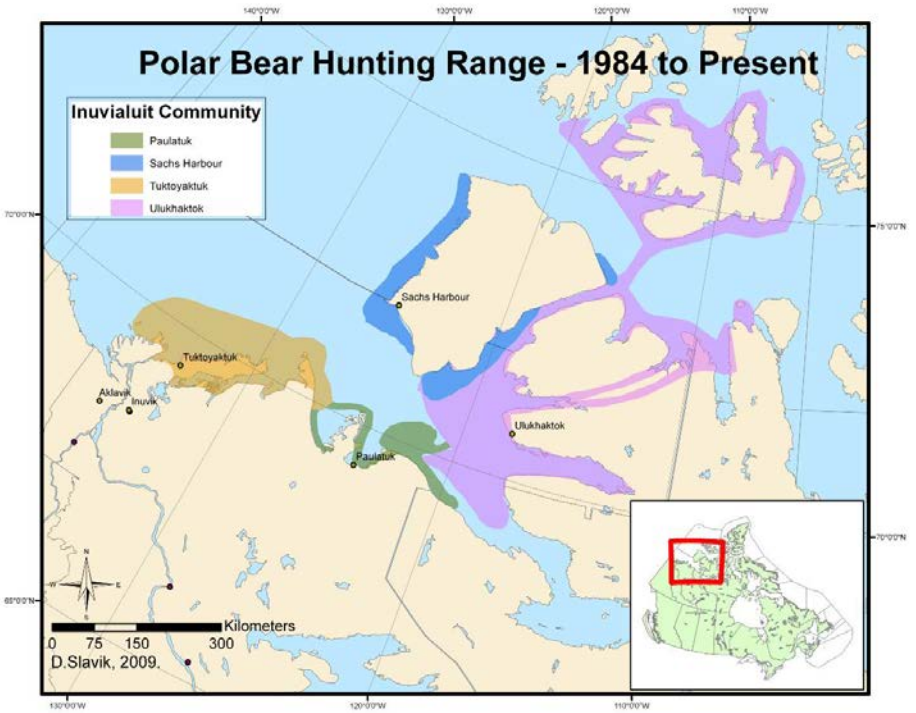

Figure 10. Approximate polar bear hunting range (1984 to 2009) of 16 Inuvialuit participants in a workshop and interviews. Reproduced from Slavik *et al.* (2009) with permission.

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)[77]. Furthermore, sled dogs, with their keen sense of smell, may have also led hunters to polar bear dens (Harington 1968). In summer time, polar bears were occasionally hunted with boats (S. Wolki in Slavik *et al.* 2009)[78]. Today, polar bears are hunted primarily with snowmobiles (*sikiituq*[79]).

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 in fall (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 (*Wildlife Act* 2010).

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 (F. Wolki in Slavik *et al.* 2009)[80]. 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; A. Carpenter in Slavik 2011)[81]. 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 only has declined from 68 (1960–65) to 56 (1988–97), the annual seal harvest has declined nearly 5-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" (Usher 2002:25).*

Today, 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 (D. Haogak in Slavik 2011)[82]. Furthermore, the increasing cost of gas and decline in sports hunting are potentially limiting the range of most harvesters.

Changing ice conditions attributed to climate change are a key limitation to search effort (J.

Keogak and L. Amos in Slavik 2011)[83,84]. Observed impacts include a decrease in the thickness and strength of ice in some areas (R. Kuptana and F. Lennie in Slavik 2011)[85, 86], making it more difficult to predict the safety of the ice (C. Gruben in Slavik *et al.* 2009)[87]. The ice breaks up more easily because it is not as thick, making it vulnerable to break-up from wind and currents (*sarvaq*[88]) (R. Kuptana in Slavik 2011)[89]. 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 2011). 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 ability to travel far onto the ice (J. Kuptana in Reidlinger 2001; L. Carpenter and L. Amos in Slavik 2011)[90].

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" (J. Lucas in Reidlinger 2001; C. Gruben in Slavik *et al.* 2009; J. Carpenter in Slavik 2011)[91, 92, 93].

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 (C. Gruben and M. Kudlak in Slavik *et al.* 2009)[94,95]. However, in the past decade there have been publicized cases of a female polar bear with two cubs traveling more than 400km south of the Beaufort coast into the Great Bear Lake (Dél̨ine) area, and a solitary male polar bear travelling to the Ft. McPherson area (see CBC 2008). There was also a recent sighting of a polar bear in Old Crow Flats (Yukon) within the last decade (Frost pers. comm. 2011). Polar bears are known to make "shortcuts" across land, but were not generally known to travel this far south (F. Wolki and E. Storr in Slavik *et al.* 2009)[96, 97], although 2008 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 summer time (August to September). Elders in Sachs Harbour said that in the past they did not hear of bears traveling on land, but "now you'll see that a little more often" (A. Carpenter in Slavik 2011; see also M. Kudlak and F. Kudlak in Slavik 2011). According to observations, these have generally been either denning females, or young or sub-adult male bears that were thought to be portaging or taking a shortcut across land (F. Lennie, A. Carpenter, T. Lucas, W.

Esau, L. Amos, and J. Keogak in Slavik 2011).

Coming in town

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 (T. Lucas in Slavik 2011), or hungry bears (*katyaaq*[98]*/ kayangnituk*[99]) in poor health (Slavik 2011). In the past in Sachs Harbour, 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 (P. Gruben in Berger 1976h)[100]. In Ulukhaktok, it was "not too common" to have bears coming into settlements until the late 1960s, but "these fortunately weren't polar bears that were terrorizing the people" (R. Goose in Berger 1976e)[101]. 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). There are conflicting perspectives on whether the number of bears coming through the communities has slightly decreased (Tuktoyaktuk Consultation in CWS 2010)[102] or slightly increased (F. Pokiak in Slavik *et al.* 2009)[103]. However, there is consensus that the number of bears coming to a community fluctuates seasonally depending on ice conditions and availability of food (E. Esau and F. Lennie in Slavik 2011).

Moving North

A consistent statement made by several sources in all NWT coastal communities is that polar bears are adjusting their range further north and further out on the multi-year ice (D. Nasogaluak and E. Pokiak in Slavik *et al.* 2009; Tuktoyaktuk Consultation in CWS 2010; J. Carpenter, T. Lennie and J. Keogak in Slavik 2011)[104, 105,106, 107]. 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 (e.g. D. Nasogaluak in Slavik *et al.* 2009)[108]. Pat Ekpakohak (in Slavik *et al.* 2009) 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."*

Hunters from Tuktoyaktuk believe bears prefer not to stay on the mainland of the NWT (D. Nasogaluak in Slavik *et al.* 2009; G. Ruben in Berger 1976i)[109,110] and that "bears don't come in [to shore] anymore because there's too much water, unless they swim across" (F. Wolki in

Slavik *et al.* 2009):

> *"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 in Slavik et al. 2009).*

Polar bears are following their food source, seals, which are migrating to different areas (D. Haogak and W. Esau in Slavik 2011): "Where the seals are, that's where the polar bears are- and the polar bears know the country! They know where there food is, that's why we don't see them much anymore" (F. Wolki in Slavik *et al.* 2009). Stronger currents and changes in the ecosystem are causing seals to move to different areas to get their prey, and polar bears to follow (F. Wolki in Slavik *et al.* 2009)[111].

As polar bears travel further out, it gets harder for hunters to access them (J. Lucas in Reidlinger 2001)[112]. Because hunters' observations and search efforts are also limited by climate change, many of the statements above are inferred through traditional knowledge and cultural beliefs, reinforced by experience, that animals will constantly be changing their range.

Habitat

Habitat Requirements

As James Pokiak (in Slavik *et al.* 2009) summarizes, the suitability of habitat for polar bears, depending on the season and where they are in their life cycle, depends on ice, wind, and currents:

> *"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" (James Pokiak in Slavik et al. 2009).*

Habitat requirements for denning

In late-October to early-November, people traveling along the coast expect to see a lot of polar bear tracks going inland. This is when pregnant females begin looking for dens where they can birth and feed their newborn cubs (Slavik 2011). Pregnant females (and occasionally non-pregnant females and males [MPEG 2006][113]) spend part of the winter in dens. These are usually snow dens located on land, although a small percentage of dens also may occur on land-fast ice (Harington 1968). Some hunters from Sachs Harbour have observed bears denning on ice, but this is rare and requires a lot of snow (E. Esau, L. Amos and W. Esau in Slavik 2011).

The ideal conditions for denning are where there is deep snow to provide insulation for the mother and cubs (F. Lennie, M. Kudlak, L. Amos, and W. Gully in Slavik 2011)[114]. Bears look for dens in areas where the wind blows over a bank, so the location of dens can depend on prevailing winds and the aspect of the slope. For example, around Tuktoyaktuk, the wind blows from the north and west so the bears try to go to the south or east side of the islands or inlets to look for where snow accumulates on the banks (C. Pokiak and C. Gruben in Slavik *et al.* 2009)[115,116]. Females will also make dens in ravines and depressions (J. Pokiak in Slavik *et al.* 2009)[117], as well high up on banks such as at Whale Bluff and Nelson Head (Barr 1996; C. Gruben in Slavik *et al.* 2009)[118].

Habitat requirements for hunting seals

Polar bears travel, looking for the best ice conditions from which to hunt seals. Most of the time polar bears will be hunting on young ice (W. Gully in Slavik 2011), along open leads, or where the old ice and the young ice meet (J. Lucas Sr. in Slavik 2011). The best ways for polar bears to hunt seals are by ambushing them at their breathing holes (*aglu*[119]) 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 (L. Carpenter and R. Kuptana in Slavik 2011)[120].

The following conversation between Pat Ekpakohak (PE) and David Nasogaluak (DN) (in Slavik *et al.* 2009) 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.*
>
> *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*[121]) and open leads (*uiniq*[122]) or "cracks"[123] are also favourable ice features for hunting seals (D. Nasogaluak, C. Pokiak and F. Wolki in Slavik *et al.* 2009)[124,125, 126]. One hunter also commented that the edge of land-fast ice (*tuvaq*[127]) near Baillie Island, where there is slushy water and pancake ice[128] or young, rubble ice[129], is good hunting habitat for bears (J. Pokiak in Slavik *et al.* 2009).

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 (J. Wolki and J. Lucas Sr. in Slavik 2011). A bear can smell a seal den through a thick layer of snow (J. Lucas Sr. in Slavik 2011), and can then pound through the ice and snow with its paws to access it (J. Pokiak in Slavik 2009; Slavik *et al.* 2009)[130]. During spring, when seals haul up, bears will also hunt basking seals beside open leads (W. Gully in Slavik 2011).

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" (J. Nasogaluak in Hart and Amos 2004: 72).*

> *"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 in Hart and Amos 2004: 73-74).*

'Good' years for polar bears at Baillie Island occurred when westerly winds (*ungalaq*[131]) 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 in Hart and Amos 2004: 74).*

Habitat availability

Inuvialuit are quick to point out that although multi-year ice is disappearing as a result of climate change (see section on *Habitat trends*, p.25), "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 believe bears will move North as annual ice replaces multi-year ice (Slavik *et al.* 2009). Olokhaktokmiut 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 encourage population surveys in this area (L. Carpenter in Slavik 2011)[132].

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 degree of marine traffic in the region (see *Threats and limiting factors* on p.42).

Inuvialuit knowledge illustrates two ways that natural habitat fragmentation can occur. The first is when there is too much open water and bears have to swim between land and ice floes (F. Wolki and D. Nasogaluak in Slavik *et al.* 2009)[133, 134]. While a polar bear is capable of swimming "for hundreds of miles without ice, it [has] to hunt on the ice floes" (D. Nasogaluak in Slavik 2009). 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 in Slavik et al. 2009).*

The second way that natural habitat fragmentation can occur is 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 (J. Keogak and G. Wolki in Slavik 2011)[135]. Joe Nasogaluak (in Hart and Amos 2004: 73-74) refers 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.

Traditional and community knowledge indicate that the natural fragmentation of sea-ice is amplified by climate change and industrial activity. This is discussed in the following section on *Habitat trends*.

Habitat trends

Traditional and community knowledge indicate that polar bear habitat is changing in association with climate change. People from all six NWT Inuvialuit communities recently confirmed that they were "already observing impacts such as warmer winter temperatures, mudslides, low summer water levels, earlier break up, later freeze up, sea-ice change – thinner, unpredictable,

fewer pressure ridges, and more open water" (CWS 2010: 10).

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 (F. Wolki in Slavik *et al.* 2009)[136]. People in the communities are noticing that freeze-up is later (CWS 2010) because of warmer temperatures, strong wind, strong currents and absence of multi-year ice to anchor ice formations to (J. Lucas Sr. in Reidlinger 2001)[137]. Likewise, spring break-up happens earlier with the warmer temperatures (D. Nasogaluak in Slavik *et al.* 2009)[138]. The shore-fast ice breaks up earlier in the spring, potentially taking seals out with it (F. Wolki in Slavik *et al.* 2009)[139].

Reidlinger (2001) discusses general changes in sea-ice based on observations from Sachs Harbour residents (further summarized in Box 1, p.28):

> *"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 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" (Reidlinger 2001:59-60).*

Wind and currents are key natural drivers that shape polar bear habitat by opening leads and causing pile-ups (J. Nasogaluak and J. Wolki in Hart and Amos 2004; P. Ekpakohak and M. Kudlak in Slavik *et al.* 2009)[140,141,142]. Some hunters have observed a change in direction of prevailing winds (C. Gruben in Slavik *et al.* 2009; L. Carpenter in Slavik 2011)[143,144]. 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) (L. Emaghok and M. Kudlak in Slavik *et al.* 2009)[145,146]. 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 in Slavik *et al.* 2009)[147]. 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).

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; F. Wolki in Slavik *et al.* 2009; CWS 2010)[148, 149,150].

Inuvialuit have been noticing a decline in multi-year ice since the late 1980s[151] and attribute it to climate change and increased activity in arctic waters (P. Ekpakohak and J. Pokiak in Slavik *et al.* 2009; Reidlinger 2001)[152]. The presence of multi-year ice helps to "freeze everything" and create good habitat for polar bears, as well as for hunters to travel (L. Emaghok in Slavik *et al.* 2009)[153]. Hunters in Tuktoyaktuk commented recently that they no longer see multi-year ice (L. Emaghok in Slavik *et al.* 2009)[154], while in Sachs Harbour, they no longer see multi-year ice floes in the summer (A. Carpenter, F. Lennie, D. Nasogaluak and L. Wolki in Slavik 2011)[155,156]. While multi-year ice remains off the west coast of Banks Island, it is no longer as close to shore (L. Amos in Slavik 2011)[157].

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 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 in Slavik et al. 2009).*

People are quick to point out that 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 an advantage 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, Olokhoktokmiut 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).

Box 1: Observed Changes in Sea-Ice from Banks Island (adapted from Reidlinger 2001)

- Less/no multiyear ice in July and August;
- More open water (and 'rougher' water);
- More ice movement than before;
- Not able to see the permanent pack ice to the west;
- Ice breaks up earlier and freezes up later;
- Rate of ice break-up has increased;
- Annual ice in harbour is weaker, thinner (not safe);
- Less and thinner landfast ice (shore ice);
- Changes in distribution and extent of local pressure ridges;
- Leads (openings in ice) farther away from shore;
- Ice pans do not push up on shore anymore; and,
- Open water in winter is closer than before.

Biology

Life cycle and reproduction

Polar bears generally have two cubs (twins). David Nasogaluak (in Slavik *et al.* 2009) 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."

Pat Ekpakohak has observed triplets on several occasions north of Ulukhaktok (Slavik *et al.* 2009)[158]. Oral history exists of a bear being seen with four cubs around Baillie Island (G. Wolki in Slavik 2011)[159], which could be explained as either adopted cubs, or her cubs from the previous year. Mating season is in March-April, when male bears will follow in the tracks of females with determination to mate (J. Lucas Sr. in Slavik 2011)[160]. Young cubs are threatened by large males, who will kill or cannibalize the cubs in order to mate with the female (J. Pokiak in Slavik *et al.* 2009; W. Esau, A. Carpenter and G. Wolki in Slavik 2011)[161,162]. In 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. 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 (Slavik 2011).

Physiology and adaptability

Polar bears are very adaptable (see *Habitat trends* (p.25) and *Threats and limiting factors* (p.42)).

Inuvialuit recognize that there are variations among different 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 in Slavik *et al.* 2009). 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).*

The main difference is in the shape of the head and body. One type that is often discussed are "weasel Bears" or "*tiriaranaq*". One "weasel bear" 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 in Slavik 2011). "Weasel bears" are generally found on the north side of Banks[163] and Victoria Island, and around Melville Island (D. Nasogaluak and P. Ekpakohak in Slavik *et al.* 2009)[164].

Some elders and hunters have also seen or have heard stories about "monster bears" – large bears that lived out onto the multi-year ice (J. Keogak in Slavik 2011). These bears are called "shovel bears" (*pualrisiktualuit*[165]).

Interactions

Interactions with seals

Seals are the main prey of polar bears. Polar bears depend on seals for their survival more than any other species. In this regard, seal abundance and condition can be used as an indicator of

polar bear population health (F. Raddi in Slavik 2011)[166].

In the NWT, polar bears feed on Ringed seals (*Pusa hispida; natchiq* (sing.), *natchiit* (pl.)), and Bearded seals (*Erignathus barbatus; ugyuk/ugruk* (sing.), *ugyuit/ugruit* (pl.)). Bearded seals are much larger, but not as abundant as ringed seals, and give birth to only a single pup (MPEG 2006). 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 (F. Wolki in Slavik *et al.* 2009; L. Carpenter in Slavik 2011)[167,168].

A key physiological requirement for polar bears is concentrated energy in the form of seal blubber (*uqsuq*[169]). 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 (F. Wolki in Slavik *et al.* 2009; F. Lennie in Slavik 2011)[170,171]. However, 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 in Slavik 2011).*

> *"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" (Paulatuk Consultation in CWS 2010: 92-93).*

During spring, seals are hauled up on the sea-ice in high concentrations. When the sea-ice breaks up, the seals go with it (F. Wolki in Slavik *et al.* 2009)[172,173]. Other times of the year, seals are migratory and follow fish migrations (MPEG 2006)[174]. 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 from Tuktoyaktuk said that ringed seals are in "good shape" (MPEG 2006: 11-23).

In the mid-1970s, numerous elders and harvesters from across the Inuvialuit region testified for the Berger Inquiry (Berger 1976a-i). In each coastal community they noted a decline in the

number and body condition of seals (F. Wolki in Berger 1976g)[175], as well as fewer young seals (W. Lucas and A. Carpenter in Berger 1976f)[176,177]. People believed that oil and gas development, ocean traffic and scientific research were responsible for this decline (J. Sittchinli in Berger 1976b; F. Carpenter in Berger 1976f)[178,179]. 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 (J. Memoganoak in Berger 1976e)[180].

More recently, people have noticed that seals are impacted by climate change. Reidlinger (2001) discusses Bankslanders' observations on 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 3 inches of fat on it; in poor ice years such as those recently experienced by Bankslanders 'ringed seals have only1/4 inch of fat on them in June'(R. Kuptana)" (Reidlinger 2001:62).*

Bankslanders have observed that there are not as many seals (P. Raddi, F. Lennie and M. Kudlak in Slavik 2011)[181] and that they are skinnier (P. Raddi and L. Wolki in Slavik 2011)[182]. 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 (M. Kudlak in Slavik 2011)[183].

Impacts of development and climate change on seals will be felt by polar bears. If polar bears cannot hunt seals due to changes in sea-ice, it will be difficult for them to adapt to hunt different prey (CWS 2010: 11).

Interactions with other prey

Polar bears are opportunistic. 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 (*Somateria spectabilis; qaugaq*[184]**) –** polar bears hunt ducks in the open water (C. Pokiak and D. Nasogaluak in Slavik *et al.* 2009)[185,186];
- Muskox (*Ovibos moschatus; umingmak*[187]*)* – polar bears scavenge muskox during the summer and fall (G. Wolki, E. Esau, F. Raddi and J. Lucas Sr. in Slavik 2011)[188,189,190];
- Beluga (*Delphinapterus leucas*; *qilalugaq*[191]) – polar bears will scavenge beached beluga or attempt to hunt belugas stranded in an open lead (J. Pokiak in Slavik *et al.* 2009)[192];
- Bowhead Whale (*Balaena mysticetus*; *arviq*[193]) – numerous bears (both polar bears and grizzly bears[194]) will scavenge on a beached bowhead whale (*silu*[195])(F. Wolki in Slavik *et al.* 2009; J. Lucas Sr. and D. Haogak in Slavik 2011)[196,197];
- Walrus (*Odobenus rosmarus; aiviq*[198]) – polar bears hunt walrus along the shoreline (G. Wolki in Slavik 2011)[199];
- Caribou (*Rangifer tarandus, tuktu*[200]*)* – polar bears scavenge or hunt young caribou (A. Carpenter in Slavik 2011)[201]; and
- Other bears, including polar bears and grizzly bears (*Ursus arctos horribilis*) (J. Pokiak in Slavik *et al.* 2009; R. Kuptana and G. Wolki in Slavik 2011)[202,203,204].

Another interesting feeding behaviour of polar bears is consuming grass, especially before entering into their winter dens (D. Nasogaluak in Slavik *et al.* 2009; G. Wolki and A. Carpenter in Slavik 2011)[205,206,207]. 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).

Interactions with bears and other predators

Although the polar bear is generally considered a solitary animal, Inuvialuit have observed that bears occasionally congregate together (D. Ruben in Slavik *et al.* 2009)[208]. Some of these occasions include congregating to feed on beached whales or to hunt seals in small groups (C. Pokiak in Slavik *et al.* 2009)[209]. There have also been observations that bears may possibly congregate for mating (L. Carpenter in Slavik 2011)[210]. Several hunters have observed that certain places can be "polar bear highways", especially around Cape Kellet and Nelson Head (Slavik 2011). One hunter observed this offshore from Tuktoyaktuk:

> *"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 in Slavik et al. 2009).

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 (J. Pokiak in Slavik *et al.* 2009)[211]:

> *"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 in Slavik 2011).*

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). However, recently, more grizzly bears have been observed on Banks and Victoria Islands than in the past (D. Nasogaluak and P. Ekpakohak in Slavik *et al.* 2009; Slavik 2011)[212,213]. In 2006, an American sport hunter guided by an Inuvialuit harvested the first recorded wild polar-grizzly bear hybrid in southeast Banksland. By 2010, two other hybrids were harvested on Victoria Island by Olokhaktokmiut (Wingrove 2010).

Beyond inter-breeding, grizzly bears and polar bears are known to fight and kill each other (J. Haluksit in Slavik *et al.* 2009)[214]. 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 in Slavik et al. 2009).*

Grizzly bears can also kill polar bears (Bayha pers. comm. 2012).

As polar bears live in such a specialized niche, they face little direct competition from other species. However, there have been signs of grizzly bears attempting to hunt seals on the shore-fast ice (P. Ekpakohak in Slavik *et al.* 2009)[215]. Other species such as Arctic fox (*Vulpes lagopus*), which are known to hunt seal pups in their dens, may also compete with polar bears for prey (E. Esau in Slavik 2011)[216].

Polar bears may face some predation from wolves, both on the mainland (C. Gruben in Slavik *et al.* 2009)[217] and on the Arctic islands (D. Haogak in Slavik 2011)[218].

Population

Structure and rates

It is possible that through traditional 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. However, this knowledge was not included in the sources examined and, to our knowledge, has not yet been recorded.

The maximum age of bears recalled the sources examined ranges from 13 years old to 33 years old. Bears this old can grow larger than 11 feet and will often be in poor condition, skinny or starving, with worn-down teeth (P. Ekpakohak, C. Gruben and M. Kudlak in Slavik *et al.* 2009)[219, 220,221]. Hunters 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 in Slavik 2011).

Movements

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

> *"Animals travel, they never stay in one place, they always traveling 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 in Parks Canada 2004: 160).*

Polar bears cover huge distances as they move from one area to another hunting seals (Summary of Ulukhaktok Consultation in CWS 2010)[222]. They can travel between continents (Canada and Russia), management jurisdictions, and scientifically defined subpopulation boundaries in a season (F. Wolki in Slavik *et al.* 2009; CWS 2010)[223,224]. This suggests that polar bears from populations outside the NWT would be able to disperse to the NWT relatively easily, if conditions were suitable.

Polar bear movements are motivated largely by locating 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" (F. Wolki in Slavik et al. 2009)".*

These movements cause polar bear numbers in certain areas to fluctuate annually as they follow their food (F. Wolki in Slavik *et al.* 2009)[225]. This pattern is affirmed in some population studies (F. Pokiak in Slavik *et al.* 2009)[226].

An individual bear may follow a migration path over several years (C. Pokiak in Slavik *et al.* 2009)[227]. Seasonal movements are also reported (M. Kuneyuna in Berger 1976e; G. Ruben in Berger 1976i)[228, 229]. 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" (F. Wolki in Slavik et al. 2009).*

During October, female bears move towards the coast to den and may travel inland (F. Wolki in Slavik *et al.* 2009)[230,231]. During December-February, some hunters have noticed bears actively traveling from east to west (L. Emaghok in Slavik *et al.* 2009)[232], or traveling in from the Beaufort Sea towards the coast as the ice gets thicker (F. Wolki in Slavik *et al.* 2009)[233].

Historically, in the Northern Beaufort, "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 along the west coast in March, April and May (P. Raddi and G. Wolki in Slavik 2011)[234,235]. Most of the time they travel where the old ice and the young ice meet[236] (J. Lucas Sr. in Slavik 2011), on young ice (W. Gully in Slavik 2011)[237] or following open leads. 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 Prince of Wales Strait (P. Ekpakohak and D. Nasogaluak in Slavik *et al.* 2009)[238,239]. Harvesters expect to find lots of tracks (i.e. "polar bear highways") around Cape Kellet (the southwest tip of Banks Island) in the spring (F. Lennie and L. Carpenter in Slavik 2011)[240]. During this time, "big male" bears travel great distances, coming

in from "way out" to track down and mate with females (J. Lucas Sr. in Slavik 2011)[241], and hunters expect to see large male bears following behind a female's tracks (W. Gully and J. Lucas Sr. in Slavik 2011)[242].

Polar bears travel around Nelson Head in the fall (A. Carpenter in Slavik 2011)[243]. It has also been noted that bears travel west through M'Clure Strait, from north of Victoria Island to Melville Island in April-May (J. Lucas Sr. in Slavik 2011)[244]. Polar bears are known to spend their summer along the southwest, west and north coasts of Banks Island (SHCCP 1992).

Polar bear migration routes may vary depending on habitat conditions, but polar bears are capable of traveling across varied terrain including very thin ice (D. Ruben and P. Ekpakohak in Slavik *et al.* 2009)[245,246]. If they need to, or if they smell food, bears can swim huge distances between ice and the shore (F. Pokiak in Slavik *et al.* 2009)[247,248].

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 (D. Nasogaluak in Slavik *et al.* 2009)[249]. There is also awareness that as ice melts in the southern Beaufort, bears will migrate further north (D. Nasogaluak in Slavik *et al.* 2009)[250]. Concerns about the impacts of climate change are also amplified by concerns about increased industrial development in the region, which could also impact polar bear migration (J. Pokiak in Slavik *et al.* 2009)[251].

Abundance

The sources of traditional and community knowledge examined do not include estimates of population abundance (numbers), but instead make observations of 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)[252]. Table 1 illustrates the evidence for relative abundance and condition of NWT polar bears and seals from the late 1800s to early 2000s.

Table 1. Evidence for relative abundance and condition of NWT polar bears and seals over time. Note that limited major traditional 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".	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; Stefansson 1923: 283
Early 1900s - Shallow Bay	Seals abundant	"When I was young there was lots of seals [around Shallow Bay]"	A. Ookpik (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 (in Hart and Amos 2004: 72)
1910 - Franklin Bay	Bears abundant	"an abundance of bears in 1910 in the Franklin Bay area"	A. Tuma (in Hart and Amos 2004: 73)
1920s - Baillie Island	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 (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 (in Hart and Amos 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 (in Berger 1976h)
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 (in Slavik *et al.* 2009

Date and Place	Abundance/ condition of species	Observations	Sources
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 (in Slavik 2011)
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 (in Hart and Amos 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 (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 (in Berger 1976e)
1974- Ulukhaktok	Seals in poor condition	"…was the only year [1974] that the seals were really poor, skinny..."	J. Memoganoak (in Berger 1976e)
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 (in Berger 1976i)
1975 - Sachs Harbour	Young seals scarce	"…hardly any [young]seals around"…"only [harvested] one young one"	W. Lucas (in Berger 1976f)
1975-76 - Sachs Harbour	Young seals scarce	"The seals there, for the last two years they have not been having young"	A. Carpenter (in Berger 1976f)
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 (in Berger 1976f)
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 (in Berger 1976f: 4042)

Date and Place	Abundance/ condition of species	Observations	Sources
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 (in Berger 1976e)
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 (in Berger 1976e)
1976 - Baillie Island	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 (in Berger 1976h)
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
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 covered up the seal breathing holes, meaning the bears have to dig through three feet of ice to get the seals now."	MPEG 2006: 11-32
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 (in Slavik *et al.* 2009
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".	Tuktoyaktuk Consultation in CWS 2010: 85

Date and Place	Abundance/ condition of species	Observations	Sources
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, p. 10
2009 - Ulukhaktok	More bears	Olokhaktokmiut 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 in Slavik *et al.* 2009

Fluctuations and trends

Traditional and community knowledge indicate that polar bear abundance changes from year to year. For example, Martha Kudlak commented in regard to polar bear numbers: "… some years it's less and some years it's more. And it's always been that way" (in Slavik 2011). Jim Wolki (in Hart and Amos 2004) refers to a "year of the polar bear" in 1972-73 when the numbers were especially high in the Cape Bathurst area[253].

Observations of seal abundance can be used to infer polar bear abundance (for example, MPEG 2006)[254]:

> *"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" (F. Wolki in Slavik et al. 2009).*

Traditional and community knowledge sources indicate that there have been population ups and downs in the past (Table 1, p.37). Inuvialuit understand that polar bear population size is "cyclical" over time and that populations across Canada will naturally increase and decrease as the population grows or bears move from one area to another (F. Wolki in Slavik *et al.* 2009)[255].

Traditional knowledge holders recognize that an observed regional decline in population does not necessarily infer an overall population decline. It could reflect the fact that polar bears are moving to different places at different times (P. Ekpakohak in Slavik *et al.* 2009; J. Carpenter in Slavik 2011)[256,257], or that hunters can no longer access the ice where the bears are (J. Keogak in

Slavik 2011)[258]. Individual observations on changes in polar bear abundance can vary depending on the individual hunter's range, experience and perspective.

Recently, hunters from Tuktoyaktuk have commented on the recent scarcity of bears (L. Emaghok in Slavik *et al.* 2009)[259]. 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"[260] (CWS 2010: 10). In Sachs Harbour, some elders recently commented that there "seems to be not too many as there used to be" (G. Wolki in Slavik 2011)[261], but some other residents of Sachs Harbour disagree (Slavik 2011). Olokhaktokmiut recently stated they are seeing more polar bears and that the population is stable (CWS 2010). One hunter who has frequently harvested polar bears around Melville Island commented on the abundance of bears in this region (P. Ekpakohak in Slavik *et al.* 2009)[262]. Olokhaktokmiut believe that the Viscount-Melville subpopulation has increased substantially since the moratorium on hunting in this area (CWS 2010: 88) and that this subpopulation needs to be re-surveyed (CWS 2010: 10).

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 (Slavik 2011). For example, Andy Carpenter 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" (A. Carpenter in Slavik 2011). 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: 10).

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 (F. Lennie in Slavik 2011). 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 (F. Raddi in Slavik 2011). "Spooked" bears may not be effective hunters, while older bears may lack agility and be in poor condition for hunting (Slavik *et al.* 2009).
- Availability of prey species – If seals are less abundant, or in poorer condition, this can affect the condition of the bears (F. Raddi in Slavik 2011).

Several elders and hunters have stories about "monster bears" (*pualrisiktualuit* or "shovel bears";

described on p.29), which they have seen, tracked, or heard stories about. "People used to see them all the time" (P. Ekpakohak in Slavik 2011), but today, hunters are noticing that there are not very many "monster bears" around, or if they are, that they have moved North (P. Ekpakohak and D. Nasogaluak in Slavik *et al.* 2009)[263,264] or out onto the multi-year ice (J. Keogak in Slavik 2011)[265].

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, and is itself identified as one of the main threats (CWS 2010: 11).

The combined effects of climate change with rapidly increasing development and activity in the Arctic are cause for high uncertainty and immense concern about the cumulative impacts on polar bears and their habitat:

> *"Some reports state that 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

Changes in sea-ice associated with climate change, and impacts on polar bears, are being observed in the NWT. Climate change is affecting the sea-ice conditions, as well as winds, currents, and timing of break-up and freeze-up (see section on *Habitat trends*, p. 25). 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: 11-32). The increase in open water due to a longer ice-free season and more open leads could affect their health and diet (F. Wolki in Slavik *et al.* 2009)[266].

Polar bears may change their range and migrations as a result of climate change (D. Nasogaluak in Slavik *et al.* 2009)[267]. Some of these changes are already being observed (see sections on *Distribution trends* (p.19) and *Movements* on (p.34)). 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 2011). However, as polar bear movements are determined largely by the migrations of seals, their ability to adapt to more northern (or southern) ranges would require 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: 11).

The adaptability of polar bears is emphasized by Inuvialuit such as Robert Kuptana who, like many, believes "that some polar bears will survive because they will learn how to change their diet and possibly live on the land" (R. Kuptana in CWS 2010). Others believe this would be very difficult, as they depend on seal blubber for the majority of their diet (F. Lennie in Slavik 2011)[268]. 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 (R. Kuptana in Slavik 2011)[269].

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 in Berger 1976c: 3870).*

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

> *"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 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" (Sam Raddi*

in Berger 1976c:3461).

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 (W. Kuptana in Berger 1976f; F. Wolki in Berger 1976g)[270,271]. 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 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 (A. Kimiksana in Berger 1976g; J. Wolki in Berger 1976h)[272,273]. As V. Steen (in Berger 1976h) shared at the 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" (V. Steen in Berger 1976h:4207).*

Polar bears are a sensitive species with excellent senses (CWS 2010: 78). Disturbances from increased development (sound, smoke, etc.) will scare bears away and impact their migration (F. Nuyaviak in Berger 1976h; L. Emaghok in Slavik *et al.* 2009)[274,275]. Conversely, if there are starving bears, they may be attracted to camps, which would pose a threat to themselves and to people (J. Wolki in Slavik 2011)[276]. Industrial activity near the shoreline can interrupt bears' denning cycles or cause them to abandon their young cubs (C. Pokiak in Slavik *et al.* 2009)[277]. Concerns remain very high today about the current and potential impact of offshore oil and gas

exploration and development on polar bears and their habitat (J. Pokiak and R. Kuptana in Slavik *et al.* 2009; CWS 2010)[278,279].

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: 15). 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 (J. Pokiak in Slavik *et al.* 2009; Tuktoyaktuk Consultation in CWS 2010)[280,281].

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)[282]. 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 behavior (CWS 2010:11), 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 (S. Wolki in Slavik *et al.* 2009)[283]. Some harvesters have also seen wounds from tranquilizer darts become infected (G. Wolki in Slavik 2011)[284]. The invasive procedures used in tagging and examining bears can disturb them and encourage them to avoid further human contact (L. Emaghok in Slavik *et al.* 2009)[285].

Harvesters and elders from numerous communities have discussed how disturbances such as hunting, helicopters, gunfire, or other startling occurrences can "spook" bears. 'Spooked bears' (*kayaaniq*) are jumpy *(kogluk),* are ineffective hunters and eventually suffer from starvation (J. Nasogaluak in Hart and Amos 2004; F. Wolki and D. Nasogaluak in Slavik *et al.* 2009)[286,287,288].

While experienced hunters will comment "there's always been the odd starving bear" (R. Kuptana in Slavik 2011)[289], several harvesters have recently observed signs of nutritional stress that include consuming the entire seal carcass (see section on *Interactions with seals* p.29). 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 the bears, as starving bears are aggressive (W. Kuptana in Berger 1976f; J. Wolki in Berger 1976h; J. Pokiak in Slavik *et al.* 2009)[290,291,292] and do not scare away as easily (A. Carpenter and E. Esau in Slavik 2011)[293]. 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 *Interactions with bears and other predators*, p.32).

Other concerns briefly mentioned in the sources examined include pollution and contamination, disturbances from aircraft and snowmobiles, and competition for food from foxes, grizzly bears and other new species entering the polar bears' range (Slavik 2011; see section on *Interactions*, p. 29).

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.

Olokhaktokmiut 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 (E. Esau and F. Lennie in Slavik 2011). 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 in Slavik 2011).*

Polar bear hunting, whether for subsistence purposes or guided (outfitter) sport hunts, was not identified in the sources examined as being currently a cause for concern in polar bear decline. Several Inuvialuit 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). During the fall of 2012, 12 or 13 polar bears were taken by hunters from Sachs Harbour prior to December, which was due to the late freeze-up along the coast. At times, as many as 12 polar bears were seen in the harbour in one day (Carpenter pers. comm. 2012).

It has been observed in the past that market factors can drastically increase prices of polar bear hides (Barr 1996; R. Goose in Berger 1976e)[294,295]. As pointed out in relation to barren-ground caribou harvest at a meeting in Inuvik (CWS 2010):

> *"Tough economic times impact communities, and consequently will increase the number of people willing to hunt for subsistence. If people cannot afford to buy food from the grocery store they will be forced to increase the number of animals that are harvested. Even if that may mean breaking the law and going against quotas as a last resort. Therefore, the economy can directly impact a species at risk such as the polar bear" (CWS 2010:78).*

Market demand for polar bear hides has increased in the last five years and it is possible that more harvesting pressure could be put on polar bears if the price of hides continues to rise on the world market (CBC 2011). This harvesting pressure, however, will continue to be checked by harvesting quotas based on science and Traditional Knowledge of the status of bear, not on market values (CWS 2012).

Positive Influences

Management

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:

- Do not hunt more than you can eat; do not waste polar bear meat (Slavik *et al.* 2009);
- Adjusting harvesting practices to leave certain areas of land to "rest" (A. Carpenter in Slavik *et al.* 2009);
- Try not to shoot or even bother the females when they are with cubs (A. Carpenter and J. Lucas in Slavik *et al.* 2009);
- Do not harass or bother a bear and her cubs while denning (C. Pokiak and J. Lucas in Slavik *et al.* 2009);
- Do not speak (disrespectfully) about animals (J. Lucas, J. Pokiak and C. Gruben in Slavik *et al.* 2009);
- Hunting animals helps to keep the populations and ecosystems in balance (A. Carpenter in Slavik *et al.* 2009);

- Give younger bears a chance to live their life and preserve them for future generations of hunters (J. M. Kudlak in Slavik *et al.* 2009); and
- Do not let animals suffer (R. Kuptana in Slavik *et al.* 2009).

A positive influence on the species in the NWT has been the development of collaborative management regimes. Inuvialuit collaborate with each other through Hunters and Trappers Committees, as well as with management authorities, other Indigenous groups and biologists to "ensure that hunting the polar bear is sustainable" (CWS 2010: 12). Many of the harvesting rules and regulations (i.e. "by-laws"; F. Pokiak in Slavik *et al.* 2009[296]) have been self-imposed by the Inuvialuit upon their 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, even when uncertainty exists (F. Pokiak and J. Pokiak in Slavik *et al.* 2009)[297,298]. The WMAC (NWT) considers best available information (scientific and all other sources) and recommends a quota to the ENR Minister. The Inuvialuit Game Council then allocates the quota amongst the HTCs and decides how many tags and from which subpopulation each community gets. The individual HTC then allocates tags within the community and designates which can be used for sport or subsistence harvesting. 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).

Changes in sea-ice

Many hunters believe that an increase in annual ice that is replacing multi-year ice will be an advantage to polar bears (CWS 2010; L. Carpenter in Slavik 2011)[299]. Annual ice is better polar bear habitat for hunting seals as the seals can make breathing holes in the thin ice (R. Kuptana in Slavik 2011; see the section on *Habitat* p. 21)[300].

Changes in ice conditions 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 traveling onto the sea-ice to hunt polar bears, naturally easing harvesting pressure (Reidlinger 2001, W. Gully in Slavik 2011; see the section on *Search effort* p. 14)[301].

Acknowledgements

A big thank you, *quyanainni*, and *quana* to the Inuvialuit Elders and Harvesters, both past and present, who contributed to previous studies upon which this report is built. We hope this report respects your knowledge and history, contributes to passing this knowledge on to the next generation, and assists in the conservation of polar bears for generations of Inuvialuit to come.

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Authorities Contacted

ABORIGINAL ORGANIZATIONS AND WILDLIFE MANAGEMENT BOARDS

Amy Thompson	Executive Director; Gwich'in Renewable Resources Board, Inuvik, NT.
Bruce Hanbidge	Resource Biologist; Wildlife Management Advisory Council (NWT), Inuvik, NT.
Cathy Cockney	Manager; Inuvialuit Cultural Resource Center, Inuvik, NT.
Jennifer Lam	Resource Management Coordinator; Inuvialuit Game Council, Inuvik, NT.
Mardy Semmler	Director; Gwich'in Tribal Council, Lands Administration and Resource Management, Inuvik, NT.
Sharon Snowshoe	Executive Director; Gwich'in Social & Cultural Institute, Inuvik, NT
Steven Baryluk	Resource Management Coordinator; Inuvialuit Game Council, Inuvik, NT.

TERRITORIAL GOVERNMENT CONTACTS

Barb Cameron	Director; Prince of Wales Northern Heritage Centre, Yellowknife, NT
Chuck Arnold	Territorial Archaeologist (Retired); Prince of Wales Northern Heritage Centre, Yellowknife, NT.
Jodie Pongracz	Regional Biologist; Environment and Natural Resources (Inuvik Region), Inuvik, NT.
Marsha Branigan	Manager, Wildlife Management; Environment and Natural Resources (Inuvik Region), Inuvik, NT.
Rob Gau	Wildlife Biologist, Species at Risk; Environment and Natural Resources (Headquarters), Yellowknife, NT.
Robert Mulders	Wildlife Biologist, Carnivores/Furbearers; Environment and Natural Resources (Headquarters), Yellowknife, NT.
Susan Fleck	Director, Wildlife; Environment and Natural Resources (Headquarters), Yellowknife, NT.

FEDERAL GOVERNMENT CONTACTS

Donna Bigelow	Species at Risk Biologist; Environment Canada, Yellowknife, NT.
Evan Richardson	Polar Bear Research Biologist; Environment Canada, Edmonton, AB.
Ian Stirling	Wildlife Biologist; Canadian Wildlife Services, Edmonton, AB.
Ifan Thomas	Western Arctic Field Unit Superintendent; Parks Canada, Inuvik, NT.

OTHER EXPERTS

Andrew Derocher	Biology Professor and past IUCN Polar Bear Specialist Group Chair; University of Alberta, Edmonton, AB.
Milton Freeman	Professor (Retired); Canadian Circumpolar Institute, Edmonton, AB.
Peter Usher	Past Member of Mackenzie Valley Pipeline Joint Review Panel, Consultant, Ottawa, ON.

Biography of Preparer

Dan Slavik is a graduate of the combined Environmental Conservation Sciences and Native Studies (B.Sc/B.A) degree, and is currently completing his Master's degree in Environmental Sociology in the Dept. of Rural Economy at the University of Alberta. With a strong, interdisciplinary training in the social and natural sciences, his research and work experience has developed his expertise in traditional knowledge studies and land-use mapping. His previous research examined Indigenous management of wildlife in the Northwest Territories, Canada and Southern New Zealand, exploring how traditional and contemporary Indigenous knowledge can be used to better understand and monitor changes in the environment.

For the last three years, he has been conducting fieldwork throughout the Inuvialuit region exploring Traditional 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 facilitating traditional knowledge workshops and training local youth as research assistants. 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, harvesting practices and terminology.

Scientific Knowledge Component

Names and classification

Ursus maritimus Phipps (1774), no subspecies

Common Name:	Polar bear, ours polaire, ours blanc, Nanuk, Nanuq
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: 185) was first to describe the polar bear as a distinct species. 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.

Figure 11. An adult polar bear (*Ursus maritimus*) walking on sea-ice in the Northwest Territories, Canada. Photograph courtesy of François Messier.

Description

Polar bears are adapted to the unique niche of hunting marine mammals from a sea-ice platform. Polar bears are large bears most comparable in size and shape to brown bears, their closest relatives. Genetic studies show that polar bear and grizzly bear are sister species and have had complex and sometimes divergent evolutionary histories for the past 4-5 million years (Miller *et al.* 2012). Polar bears may have evolved more than once from common ancestors with grizzly bears (brown bears), tracking past climatic changes. The latest divergence was during the middle Pleistocene about 600,000 years ago, corresponding to a cooling period in Arctic Ocean (Hailer *et al.* 2012). Low genetic diversity points to a prolonged decline in polar bear numbers during the last half million years (Miller *et al.* 2012). Mitochondrial evidence of past hybridization between polar bears and grizzly bears also exists with, for example, grizzly bears from Admiralty, Baranof, and Chichagof islands in Alaska's Alexander Archipelago (Lindqvist *et al.* 2010), and with a now extinct brown bear in Ireland (Edwards *et al.* 2011).

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 rostrum, and an elongated neck (Fig. 11). Although possessing similarly strong bite strength, the skull of the polar bear is

less robust than that of the brown bear (Slater *et al.* 2010). Compared to brown bears, the grinding surfaces of the cheek teeth of polar bears are more serrated, which is an adaptation to an almost entirely carnivorous diet, compared to the omnivorous diet of the brown bear. The claws of the polar bear are smaller and sharper than those of the brown 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).

Distribution

Polar bears are distributed throughout the circumpolar Arctic (Fig. 12, 57), 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 2008); however, it is clear that movements by some bears can be very large (e.g., hundreds of kilometres within a single year; Messier *et al.* 2001). Large-scale movements have made it difficult to delineate more than one discrete and evolutionarily significant unit for status rankings for polar bears (e.g., COSEWIC 2008). Currently, however, there are 19 ‘subpopulation’ units of polar bears recognized throughout the circumpolar Arctic by the International Union for the Conservation of Nature/Species Survival Commission (IUCN/SSC) Polar Bear Specialists Group (PBSG) and most management jurisdictions (PBSG 2010). Studies based on allele frequencies suggest that polar bears from these various subpopulations are genetically similar (Paetkau *et al.* 1999), and that there is no evidence that any of the groups have been evolutionary separated for significant periods of time. Although there may be some limitations on exchange between subpopulations (Bethke *et al.* 1996; Taylor *et al.* 2001), both demographic and genetic exchange clearly occurs, and consequently ‘management units’ may be a more correct term instead of subpopulation (Vongraven and Peacock 2011). However, because some agencies manage polar bears using slightly different unit boundaries, the term ‘subpopulation’ is used throughout this report for clarity and refers specifically to units delineated in Fig. 12, p.57.

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. 12, p.57). In North America, 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 2008). 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 ~52º 35' N (Obbard pers. comm. 2011). In North America, polar bears are considered resident species in Alaska, Yukon, NWT, Nunavut, Manitoba, Ontario, Québec, Newfoundland and Labrador, and Greenland.

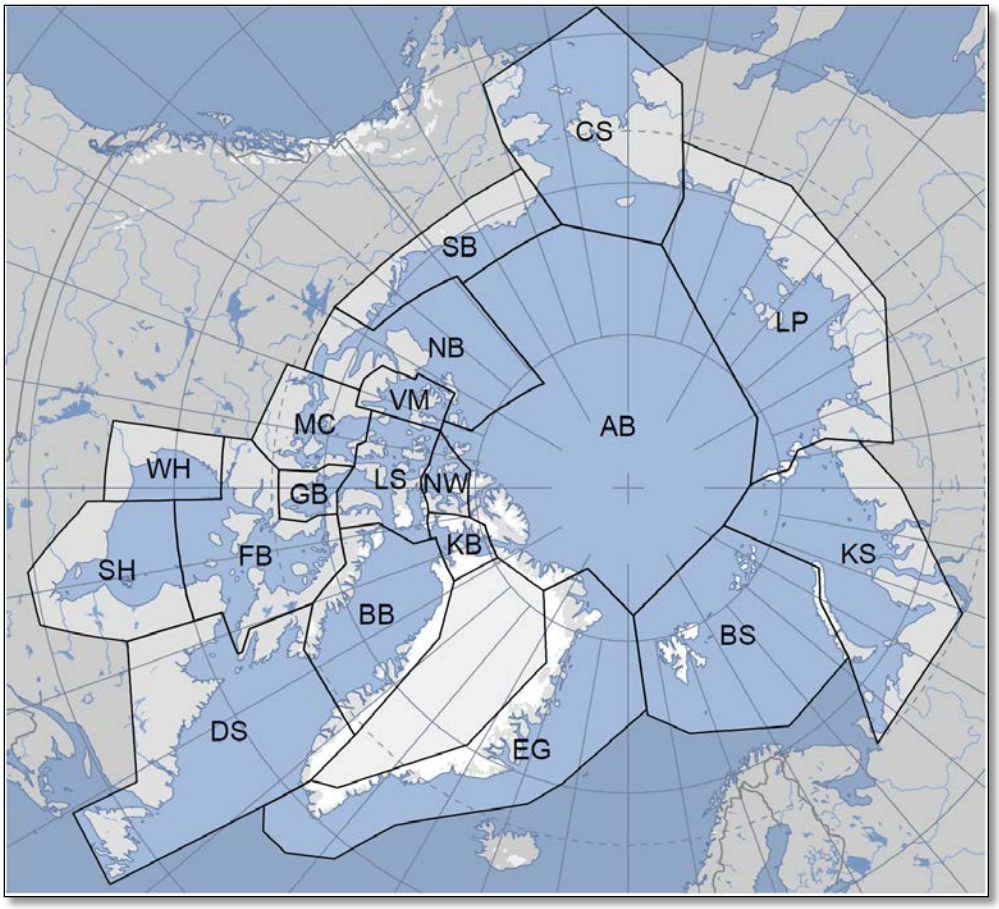

Figure 12. Circumpolar map of subpopulation boundaries of the polar bear, *Ursus maritimus*, as recognized by the IUCN/SSC Polar Bear Specialists Group (see PBSG 2010). Total area covered is 24 × 107 km^2. Subpopulations are: Davis Strait (DS), Baffin Bay (BB), Kane Basin (KB), Southern Hudson Bay (SH), 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). Map and data reprinted with permission from Vongraven and Peacock (2011).

NWT distribution

Polar bears occur throughout all parts of the Arctic Ocean in the NWT (Urquhart and Schweinsburg 1984; Fig. 13, p.59). Polar bears do not generally venture far inland when they occur on the NWT mainland; however, there have been some exceptions to this statement. Three bears (a female and two cubs) were shot in Déļine in April, 2008, and a female bear was seen near Fort McPherson in 2006 and later captured by wildlife biologists and moved. Based on surveys and telemetry information, it is rare to see a bear in the NWT more than a few kilometres inland (Derocher pers. comm. 2011).

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 (Fig. 13, p.59; map and area computation provided by R. Gau, Government of the NWT).

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. 13, p.59). 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 the NWT's Species at Risk Committee (SARC) 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. 13; map and area computation provided by R. Gau, Government of the Northwest Territories [GNWT]).

The distribution of polar bears where they occur in the NWT is continuous. Four recognized subpopulations occur in the territory (Figs. 14 and 15, p.60 and p.61), including bears of the Southern Beaufort Sea, Northern Beaufort Sea, Viscount Melville Sound, and the Arctic Basin. The Southern Beaufort Sea subpopulation occurs south of Banks Island and east of the Baillie Islands, and ranges west to Point Hope, Alaska; this includes the coastline of Northern Alaska, Yukon, and the NWT (PBSG 2010; USFWS 2010). The subpopulation is shared by all three jurisdictions. The Northern Beaufort Sea and Viscount Melville subpopulations are shared with Nunavut.

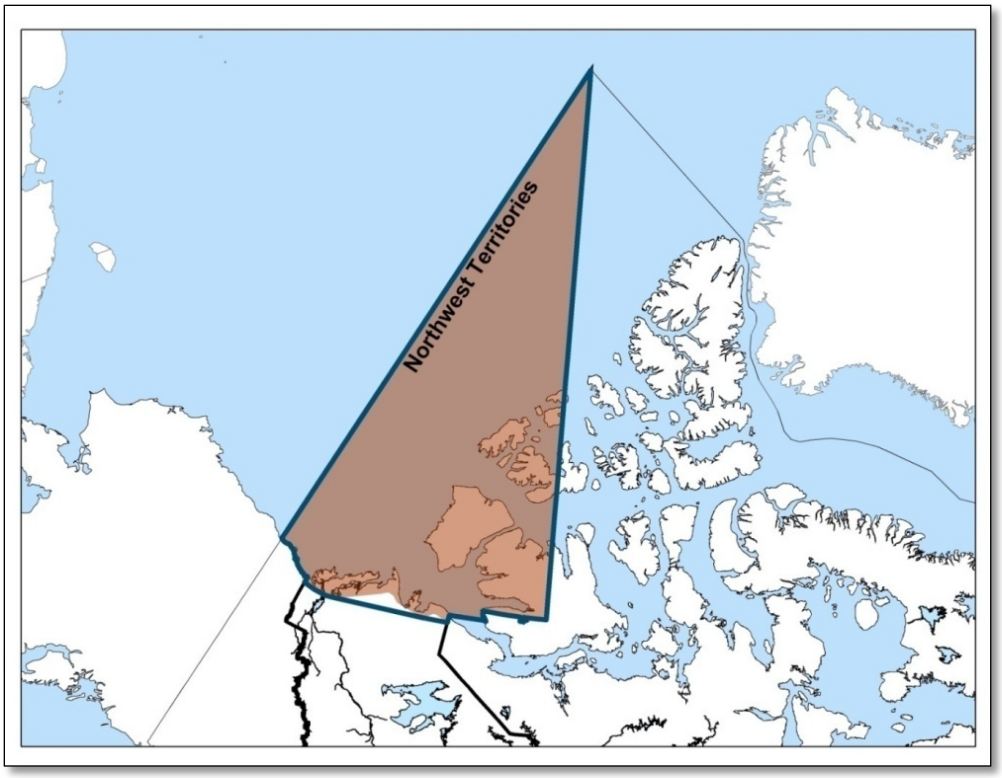

Figure 13. Distribution of the polar bear, *Ursus maritimus*, in the Northwest Territories, Canada. The area contained within the shortest continuous boundary drawn to encompass all the known, inferred or projected sites of present occurrence of the species is the extent of occurrence (navy bold line, 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 shaded region (1,454,148 km^2). The NWT boundary considered by SARC extends to the North Pole and includes NWT territorial waters and all islands therein, except Herschel Island (Yukon) (*Northwest Territories Act* 1985*).* Map and area calculations provided by R. Gau, Government of the NWT.

There are no NWT subpopulations of polar bears considered to be particularly isolated from each other. Satellite telemetry of female bears and probabilistic modeling indicates that, rather than exhibiting distinct boundaries, there are areas of overlap between the Southern and Northern Beaufort Sea subpopulations. At Tuktoyaktuk, for example, 50% of bears are from the Southern Beaufort Sea subpopulation and 50% are from the Northern Beaufort Sea subpopulation, and bears in the vicinity of the current eastern boundary near Pearce Point, NWT, are rarely members of the Southern Beaufort Sea subpopulation (Amstrup *et al.* 2004a,b). To address this issue, user groups, scientists, and managers are currently discussing a western shift of the Southern-Northern Beaufort Sea subpopulation boundary (PBSG 2010). After soliciting support from Inuvialuit Hunter and Trapper Organizations, both Wildlife Management Advisory Councils (NWT and North Slope) in June 2011 recommended to the Inuvialuit Game Council a new

Southern-Northern Beaufort Sea subpopulation boundary of 133º longitude. The abundance and status of the new Southern Beaufort Sea and Northern Beaufort Sea subpopulations will need to be re-evaluated.

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 (PBSG 2010). 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; PBSG 2010). Polar bears occupying the Arctic Basin can be considered resident in the NWT where they occur within the NWT boundary.

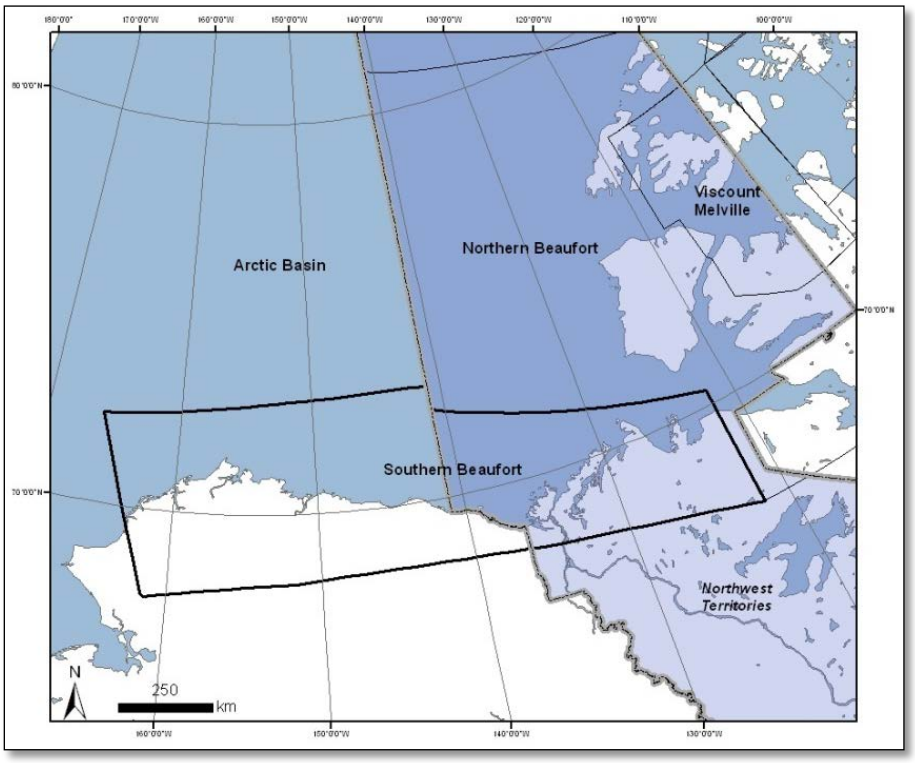

Figure 14. Boundaries of the Southern Beaufort Sea subpopulation of polar bears, *Ursus maritimus*, as recognized by the IUCN/SSC Polar Bear Specialists Group (see PBSG 2010). Total area covered is 715,000 km^2. Map and data adapted from Vongraven and Peacock (2011).

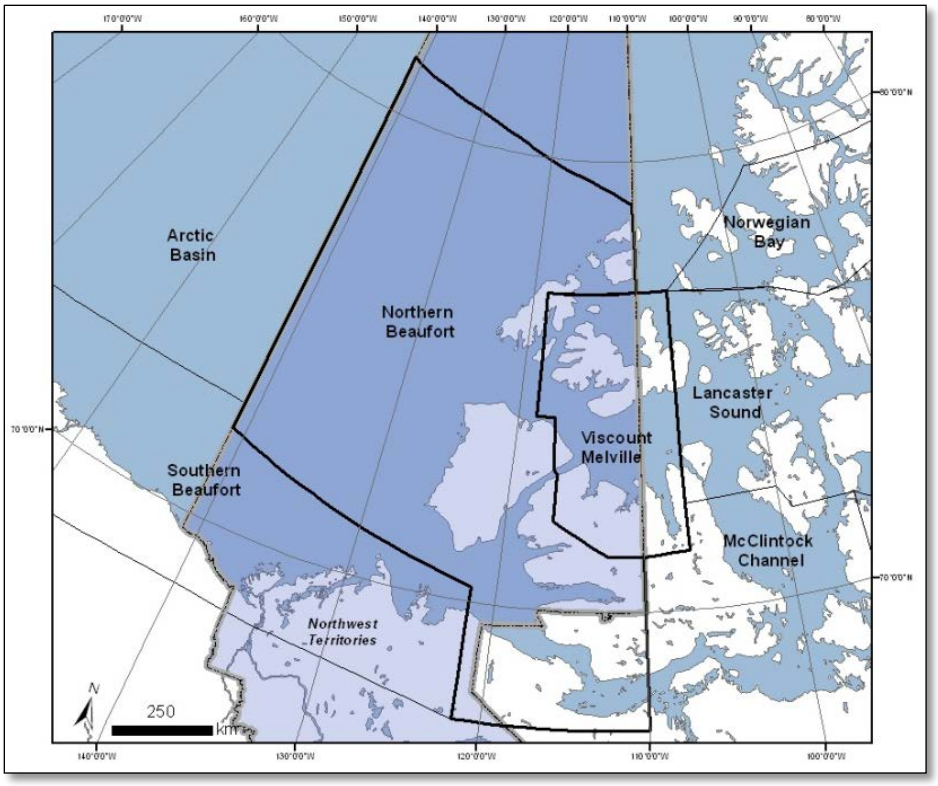

Figure 15. Boundaries of the Northern Beaufort Sea and Viscount Melville Sound subpopulations of polar bears, *Ursus maritimus*, as recognized by the IUCN/SSC Polar Bear Specialists Group (see PBSG 2010). Total area of the Northern Beaufort Sea unit is 940,000 km^2; total area of the Viscount Melville Sound unit is 210,000 km^2. Map and data adapted from Vongraven and Peacock (2011).

Search Effort

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 2008; PBSG 2010; Stirling *et al.* 2011). 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), but rarely move south from the mainland coast of the NWT (although such occurrences do happen). Long-term study of the movements of collared polar bears and local knowledge of the species suggest that 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.

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*, pg.64.

Habitat

Habitat requirements

Polar bears are dependent on sea-ice as a hunting and denning platform, and the physical attributes of sea-ice 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 depth and kinematic or topographic characteristics of sea-ice, 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; Durner *et al.* 2009; USFWS 2010).

COSEWIC (2008), PBSG (2010), and USFWS (2010) 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) 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). 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, and leads (Amstrup and DeMaster 1988; Stirling *et al*. 1993; Stirling and Øritsland 1995; Stirling 1997; Amstrup *et al.* 2000; review in USFWS 2010). 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 300m or less.

Based on telemetry data from female bears, polar bears in the Southern Beaufort Sea of the NWT 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 Southern 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, 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 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). Polar bears in Viscount Melville Sound also used to have access to sea-ice throughout the year (Taylor *et al.* 2002); however, this area was observed as ice-free in summer 2011 (USFWS 2012, Comiso 2012) and again in 2012 (Williams pers. comm. 2012). The type of ice present in Viscount Melville Sound (multiannual vs. annual) may be changing (Comiso 2012). Polar bears depend on sea-ice not only for feeding but also for seeking mates and breeding, for travel, and in some cases for denning (Richardson pers. comm. 2011). Amstrup and Gardner (1994) observed that in the Beaufort Sea maternal dens on drifting pack ice were common. 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 (Harington 1968; Lentfer *et al.* 1980; Ramsay and Stirling 1990; Amstrup and Gardner 1994). Dens of polar bears 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 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). Most polar bear dens on land for the Alaskan portion of the Southern Beaufort Sea subpopulation occur relatively near the coast along the coastal hills and river banks of the mainland and barrier islands in Alaska (Amstrup and Gardner 1994; Amstrup 2003). 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).

During summer, polar bears may remain on islands or along coasts with shore-fast ice or drift on ice floes. However, polar bears will use mainland terrestrial habitat even when shore fast ice is not present, and shore fast ice does not exist during summer in the US portion of the Beaufort Sea (USWFS 2012). In Alaska, coastal communities consistently deposit harvested bowhead whales onshore, thereby attracting bears (Schliebe *et al.* 2008); a practice not prevalent in the Canadian Beaufort. When forced to use mainland terrestrial habitats during the summer due to lack of sea-ice, polar bears in the Western Hudson Bay subpopulation vary in their habitat selection, often by sex and age group, with males displacing females and cubs inland and away from the coast (Stirling *et al.* 2004). To date, bears are not forced to use mainland terrestrial habitats in the NWT portion of the South Beaufort region, and there is no evidence of bears on land being sexually segregated such that females with cubs are inland. There are generally few bears seen on the shore in the summer; however, it seems in the last few years the frequency of these sightings may be increasing (Branigan pers. comm. 2012). Most collared bears in the NWT retreat north with the ice pack; however, satellite collar data indicates some bears collared in the NWT portion of the South Beaufort subpopulation visit bowhead whale bone piles along the Alaskan coast (Pongracz pers. comm. 2012).

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 COSEWIC 2008, PBSG 2010; USFWS 2010). Scientific observations of changes in sea-ice in the Arctic (Fig. 16, p.66) have been summarized by Lemke *et al.* (2007) in their collaborative chapter as part of the 2007 report of the Intergovernmental Panel on Climate Change (IPCC) and updated by Pampal *et al.* (2011), Stroeve *et al.* 2011, and Comiso (2012). Briefly, earlier estimates from satellite data indicated a -2.7 ± 0.6% per decade decline in annual mean Arctic sea-ice extent observed since 1978. Recent data suggests an even

higher rate of decline of -12.4% per decade (Stroeve *et al*. 2011, Comiso 2012), indicating that IPCC models may have underestimated Arctic ice declines (Pampal *et al.* 2012). The decline for summer extent is larger than for winter in the Arctic. Some data indicate that the summer decline began around 1970. Submarine-derived data for the central Arctic indicate that the average thickness of sea-ice in the central Arctic has very likely decreased by up to 1m in 1987-1997. Kwok and Untersteiner (2011) provide an update of Arctic Ocean sea-ice thickness changes for winter and fall, 1979-2009. Using a combination of submarine and satellite data, they show that the average ice thickness during winter declined from ~3.5m in 1979 to 1.9m in 2009. During the same years, fall ice thickness declined from ~2.7m to 0.9m. Model-based reconstructions support this, suggesting an arctic-wide reduction of 0.6 to 0.9m over the same period. Of particular note for the status of polar bears in the NWT, changes in ice concentrations (measured as minimum ice concentrations in summer) and age have been greatest in the Beaufort Sea (Parkinson and Cavalieri 2002; Comiso and Parkinson 2004; Barber *et al.* 2009; Comiso 2012). These changes are ongoing, with Arctic sea-ice extent for February 2011 being tied with February 2005 as the lowest recorded in the satellite record (National Snow and Ice Data Center CIRES 2011). Summer sea-ice extent was the lowest on record in September 2012 (CBC News 2012a, CBC News 2012b)

Higher temperatures and loss of sea-ice in the Arctic do not bode well for the long-term future of polar bears (Amstrup *et al.* 2008). The extensive report of the PBSG (2010) provides a very good and up-to-date assessment of trends in habitat (sea-ice) for polar bears in the Canadian Arctic and what this can be expected to mean for polar bears in the region. This includes empirical research which has been shown to correlate variables of climate change with survival and reproduction of polar bears in the Western Hudson Bay (Regehr *et al.* 2007) and Southern Beaufort Sea (Hunter *et al.* 2010; Regehr *et al.* 2010; Rode *et al.* 2010a). Effects of changes in sea-ice habitat to polar bears are forecasted to be most severe in the Southern Beaufort Sea compared to other subpopulations of NWT polar bears (e.g., Southern vs. Northern Beaufort Sea: Figs. 17 and 18, p.66 and p.70): sea-ice extent is expected to decline more rapidly over time in the former region. There is less information pertaining to polar bear habitat available for the Viscount Melville Sound subpopulation. Research on the subject of climate change and polar bears has been directed at the Southern Beaufort Sea subpopulation more than any other subpopulation in the NWT.

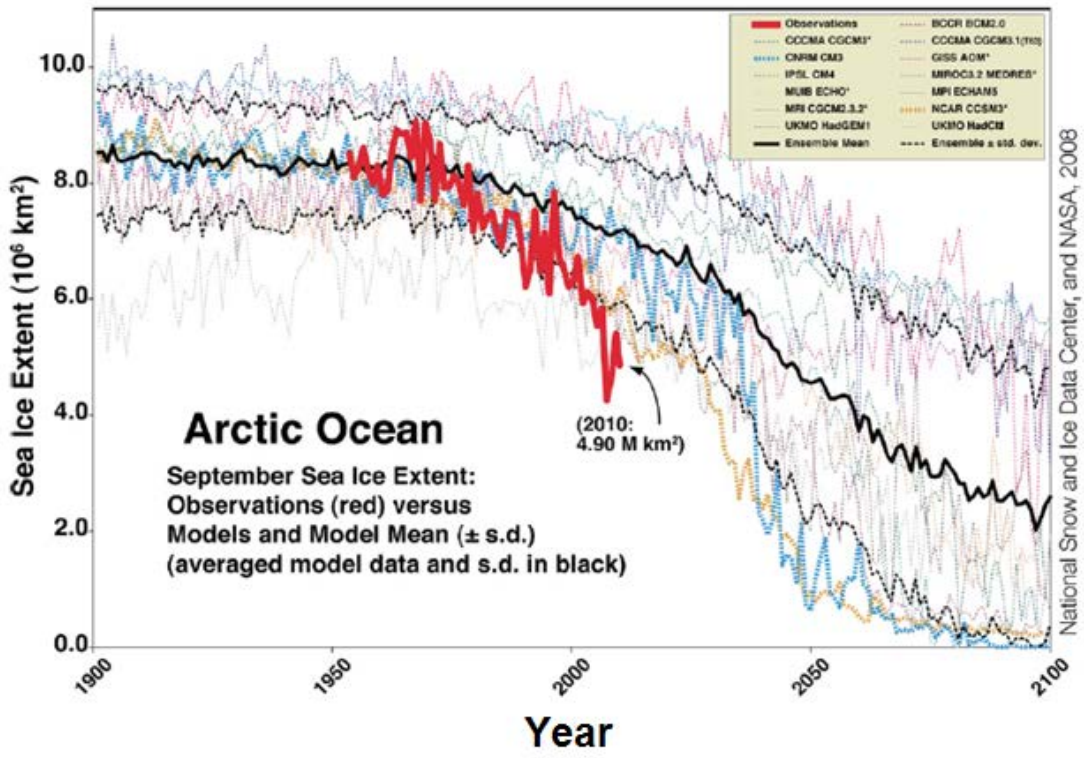

Figure 16. Actual and projected summer sea-ice extent in September for the Arctic Ocean from observations (bold red line) and 13 IPCC AR4 climate models. Updated by Vongraven and Peacock (2011) from data originally presented by Stroeve *et al.* (2007).

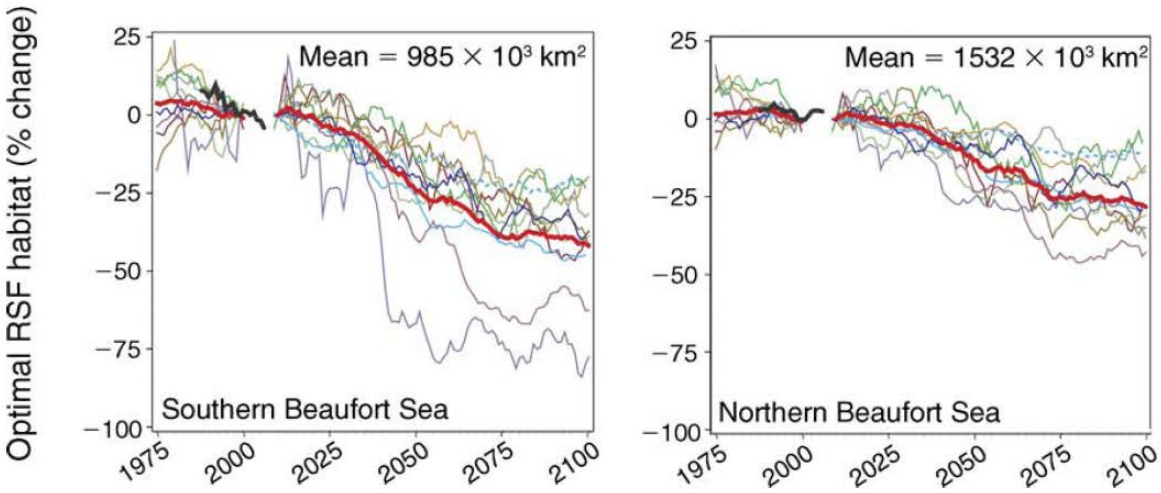

Figure 17. Percentage change in the current and projected total annual (12 month) area of optimal polar bear habitat (based on resource selection function [RSF] modelling) in the IUCN/SSC polar bear subpopulation units of the Southern Beaufort Sea and Northern Beaufort Sea, plotted as 10-year running means. The red line is the ensemble trend from RSF models using 11 climate models (described in Durner *et al.* [2009]), with the observed results to date from satellite observations presented in bold black. Modified from Durner *et al.* (2009), with permission.

For bears of the Southern Beaufort Sea, recent sea-ice loss over the continental shelf has been associated with declining survival and breeding (Regehr *et al.* 2010). It appears that polar bears of the Southern Beaufort Sea are under increasing nutritional stress in association with this loss of sea-ice (Rode *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 Southern Beaufort Sea. Although captures in the latter study were focused on polar bears of Alaska, the bears captured in the study ranged into the NWT and thus these results apply directly to the status of the polar bear in the NWT. In addition to the above, through the use of serum biomarkers, Cherry *et al.* (2009) found that a higher proportion of polar bears 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%).

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). The recent losses of annual sea-ice in the Southern Beaufort Sea have also been associated with reports of what the IUCN/SSC Polar Bear Specialists Group calls 'inefficient foraging behaviours by polar bears', including observations of cannibalism (Amstrup *et al.* 2006) and apparent starvation (Regehr *et al.* 2006). Increased ice roughness was linked to observation of inefficient foraging behaviours during spring in the eastern Beaufort (Stirling *et al.* 2008). Polar bears had been attempting to claw holes in rafted sea-ice to reach seals. Ice roughness was attributed the extensive rafting due to late freeze-up during the previous autumn, relatively thin ice, and late autumn/early winter storms.

Durner *et al.* (2009) predicts that the Southern Beaufort Sea region will lose 5.2% per decade of prime polar bear habitat from 2001–2099, which includes the subpopulation's range into the NWT (Fig. 17, p.66). Hunter *et al.* (2007, 2010) and Amstrup *et al.* (2008) suggest that the Southern Beaufort Sea subpopulation will likely face severe declines in the next 100 years if sea-ice loss continues as forecasted. Findings by Barber *et al.* (2009) suggest that current estimates of sea-ice loss may actually be greater than forecasted in the Southern Beaufort Sea, especially as what currently appears as multi-year ice on satellite images is, in fact, heavily decayed ice. A shortcoming in satellite observation of fragmented ice as pack ice may explain why sea-ice declines have been faster than forecasted (Stroeve *et al.* 2007), and concentrations of multi-year

ice are much less than expected (Pampal *et al.* 2011).

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 more dire forecasts of habitat trends for polar bears in the Southern Beaufort Sea versus the Northern Beaufort Sea (Figs. 17 and 18, p.66 and p.70). Polar bears of the Southern Beaufort Sea live in what is called a divergent sea-ice zone (called "Ecoregion" in Amstrup *et al.* 2008; Fig. 19), 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 year round (Durner *et al.* 2009). Conditions in the Northern Beaufort Sea are thus considerably different from those of the Southern Beaufort Sea. Although there are currently fluctuations in the amount of ice remaining in the Northern Beaufort Sea by late summer, trends are mild compared to that of the Southern Beaufort Sea (Figs. 17 and 18, p.66 and p.70). Recent changes in the Northern Beaufort Sea (and possibly also in the Viscount Melville Sound, below) may have benefited polar bears, which prefer the less heavy sea-ice than has historically occurred in this area for feeding on seals. Stirling *et al.* (2011) write: "although the ice conditions in the [Southern Beaufort Sea] appear near, or may already have passed, the point at which polar bears could benefit from milder conditions, that threshold may not yet have been crossed in the [Northern Beaufort Sea]. This seems the most likely explanation for the stable or possibly even increasing population that we observed over the last 30 years." Stirling *et al.* (2011) caution, however, that: "although [Northern Beaufort Sea] polar bears do not appear to have been harmed, and may even have benefited from sea-ice trends of the past 30 years, this is most likely a transitory effect. The mean sea-ice concentration at the September minimum has significantly declined over the period of our study." The projections of Durner *et al.* (2009) also suggest local improvements in sea-ice conditions for polar bears in the Northern Beaufort Sea in recent times (Fig. 18, p.70), but that over time (next 100 years) conditions will nonetheless deteriorate (Fig. 17, p.66).

For polar bears in the Viscount Melville Sound subpopulation, seasonal sea-ice profiles conform to neither those of the Southern nor Northern Beaufort Sea (Fig. 19, p.71). 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; North American Ice Service 2011). Research to update information on polar bear distribution and abundance in the Viscount Melville Sound subpopulation are underway (Branigan pers. comm. 2011). Trends in sea-ice characteristics as they pertain to polar bear habitat have not been analyzed for the Arctic Basin.

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), in part due to increasing sea levels (James in ENR 2011b) and other factors such as low ice cover and increasing frequencies of storms (Kokelj *et al.* 2012), on polar bear maternal denning habitat. It is a potential concern for the southern Beaufort Sea polar bear population because many pregnant bears may den on barrier islands and next to coastal banks were the terrain allows drifting snow to accumulate (see *Habitat Requirements*, p.62). Some coastal denning habitat may disappear in the future, and this can result in a change in denning distribution (USFWS 2012). In addition, 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,* p.55).

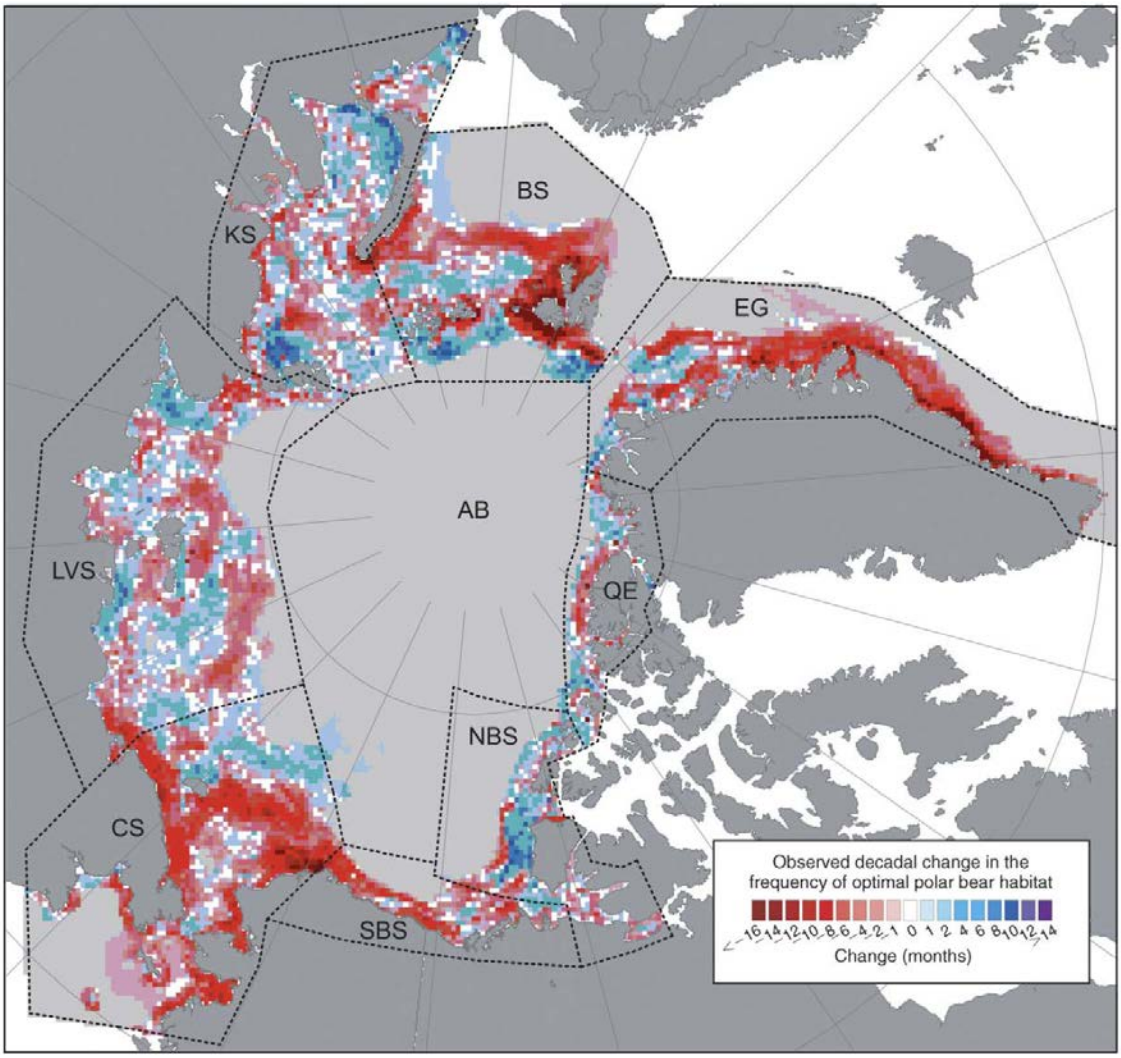

Figure 18. Losses and gains of prime polar bear habitat (determined from resource selection function [RSF] modelling based on movements for polar bears with projected climate change models) in polar bear subpopulations monitored by Durner *et al.* (2009). The base map shows the cumulative number of months per decadal period where optimal polar bear habitat was either lost (red) or gained (blue) from 1985–1995 to 1996–2006. Offshore gray shading denotes areas where optimal habitat was absent in both periods. Figure and legend reprinted with permission from Durner *et al.* (2009).

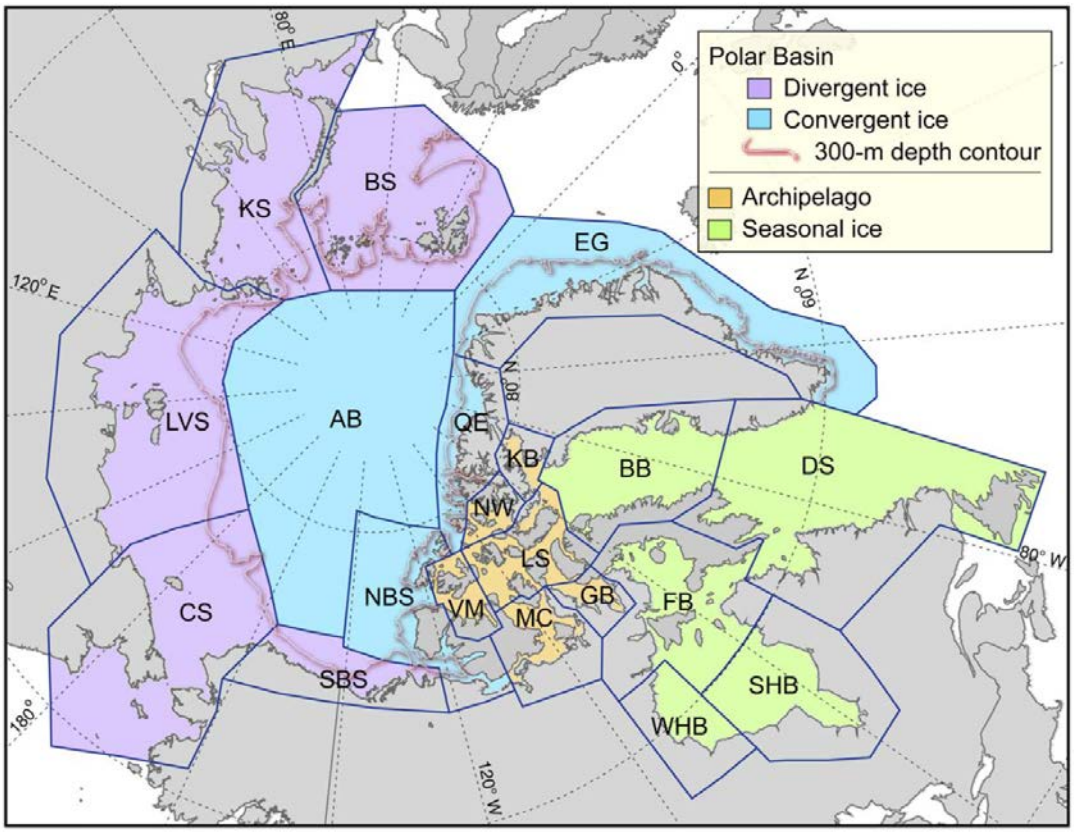

Figure 19. The polar basin study area of Durner *et al.* (2009), defined by a composite of IUCN/SSC polar bear subpopulation units located in the Arctic Ocean and peripheral seas (pelagic region). Subpopulation units are color-shaded to distinguish membership within two groups based on general sea-ice 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. 12, p.57. Polar bear subpopulations that range into the NWT include the Southern Beaufort Sea (SB), Northern Beaufort Sea (NB), Viscount Melville Sound (VM), and Arctic Basin (AB). Figure legend and figure modified with permission from Durner *et al.* (2009).

Biology

Life cycle and reproduction

Specifics of the life cycle of the polar bear (survival and reproductive rates from published studies) are discussed in detail in the section on *Population* (p.76) and in Tables 2–7 (p.81-83). However, the following generalized discussion applies to polar bears as a species. Age at first reproduction of female polar bears may be as early as 4 years, with most polar bears throughout the Canadian Arctic Archipelago producing litters at relatively high rates by age 6 (Table 2). 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 few as 50% of adult females (>5 years) that are 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) to as many as 100% (Taylor *et al.* 2005). 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 latitude (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.

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). Despite physiological maturity younger males are not likely to reproduce because older males (if they are around) prevent them from doing so. Saunders (2005) recently demonstrated using paternity analysis that older adult male bears sire a disproportionate number of cubs compared to their representation in the population. It appears that most males 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).

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*, p.76 including Tables 3–7 (p.81-83), and under *Threats and limiting factors,* p.86).

Generation length in polar bears has been poorly studied, despite the variable being key to

identifying categories of risk (i.e., likelihoods of decline over 3 generations) by bodies such as the IUCN/SSC and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The IUCN/SSC Polar Bear Specialist Group (PBSG 2006) used 15 years as generation length: "calculated from the age of maturity (five years) plus half the length of the reproductive period in a complete life cycle (10 yrs; = 0.5 × 20 yrs)." COSEWIC 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 the NWT Species at Risk Committee. Data on the average age of female polar bears with cubs-of-the-year in spring in a random sample of bears of all ages have seldom been reported. The paper of Regehr *et al.* (2006) allowed COSEWIC (2008) to compute this variable for bears of the Southern Beaufort Sea (from proportions presented in Table 4 of Regehr *et al.* [2006]). For the period 1967–1989, and conservatively assuming all bears in the age 20+ category were 25 years old, the mean age of females with newborns was 9.9 years. For 1990–2006 the average was 11.7 years. In Western Hudson Bay, the age-specific female mortality data of Regehr *et al.* (2007) suggest an average age of 12.7 years for females aged 5 years and older. Given these data, COSEWIC used 12 years as the generation length for polar bears (COSEWIC 2008). Cronin *et al.* (2009), using genetic data, claim that polar bears in the Southern Beaufort Sea reproduce faster than had been previously thought. These authors suggest that a generation time of about 10 years is more accurate for modeling future polar bear dynamics than either the 15 years or 12 years used by COSEWIC. This report will retain the 12-year generation length as calculated for polar bears in COSEWIC (2008).

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 when forced on land during the ice-free season, without access to seals (as is the case for 50–60% of bears in Canada; COSEWIC 2008). This is also the case for some bears in the Alaska portion of the Southern Beaufort Sea (4–8% [Schliebe *et al.* 2008]), but generally not the case for bears in the Northern Beaufort Sea and Viscount Melville Sound although collar locations from 2012 (ENR 2012) in Viscount Melville Sound suggests some bears there have moved to land during periods of no or limited ice (unknown for bears of the Arctic Basin). While on land little food is available, and bears must 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). Pregnant females must also 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. Obtaining data on how the success of the seal hunt in the period preceding break-up impacts the reproduction and survival of polar bears is a major research priority for groups such as the IUCN/SSC Polar Bear Specialists Group (e.g., PBSG 2010).

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 non-natural sources of food (e.g., 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. The curiosity of polar bears makes them particularly vulnerable to human-caused mortality in defence of life or property. 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), and Inuit observers 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 below, the diet of polar bears can extend to several species of mammals and birds, meat caches, and vegetation including berries. However, a few studies show that terrestrial foods do not appear to provide substantive nutritional resources for polar bears (Hobson *et al.* 2009; Rode *et al.* 2010b). Polar bears are best characterized as an obligate predator of seals using sea-ice as a hunting platform.

Information on movements and home range size and dispersal for polar bears in the NWT are presented in detail in the section *Movements*, p.78.

Interactions

Polar bears are carnivores that occupy the highest trophic level in the Arctic. As mentioned previously, the polar bear is particularly noted as a predator of ringed seals and bearded seals, species upon which they are highly dependent for food. Harp seals (*Pagophilus groenlandica*), spotted seals (*Pusa largha*), hooded seals (*Cystophora cristata*), walrus (*Odobenus rosmarus*),

beluga whales (*Delphinapterus leucas*), and narwhal (*Monodon monoceros*) also feature occasionally in the diet of polar bears mostly outside the NWT (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); however, scientific knowledge and Aboriginal Traditional Knowledge suggest it is the young ringed seal hunted at its subnivian den that is most important to the majority of polar bears (Stirling and Archibald 1977; Smith 1980; McDonald *et al.*1997). 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 the distribution of ice-dependent seals in response to climate warming are certain to impact the distribution of polar bears (Stirling and Derocher 1993; Barber and Iacozza 2004; Derocher *et al.* 2004).

In some areas where polar bears are forced onto land in summer (e.g., northeast Manitoba [Derocher *et al.* 1993] and Southern Beaufort Sea [Schliebe *et al.* 2008]), 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). Whale carcasses attract large numbers of bears during the open-water season, and this has been observed along the Alaskan coast of the Southern Beaufort Sea (Kalxdorff 1997; Perham 2005). As the ocean freezes again in late autumn, bears that were trapped on land redistribute themselves throughout subpopulation ranges except pregnant females, which excavate maternity dens.

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 has not been noted yet as an important limiting effect in any polar bear population (COSEWIC 2008; PBSG 2010; USFWS 2010), 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).

Population

Because all NWT subpopulations of polar bears are shared, either internationally or with Yukon and Nunavut (Figs. 12–14, p.57-60), and each is managed independently, it is difficult to meaningfully discuss dynamics of a single 'NWT population' of polar bears. The discussion below presents information on the structure, rates, movements, status, and viability of the three main subpopulations that overlap NWT borders (i.e., the Southern Beaufort Sea, Northern Beaufort Sea, and Viscount Melville Sound subpopulations). Little information exists for polar bears living in the Arctic Basin where this 'catch-all' subpopulation overlaps with the NWT (Fig. 12, p.57), and so this subpopulation is not discussed here, other than by noting 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 (PBSG 2010). 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).

Structure and rates

True standing age distributions of polar bear subpopulations are not well known. This is because the sampling of polar bear subpopulations cannot 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 such biases, structures can still be estimated. Hunter *et al.* (2007) present a partial age structure (proportions of the population) for non-cub or non-yearling female polar bears of the Southern Beaufort Sea that is: 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. This is an estimate of the structure of the subpopulation 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). What is not presented are the estimated numbers of cubs or yearlings; however, these can be estimated 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 1000 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 would be 63.7%. Little information has been presented in the published and unpublished literature on sex structure for polar bear populations; 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 Northern Beaufort Sea and the Canadian portion of Southern 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 (χ^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 Southern Beaufort Sea, for the total estimate of 1526 bears estimated for the subpopulation (Regehr *et al.* 2006; Table 8, p.84), we can estimate that the number of mature individuals (both male and female aged 5+) sum to 950 individuals (i.e., 62.2% of the population is either a mature female or mature male).

As mentioned above, sighting-related biases in capture-recapture programs can be accounted for in demographic modeling, 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). Hence, although the sex-age structure of polar bear subpopulations might only be simulated (e.g., as the stable age distribution), we are still able to accurately compute age and sex-specific structures of survival and reproduction. Sex- and age-stratified rates of survival and reproduction are thus generally well-known for polar bear subpopulations inhabiting the NWT. Age- and/or sex-stratified estimates of reproductive parameters as they pertain to NWT polar bears are presented in Table 2 (p.81) and survival rates in Tables 3–7 (p.81-83).

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) shows that this is also true for polar bears in the Southern Beaufort Sea. 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. Total adult female survival rate in the Northern Beaufort Sea is thought to be 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; Table 7, p.83), which is similar to that of the Northern Beaufort Sea. Regehr *et al.* (2010)

show that from 2001–2003, the ice-free period in Southern Beaufort Sea 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 was low (0.73–0.79, depending on reproductive state). Given these results, it is expected that the current ice-free season in the Southern Beaufort Sea is resulting in lower adult survival than in the Northern Beaufort Sea and Viscount Melville Sound. More information on how survival and reproductive rates are affected by trends in habitat is presented in the sections *Habitat* (p.62) and *Threats and limiting factors* (p.86).

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 possess large annual home ranges, varying from 940 km^2 to 540,700 km^2 ($\bar{x}$ = 125,500 km^2, SD = 113,795, n = 93; Ferguson *et al.* 1999 [includes NWT polar bear ranges]). 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). If forced on shore for summer, movements of polar bears are considerably less than on sea-ice and bears spend most of their time resting or, if female and pregnant, investigating areas of potential den sites (Ferguson *et al.* 1997, 1998; Lunn *et al.* 2004).

Annual movements associated with the distribution of sea-ice have been well documented for NWT polar bears of the Southern and Northern Beaufort Sea. 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, 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 the southern Beaufort that the frequency of long-distance swims may be increasing. There is concern about the effects of this behaviour on body condition and survival (e.g., Durner *et al.* 2011, Pagano *et al.* 2012).

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). Results from bears in the Gulf of Boothia and M'Clintock Channel (Saunders 2005), and Western Hudson Bay, Southern Hudson Bay, Foxe Basin, and Davis Strait (Crompton 2004) suggest that dispersing bears can and do cross identified subpopulation boundaries. Dispersal across subpopulation boundaries—initially identified based on movements of marked and radio-collared adults (Taylor and Lee 1995; Bethke *et al.* 1996)—may in part explain the lack of sharp genetic differences among subpopulations (below).

Delineation of subpopulations in the NWT and Canada (Figs. 12-15, p.57-61) has been largely

based on hierarchical cluster analysis of movements of radio-collared females (Bethke *et al.* 1996; Taylor *et al.* 2001; Amstrup *et al.* 2004a).Within most subpopulations, population dynamics appear to be determined from internal rates of birth and death (mainly from harvest, which is set at different levels according to subpopulation), rather than emigration and immigration, although annual rates of exchange between adjacent subpopulations range from 0.4–8.9% (Taylor *et al.* 2001). Genetic distances between sampled individuals from subpopulations based on F_{ST} (a correlation of allele frequencies between populations [Weir and Cockerham 1984]) suggest the possibility of four population clusters among identified subpopulations (Paetkau *et al.* 1999); however, misclassification rates in assignment tests among clusters and subpopulations do not support definitive boundaries in terms of genetic isolation across the range of the polar bear (Paetkau *et al.* 1999). The data of Paetkau *et al.* (1999) strongly support the hypothesis of a polar bear population that—despite the presence of regional differences in dynamics and environmental conditions—maintains considerable genetic interchange among subpopulations, with a gradation in genetic relatedness across the range. No localized adaptations have led to the genetic isolation of any subpopulation: identified units are not evolutionarily significant (Paetkau *et al.* 1999).

In summary, the polar bears living in the NWT are linked by movements and genetics with those living in adjacent jurisdictions.

Rescue effects for NWT polar bears may thus 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. The current environment for polar bears remains suitable throughout the NWT, although polar bears in the Southern Beaufort Sea are currently showing signs of stress and the population is showing signs of decline, likely in response to climate change-related losses of sea-ice habitat (see *Habitat*, p.62 and *Threats and limiting factors*, p.86). Over the long term, the status of the polar bear in the NWT will depend not only on the survival and reproduction of bears living mainly in the territory, but also on the dynamics of polar bears in Alaska and Yukon (specifically Southern Beaufort polar bears), and Nunavut (polar bears in the Northern Beaufort Sea and Viscount Melville Sound), particularly in relation to changing conditions of sea-ice as related to climate change (see *Habitat*, p.62 and *Threats and limiting factors*, p.86). The population trend in Alaska is one of likely decline (the species is listed as Threatened under the United States *Endangered Species Act*), although some adjacent populations in Nunavut are expected to be increasing; however, information on the species is 20 year-old for areas like the eastern Viscount-Melville Sound and M'Clintock Channel (PBSG

2010). Efforts to survey these areas are underway (EC 2012).

Table 2. Estimated means (and standard errors [SE] in parentheses) 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 Northwest Territories. 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.

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 presented in COSEWIC (2008) and PBSG (2010) as part of simulations specific to these reports.

[3]Data presented in Taylor *et al.* (2002).

Table 3. Mean (SE in parentheses) of natural (i.e., unharvested) annual survival rates for age (in years) and sex classes of Southern Beaufort Sea and Viscount Melville Sound subpopulations of polar bears . Unharvested annual survival rates are unavailable for the Northern Beaufort Sea subpopulation. Source: IUCN/SSC Polar Bear Specialist Group (PBSG 2010). Estimates for the Southern Beaufort Sea date to 2006; for the Viscount Melville Sound estimates date to 1992.

Subpopulation	Males				Females			
	Natural Survival				Natural Survival			
	COY	1-4	5-20	>20	COY	1-4	5-20	>20
Southern Beaufort Sea	0.335 (0.071)	0.900 (0.130)	0.961 (0.092)	0.961 (0.092)	0.335 (0.071)	0.934 (0.162)	0.965 (0.099)	0.965 (0.099)
Viscount Melville Sound	0.448 (0.216)	0.924 (0.109)	0.924 (0.109)	0.924 (0.109)	0.693 (0.183)	0.957 (0.028)	0.957 (0.028)	0.957 (0.028)

Table 4. Total (i.e., harvested + natural) apparent survival rates for different age, sex, and reproductive status for polar bears of the Southern Beaufort Sea, 2001–2006.Data from the time-invariant model of Regehr *et al.* (2010).

Sex/age/reproductive status	Survival rate	90% CI
Cub litter	0.496	0.326–0.668
Subadult female	0.916	0.605–0.995
Solitary adult female	0.947	0.750–0.992
Adult females with a cub litter	0.950	0.679–0.995
Adult females with yearlings	0.947	0.750–0.992
Adult female with 2-year-old offspring	0.947	0.750–0.992
Subadult males	0.870	0.622–0.976
Adult males	0.933	0.753–0.985

Table 5. Annual apparent (i.e., harvested + natural) survival of male cub-of-the-year, yearling, subadult, adult, and senescent adult polar bears in the Northern Beaufort Sea from 1971–2005. Data presented in Stirling *et al.* (2011).

	Cubs-of-the-year			Yearlings			Subadults			Adults			Senescent adults		
Year	Survival	95% CI_L	95% CI_U	Survival	95% CI_L	95% CI_U	Survival	95% CI_L	95% CI_U	Survival	95% CI_L	95% CI_U	Survival	95% CI_L	95% CI_U
1971		NA			NA		0.832	0.763	0.900	0.833	0.770	0.897		NA	
1972	0.506	0.162	0.850		NA		0.832	0.763	0.900	0.833	0.770	0.897		NA	
1973	0.506	0.162	0.850	0.319	0.065	0.573	0.832	0.763	0.900	0.833	0.770	0.897		NA	
1974	0.508	0.156	0.859	0.322	0.068	0.576	0.830	0.757	0.902	0.832	0.764	0.900		NA	
1975	0.508	0.156	0.859	0.322	0.068	0.576	0.830	0.757	0.902	0.832	0.764	0.900	0.403	0.122	0.684
1976		NA		0.322	0.068	0.576	0.830	0.757	0.902	0.832	0.764	0.900	0.403	0.122	0.684
1977	0.506	0.162	0.850		NA		0.832	0.763	0.900	0.833	0.770	0.897	0.397	0.119	0.675
1978	0.506	0.162	0.850	0.319	0.065	0.573	0.832	0.763	0.900	0.833	0.770	0.897	0.397	0.119	0.675
1979	0.514	0.486	0.542	0.337	0.334	0.339	0.832	0.721	0.943	0.834	0.727	0.940	0.408	0.401	0.415
1985	0.573	0.085	1.000	0.364	0.029	0.698	0.842	0.745	0.940	0.844	0.752	0.937	0.435	0.123	0.746
1986	0.669	0.176	1.000	0.277	0.000	0.589	0.821	0.698	0.945	0.823	0.704	0.942	0.393	0.067	0.718
1987	0.517	0.242	0.793	0.317	0.206	0.427	0.830	0.716	0.943	0.832	0.725	0.938	0.397	0.237	0.556
1989	0.546	0.543	0.549		NA		0.831	0.765	0.898	0.833	0.768	0.898	0.432	0.432	0.432
2000		NA		0.318	0.278	0.358		NA		0.831	0.705	0.958	0.398	0.325	0.470
2003	0.495	0.107	0.884	0.295	0.041	0.550	0.823	0.738	0.908	0.825	0.745	0.905	0.384	0.102	0.665
2004	0.651	0.168	1.000	0.349	0.007	0.691	0.844	0.738	0.951	0.846	0.745	0.948	0.442	0.115	0.769
2005	0.219	0.000	0.709	0.348	0.000	0.838	0.769	0.500	1.000	0.771	0.505	1.000	0.368	0.000	0.784

Table 6. Annual apparent (i.e., harvested + natural) survival of female cub-of-the-year, yearling, subadult, adult, and senescent adult polar bears in the Northern Beaufort Sea from 1971–2005. Data presented in Stirling *et al.* (2011).

Year	Cubs-of-the-year			Yearlings			Subadults			Adults			Senescent adults		
	Survival	95% CI_L	95% CI_U	Survival	95% CI_L	95% CI_U	Survival	95% CI_L	95% CI_U	Survival	95% CI_L	95% CI_U	Survival	95% CI_L	95% CI_U
1971		NA			NA		0.910	0.865	0.956		NA			NA	
1972	0.512	0.169	0.855	0.324	0.067	0.582	0.910	0.865	0.956	0.912	0.870	0.954		NA	
1973	0.512	0.169	0.855	0.324	0.067	0.582	0.910	0.865	0.956	0.912	0.870	0.954		NA	
1974	0.513	0.162	0.864	0.327	0.070	0.584	0.909	0.861	0.958	0.910	0.865	0.956		NA	
1975	0.513	0.162	0.864	0.327	0.070	0.584	0.909	0.861	0.958	0.910	0.865	0.956	0.581	0.345	0.817
1976	0.513	0.162	0.864	0.327	0.070	0.584	0.909	0.861	0.958	0.910	0.865	0.956	0.581	0.345	0.817
1977	0.512	0.169	0.855	0.324	0.067	0.582	0.910	0.865	0.956	0.912	0.870	0.954	0.575	0.338	0.811
1978	0.512	0.169	0.855	0.324	0.067	0.582	0.910	0.865	0.956	0.912	0.870	0.954	0.575	0.338	0.811
1979	0.520	0.490	0.550	0.346	0.342	0.349	0.911	0.773	1.000	0.912	0.782	1.000	0.581	0.541	0.621
1985	0.579	0.094	1.000	0.369	0.034	0.704	0.916	0.857	0.975	0.917	0.862	0.973	0.611	0.356	0.865
1986	0.675	0.189	1.000	0.282	0.000	0.598	0.904	0.826	0.982	0.905	0.831	0.979	0.567	0.276	0.858
1987	0.523	0.246	0.799	0.322	0.208	0.436	0.910	0.830	0.989	0.911	0.837	0.984	0.573	0.361	0.785
1989	0.549	0.546	0.553		NA		0.910	0.780	1.000	0.911	0.788	1.000	0.579	0.576	0.582
2000		NA		0.324	0.281	0.367	0.909	0.801	1.000	0.910	0.810	1.000	0.573	0.425	0.721
2003		NA		0.300	0.042	0.559	0.906	0.854	0.958	0.907	0.858	0.955	0.561	0.319	0.802
2004	0.657	0.181	1.000	0.354	0.011	0.697	0.917	0.853	0.982	0.918	0.857	0.979	0.616	0.348	0.884
2005	0.224	0.000	0.727	0.353	0.000	0.847	0.867	0.678	1.000	0.868	0.682	1.000	0.525	0.118	0.932

Table 7. Mean (SE in parentheses) of total (i.e., harvested) annual survival rates for age and sex classes of polar bears of the Viscount Melville Sound, dating to 1992. Source: Taylor *et al.* (2002).

Males				Females			
COY	**1-4**	**5-20**	**>20**	**COY**	**1-4**	**5-20**	**>20**
0.448 (0.216)	0.774 (0.081)	0.774 (0.081)	0.774 (0.081)	0.693 (0.183)	0.905 (0.026)	0.905 (0.026)	0.905 (0.026)

Table 8. Status of subpopulations of polar bears, *Ursus maritimus*, within or shared by the Northwest Territories. Sources: data from Taylor *et al.* (2002), PBSG (2010), Hunter *et al.* (2010), Regehr *et al.* (2006), Stirling *et al.* (2011), Environment and Natural Resources (2011a), and PBTC (2012). ISR = Inuvialuit Settlement Region in the Northwest Territories and Yukon.

Subpopulation	Population estimate		Human-Caused Mortality[1]		Population viability and trend			
	No. of bears (year of estimate)	±2 SE (95% CI)	Identified permitted harvest (bears/year)	5-year mean kill in bears/year (2006-2011)	Status (from historic levels)	Current Trend	Risk of future decline (10 years)[2]	Finite rate of increase at year of estimate (λ ± 1 SE)[3]
Southern Beaufort Sea[4,5]	1526 (2006)	1210–1842	40-ISR 40-Alaska	14.6-ISR 18 -Alaska	Reduced	Likely declining	Moderate	0.997 ± 0.105
Northern Beaufort Sea[5,6]	1202 (2006)	686–1718	65	28.2	Not reduced	Likely stable	Data deficient	n/a
Viscount Melville Sound[7]	161 (1992)	121–201	7	4.8	Data deficient	Data deficient	Data deficient	1.059 ± 0.063

[1]The identified permitted harvest in the NWT (Inuvialuit Settlement Region [ISR]) and as shared with adjacent jurisdictions, as presented by Environment and Natural Resources (2011a) and PBSG (2010).

[2]Risk of future decline is a qualitative statement made by the IUCN/SSC Polar Bear Specialists Group based on results of population simulation. Estimated risk of future decline is based on vital rates estimated from the 2001–2006 data used in matrix-based demographic models that incorporate sea-ice forecasts.

[3]The published estimate of finite rate of population increase (± 1 SE). A value less than 1.00 indicates projected population decline; a value greater than 1.00 indicates increase (with 1.00 equating to stability). Published finite rates of increase are available for the Southern Beaufort Sea from Hunter *et al.* (2010) and Viscount Melville Sound from Taylor *et al.* (2002).

[4] Population estimate is from an analysis of mark-recapture data from 2001–2006 (Regehr *et al.* 2006).

[5]The Southern Beaufort and Northern Beaufort Sea subpopulation boundaries are being reconsidered, which may affect estimates of the size and status of both subpopulations.

[6]Population estimate is from mark-recapture analysis (Stirling *et al.* 2011). PBTC (2012) subsequently revised this estimate to 980 (95% CI 970-1290) and noted that the population size for management was historically adjusted to 1200 due to biases in sampling. However, information explaining how the estimate was revised was not provided by PBTC (2012).

[7] Estimate from PBTC 2012. Abundance data and estimates of population growth are now 19 years old (hence projections deemed data deficient). A subpopulation survey is currently underway (began in spring 2012).

Abundance

Worldwide, the total number of polar bears is estimated to be 20,000–25,000 (PBSG 2010). This estimate is based on the sum of various subpopulation inventories and expert opinion, as detailed in PBSG (2010).

Table 8 (p.84) presents the estimated total number of individuals of all ages in subpopulations of polar bears shared by the NWT, which sums to almost 3000 bears (2943 animals; reprinted from PBSG 2010). At any point in time, within the actual borders of the NWT the number of polar bears is likely to number somewhere around 1500–2000 bears, or approximately 6–10% of the global population. Assuming 62% of these individuals are age 5+ (see computations presented in *Structure and rates* p.76), we can thus estimate 930-1240 bears aged 5+ within the NWT borders. It is impossible to identify the exact numbers of individuals that fall within NWT borders year-round, as in all subpopulations individuals move annually across international and territorial boundaries. Estimates of abundances identified in Table 8 (p.84) are presented from published sources only.

Fluctuations and trends

The worldwide trend is deemed to be declining, and the species is considered 'Vulnerable' by the IUCN/SSC Polar Bear Specialists Group based on an expected worldwide reduction in polar bear numbers of at least 30% over the next 45 years, due to anticipated changes as a result of climate change.

Current trends in NWT subpopulations of polar bears, as most recently reported by COSEWIC (2008), the IUCN/SSC Polar Bear Specialists Group (PBSG 2010), and Stirling *et al.* (2011), are presented in Table 8 (p.84). Aside from the recent analysis of Stirling *et al.* (2011), which is illustrated in Figure 20 (p.86), detailed year-by-year trend data are not available for polar bears in the NWT. Nonetheless, averaged trends in the form of estimated finite rates of population increase (λ) for polar bears of the Southern Beaufort Sea and Viscount Melville Sound are available from survival and reproduction data (Table 2, p.81). Note that estimates from Viscount Melville Sound are not current and use data from 19 years ago (Taylor *et al.* 2002).

In summary, the polar bear subpopulation in the Southern Beaufort Sea as estimated in 2006 is showing signs of slight decline (although this decline is not significant; Table 8, p.84) (Hunter *et al.* 2010); hence, projected future declines are probably going to be moderate but not catastrophic over the next ten years. The subpopulation of the Northern Beaufort Sea is concluded to be stable

at the present time with a slight possibility of increase, although again there is no statistical significance to assign to this trend (Stirling *et al.* 2011). Under the current harvest regime the Viscount Melville Sound subpopulation is probably increasing (ENR 2012). Data on this subpopulation is dated by almost 20 years and a subpopulation survey is currently underway (commenced in spring 2012), and it is clear that confidence in declaring this status is impaired by the very dated nature of the demographic rates available for this subpopulation. In considering all NWT polar bears, we can only conclude that a small decline in abundance is evident for those bears that range into the Southern Beaufort Sea, and this is likely to continue unless remedial measures are taken (i.e., mitigating climate change-associated losses in sea-ice; see *Threats and limiting factors*, p.**Error! Bookmark not defined.**).

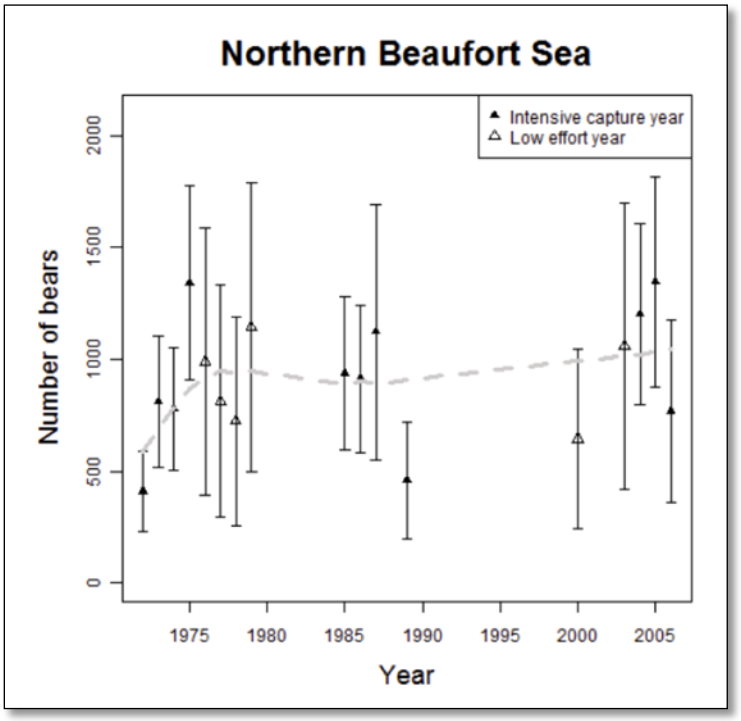

Figure 20. Stirling *et al*'s (2011) analysis of trends in abundance for polar bears of the Northern Beaufort Sea, 1973–2006. Trend line is based on model-averaged estimates of abundance during intensive capture years. Bars indicate 95% confidence intervals that include model selection uncertainty. Graph presented in Stirling *et al.* (2011), reproduced with permission.

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) or 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 space free from human interference). 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. 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), we find few polar bears; where conditions are favourable for both ice-dependent seals and polar bears, the species is likely to occur (e.g., throughout much of the shallow-water, circumpolar Arctic; Fig. 19, p.71).

In all parts of the NWT the harvest of polar bears has been below the quota (Table 8, p.84; Branigan and Pongracz 2011). The Viscount Melville Sound subpopulation is being managed for population increase after overharvesting in the late 1980s and early 1990s (Taylor *et al.* 2002); and the few 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 are thus dying natural deaths in the NWT, the direct nature of which may be difficult or 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 debate surrounding polar bear conservation. Review papers (e.g., Stirling and Derocher 1993; Barber and Iacozza 2004; Derocher *et al.* 2004; Stirling and Parkinson 2006), Aboriginal Traditional Knowledge studies (e.g., Dowsley 2005), observational reports (e.g., Amstrup *et al.* 2006; Monnett and Gleason 2006), previous status reports (COSEWIC 2008; PBSG 2010), and government findings (USFWS 2010) and projections (Hunter *et al.* 2010) offer insight into the possible impacts of past and continued climate warming on polar bears. Empirical studies of correlations between variables of climate change and body condition (Stirling *et al.* 1999; Obbard *et al.* 2006; Rode *et al.* 2010a), and, recently, demographic rates (Regehr *et al.* 2006, 2007, 2010; Rode *et al.* 2010a; Stirling *et al.* 2011) are more useful for quantitative predictions of how climate warming might underlie

proximate limiting factors and threats faced by bears (e.g., Durner *et al.* 2009; Hunter *et al.* 2010). Climate change will likely influence all of the direct limiting factors to polar bears listed above and may therefore be thought of as an ultimate, indirect limiting factor to the species. Climate change must be treated as an integral part of any discussion of the limiting factors of polar bear distribution and abundance; it is treated as such here.

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

Unsustainable harvesting due to quotas being set too high has, until the mid-1990s', been a major concern for some subpopulations close to or within NWT borders (e.g., M'Clintock Channel which is adjacent to the NWT [Taylor *et al.* 2006] and the Viscount Melville Sound subpopulation [Taylor *et al.* 2002]). Today, substantially reduced mean rates of annual kill (34.0 bears [1979–1999] reduced to 2.2 bears [2003–2008] for M'Clintock Channel; 19.6 bears [1985–1990] reduced to 4.6 bears [2006–2011] for Viscount Melville Sound [Table 8, p.84]) are projected by simulations to have reversed trends in these subpopulations (Taylor *et al.* 2002, 2006; COSEWIC 2008). That said, due to the long period since the latter subpopulation has been last inventoried (Table 8, p.84), the current status of polar bears in the Viscount Melville Sound is not entirely clear.

To give an appreciation for the importance of human-caused mortality as a proximate limiting factor for polar bears in the NWT today, consider the following statistics. For the Southern Beaufort Sea subpopulation, which was estimated to number 1,526 bears in 2006 (Table 8, p.84), the 5-year, mean annual human-caused removal rate was 44.4 bears during the period in which the population size was estimated (kills from both Alaska and the ISR (in NWT and Yukon) from 2003–2008; PBSG 2010). This translates into a subpopulation-wide annual kill rate of 2.9%, which is biased strongly in favour of males (PBSG 2010). For a polygynous species such as the polar bear, if this was the only source of mortality in the population we should probably be seeing rapid population growth (McLoughlin *et al.* 2005); however, the best available information suggests this population is in slight (though not statistically significant) decline (Table 8, p.84; PBSG 2010; Hunter *et al.* 2010), telling us that there is likely to be a large source of mortality other than known human-caused mortality affecting population growth rate. We can

deduce that more bears in the Southern Beaufort Sea subpopulation are dying from natural deaths than from direct killing by humans by comparing the reported differences between 'natural' and 'total' estimates of survival (Tables 3 and 4, p.81 and p.82). We see, for example, that for the adult female segment of the population (which is most important for population trajectory), the difference between reported natural mortality (1 – natural survival) and total mortality (1 – total survival) is small. Natural mortality is estimated at 3.5% (i.e., 1 – 0.965; Table 2) for adult females of all categories in the Southern Beaufort Sea (PBSG 2010), which compares to total mortality that averages between 5.0–5.3% (i.e., 1 – 0.947 and 1 – 0.950 for solitary adult females or females with yearlings, and females with a new litter, respectively; Table 4 (p.82) and Regehr *et al.* 2010). The difference between these rates suggests that in any given year, 3.5% of adult females are expected to die a natural death, but only an additional 1.5–1.8% of adult females are expected to die at the hands of humans. As a source category, however, human-caused mortality may still be the largest, as we do not know how the remaining estimated 3.5% of mortality is partitioned (e.g., by predation, starvation, drowning, accident, etc.).

In the Northern Beaufort Sea subpopulation, of the 1,202 (1200) bears currently estimated to live in the subpopulation (as determined by Stirling *et al.* [2011] and as accepted by the IUCN/Polar Bear Specialists Group; Table 8 (p.84), 28.2 bears have been killed each year on average from 2006 to 2011 (Environment and Natural Resources 2011a). This human-caused mortality rate relative to total population size is even less than that of the Southern Beaufort Sea (i.e., 2.5% instead of 2.9%). Human-caused mortality must be a small component of overall mortality in the Northern Beaufort Sea, as Stirling *et al.* (2011) estimate total survival rates for non-senescent adults as 0.920 (i.e., mortality from all sources is somewhere around 8.0%).

The low quota in Viscount Melville Sound also means that few bears die directly at the hands of humans in this subpopulation (4.8 bears killed each year from 2006 to 2011; Environment and Natural Resources 2011a).

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). Reductions in food availability may result in increases in nutritionally stressed bears spending longer periods of time onshore, where humans live. Increases in problem bear activity in areas most affected by climate warming have been reported in recent years, including for communities adjacent to the Southern

Beaufort Sea (Schliebe *et al.* 2006) and Western Hudson Bay (McDonald *et al.* 1997; Stirling *et al.* 1999; Stirling and Parkinson 2006; Towns *et al.* 2009). A positive interaction between climate warming and human-caused mortality may pose a serious problem. Stirling and Parkinson (2006) clearly show that for Western Hudson Bay, the earlier the ice breaks up the more problem bears there are in a year, and vice versa (see Figure 14 of Stirling and Parkinson [2006]). Increased numbers of problem bears in some communities in recent years has also been voiced repeatedly by Inuit participants at meetings of the Federal/Provincial/Territorial Polar Bear Administrative Committee, and through collection of Aboriginal Traditional Knowledge. However, this has not been the case to date in the NWT (COSEWIC 2008, Dowsley and Wenzel 2008).

In conclusion, unsustainable human-caused mortality is not expected to be a present cause of concern for the Management Authorities 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 a regulating factor.

Climate change and effects on natural survival and reproduction

Recently, researchers from Environment Canada and the United States Geological Survey (USGS) Alaska Science Center have been able to establish clear 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), providing quantitative evidence for effects of climate-related stressors on polar bear demographic rates (reviews in COSEWIC 2008; PBSG 2010; USFWS 2010). Coupled with observations that body size and condition (Stirling *et al.*1999; Obbard *et al.* 2006; Molnár *et al.* 2010) and recruitment (e.g., numbers of yearlings per female, litter size [Rode *et al.* 2010a; 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 that trends of likely decline in subpopulations at their southernmost continental ranges (e.g., Southern Beaufort Sea and Western Hudson Bay) may be 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 become problem animals, and thus die at the hands of humans. In addition, any future increase in the proportion of bears that move to land in the summer may increase incidents of long distance swimming. A further retreat of sea-ice and more frequent storms during the open water season may cause a rise in natural mortality due to drowning (Monnett and

Gleason 2006). In other words, there is an interaction between food availability, human-caused mortality, and natural mortality that is unrelated to hunting pressure.

In the Southern Beaufort Sea, polar bear survival declined with an increasing number of days per year that waters over the continental shelf were ice free (Regehr *et al.* 2010). 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). Breeding rates and cub litter survival also declined with increasing duration of the ice-free period, although confidence intervals on vital rate estimates were wide. Rode *et al.* (2010a) tested whether patterns in body size, condition, and cub recruitment of polar bears in the Southern Beaufort Sea (including bears captured in Alaska that ranged into 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 International 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.

All of these results, based on analysis of the long-term data set that exists for the Southern

Beaufort Sea (which included bears that ranged into and lived in the NWT), suggest that declining sea-ice in this region is a serious threat to polar bears, manifest in nutritional limitations that will reduce body size, survival, and reproduction. Unfortunately, however, no analysis is available to identify specific risks within shorter-term time frames over, e.g., the next 3 generations of polar bears (or 36 years, if we take 12 years to equal one polar bear generation [COSEWIC 2008]).

Even less is understood about what may be happening to 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. Stirling *et al.* (2011) concludes the Northern Beaufort Sea polar bear population appears to have been stable or possibly increasing (not statistically significant) during the period of 1971–2006, which appears to reflect ice conditions that have remained suitable and similar for feeding in summer and fall during most years (Durner *et al.* 2009; Fig. 18, p.70) and that the harvest has not exceeded sustainable levels. However, Stirling *et al.* (2011) also note the amount of ice remaining in the study area at the end of summer, and the proportion of that which continues to lie over the biologically productive continental shelf (<300 m water depth), has declined over the 35 year period of this study. If the climate continues to warm as predicted, these authors predict the polar bear subpopulation in the Northern Beaufort Sea will eventually decline.

What may be happening in the Viscount Melville Sound area is also relatively obscure. Reports of higher numbers of bears and triplets suggest that loss of multi-year ice in the region, coupled with a low harvest rate (Table 8, p.84), may be benefiting polar bears in the region (Atkinson pers. comm. 2011; and Branigan pers. comm. 2011). Derocher *et al.* (2004) provide 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, at least over the shorter term. 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).

Although it remains uncertain as to how every subpopulation in 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), 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 (COSEWIC 2008). However, the elimination of annual winter sea-ice is not expected to happen for the NWT in the next three generations of polar bears (Branigan pers. comm. 2012).

One additional comment can be made regarding potential effects of climate change on polar bear reproduction. Recently, some attention has been directed to the expansion in range of the grizzly bear[303] in the Canadian Arctic (Doupé *et al.* 2007). At the same time, hybridization between polar bears and grizzly bears in the wild has been documented. A first generation hybrid bear was harvested in 2006 near Banks Island (Gau 2006 cited in COSEWIC 2008) and a minimum second generation hybrid bear was harvested in 2010 near Ulukhaktok providing evidence of offspring fertility in the wild (Gau pers. comm. 2011 cited in ENR 2012). Successful cross-mating in captivity has also been observed, with evidence of offspring fertility, which is testament to the very close relationship between the two species (review in COSEWIC 2008, Miller *et al.* 2012). There is yet no evidence to suggest that hybridization between polar bears and grizzly bears is a threat to the existence of either species, although grizzly bears may be reducing the reproductive chances of polar bears contributing to their population. What may be of a concern to the status of the polar bear in the NWT is the greater competitive ability of the grizzly bear when the two species come into contact with one another (Slater *et al.* 2010). There is evidence of grizzly bears expanding their range in northern Canada (Doupé *et al.* 2007). However, 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.

To summarize, for the purpose of assigning status to the polar bear in the NWT, there is a strong likelihood of further reductions of ice conditions that are amenable to a viable polar bear population in the Southern Beaufort Sea (Durner *et al.* 2009 [Figs. 17 and 18, p.66 and p.70]; Hunter *et al.* 2010). However, there are potentially favourable but unknown responses of polar bears to present (short-term) climate-change related changes in ice conditions in the Northern Beaufort Sea and Viscount Melville Sound (Fig. 18, p.70). The best available evidence suggests that the polar bear subpopulation in the Southern Beaufort Sea is likely declining (Figure17, p.66) due to lack of preferred ice habitat and an increased open-water season (PGBS 2010; Hunter *et al.* 2010). In other parts of polar bear range in the NWT, polar bear subpopulations

appear to be stable or increasing in response to harvest protections and/or favourable changes in sea-ice which may be occurring as a result of climate change. Further monitoring of the subpopulations of the Northern Beaufort Sea and Viscount Melville Sound may provide further insight into how climate change is impacting these subpopulations.

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 exploratory 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). Recently, oil companies have pointed out practical difficulties of drilling a relief well in the event of an oil well blow-out in Arctic waters (CBC News 2010). 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 3.3×10^6 barrel (oil) and 17.4×10^8 ft^3 (gas) reserves of the Sverdrup sedimentary basin (Drummond 2006), which overlap the subpopulations of Viscount Melville Sound and Northern Beaufort Sea. Continued development of the 1.0×10^7 barrel (oil) and 9.7×10^8 ft^3 (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.

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 (e.g., Norstrom *et al.* 1988; Born *et al.* 1991;, Norstrom and Muir 1994; Letcher *et al.* 1995; Bernhoft *et al.* 1996; Henriksen *et al.* 2001; Kucklick *et al.* 2002; Oskam *et al.* 2004; Sonne *et al.* 2004, Wolkers *et al.* 2004; Smithwick *et al.* 2005; Muir *et al.* 2006; McKinney *et al.* 2009, 2010, 2011a,b; Sonne 2010). 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 (Amstrup 2003).

Inuit interviewed for Aboriginal Traditional Knowledge have recently expressed concerns that studies for scientific research, whereby bears are immobilized using drugs and helicopters and snowmobiles are used to capture bears, 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. Messier (2000) reported that mortalities occurred at an average rate of 1 per 1000 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 1000 bears handled).

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 2008). Routes from Europe to the Far East are reduced by as much as 4000 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. 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 (Arctic Council 2009).

Disease is a potential limiting factor to consider based on predictions of pathogen invasion (Kutz *et al.* 2009) into the Arctic. For example, a disease (or a set of health conditions) in seals (JAVMA 2012) and walrus causing hair loss (alopecia) and skin lesions (NSB-DWM 2012) was also observed in polar bears in the Barrow region, Alaska (APRN-Anchorage 2012). These unusual health issues in Alaskan wildlife are relatively new and the causes are not well understood (Elkin pers. comm. 2012).

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; Figs. 17 and 18, p.66 and p.70), thorough research on the potential effects of improved ice conditions for polar bears has not been conducted for bears of the NWT (e.g., in the Northern Beaufort Sea, Viscount Melville Sound, or Arctic Basin).

International 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). This agreement obliges each signatory to conduct research relating to the conservation and management of the species, the results of which are conveyed to each member nation. 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 Aboriginal people or sport hunters guided by Aboriginal 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 and further supported at the 15th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, Copenhagen, Denmark, 29 June–3 July 2009 (PBSG 2010). The Specialist Group's move was in response to recent modelling of trends in sea-ice extent, thickness, and timing of

coverage which predicts dramatic reductions in sea-ice coverage over the next 50 to 100 years due to climate warming (PBSG 2010), and recent demonstrations of and hypothesized impacts on polar bears (see *Threats and limiting factors*, p.86). The reassessment was based on an expected worldwide reduction in polar bear numbers of at least 30% over the next 45 years (3 generations for polar bears as adopted by the IUCN/SSC Polar Bear Specialist Group), manifest in declines in area of occupancy and extent of occurrence (Schliebe *et al.* 2008).

Polar bears are listed under Appendix II of CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna). Under CITES, any international shipment of polar bears or parts thereof requires a permit. 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. This means that a management plan must be developed within 3 years of listing which sets out measures for the conservation of polar bears and their habitat (www.sararegistry.gc.ca). A National Polar Bear Conservation Strategy (2011) will promote a committed and coordinated approach to polar bear conservation and management among the Government of Canada, provincial governments, territorial governments, and wildlife co-management boards. It will explain the existing co-ordination of management activities among Canadian jurisdictions, the current challenges to management, and how these will be addressed (Gau pers. comm. 2011).

Polar bears are listed and protected as a 'Threatened' species under the United States *Endangered Species Act* (ESA). At this time it is unknown what effects of legal protections and restrictions on hide importation in the United States might mean to hunting pressure on polar bears in the NWT. The US listing ruling was based primarily on USFWS 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 (see USFWS 2010). The USFWS concluded that the incremental loss of sea-ice habitat over time would limit the ability of polar bears to satisfy essential life-history requirements and would result in the species likely being in danger of extinction within the foreseeable future. Accordingly, the USFWS determined that it was appropriate to list polar bears as a threatened species. Threatened species 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.

Following the listing of polar bears as a Threatened species under the ESA, in 2010 the USFWS designated critical habitat for polar bear populations in the United States. This includes 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 fall within the boundaries of the United States' critical habitat designation. This rule became effective on January 6, 2011. The primary regulatory effect of critical habitat designation is that, under Section 7(a)(2) of the ESA, federal agencies of the United States 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 of this positive influence on polar bears in the NWT is currently unknown.

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) and the United States (Alaska). Polar bears in the Southern Beaufort Sea are harvested for subsistence in the United States, and for both subsistence and Aboriginal-guided hunting in Canada. Recognition that bears of the Southern Beaufort Sea 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 in 1988. 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 (80 bears [40 in the NWT]; Table 8, p.84); the quota was revised down to 70 bears in 2010 (USFWS 2012). Harvest levels are reviewed annually in light of the best scientific information available (Treseder and Carpenter 1989; Nageak *et al.* 1994). Brower *et al.* (2002) evaluated the effectiveness of the *Agreement* after the first 10 years and concluded that overall it had been successful in ensuring that the total harvest and the harvest of adult females remained within what were thought to be sustainable limits. In the NWT, the Inuvialuit have exclusive rights to harvest polar bears under quotas[304] 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 sport hunters (for Aboriginal-guided hunting) who are not always successful; the subpopulation has been harvested at levels below allowable quota for more than 20 years (Branigan and Pongracz 2011).

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 to facilitate management decisions as co-ordinated by their Wildlife Directors and the Canadian Federal/Provincial/Territorial Polar Bear Technical Committee (PBTC), in consultation with wildlife co-management boards. The PBTC includes biologists from each jurisdiction, representatives of the Wildlife Management Advisory Councils and the Inuvialuit Game Council, and invited experts from user groups and other research organizations (such as universities) who have expertise with ATK 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.

The PBTC conducts an annual review of the status of each subpopulation of polar bears and its sustainable harvest, and monitors the annual kill. The sustainable harvest of independent female polar bears (i.e., 2 years of age and older) for each subpopulation was, in the mid-1980s, estimated to be about 1.5% for most subpopulations (Taylor *et al.* 1987). This estimated sustainable yield, which now includes a flexible-quota system in Nunavut to maintain an average 2 males:1 female sex ratio of the harvest, has been the basis for assigning harvests for most subpopulations in Canada for the past 15 years (see Taylor *et al.* 2008).

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. The polar bear quota in the Northern Beaufort Sea is shared between Inuvialuit in the NWT and the Inuit of Nunavut. There is a total allowable harvest of 59 bears per year, but the actual harvest in the past five years has averaged less than 30 per year (Environment and Natural Resources 2011a; Table 8, p.84), and the subpopulation is consistently harvested below allowable quota (last 20 years; Branigan and Pongracz 2011). 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).

Scientific sources indicate that only in the past 30 years have polar bears of the Viscount Melville Sound experienced regular hunting pressure. Farquharson (1976) noted that by the mid-

1970s, hunters from the Ulukhaktok area had expanded their traditional hunting range to kill polar bears along the western and northern coasts of Victoria Island to Glenelg Bay. At the same time, Inuit from Cambridge Bay began travelling by land or air to reach northern Victoria Island to hunt polar bears. In response to increased interest in hunting bears of the Viscount Melville Sound, the Government of the NWT established quotas. When quotas were originally allocated in the 1970s, the size and productivity of the Viscount Melville Sound subpopulation was overestimated. Polar bear density was lower in 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). Overestimating abundance when initially setting quotas resulted in a substantial overharvest of bears in the region during the 1980s and early 1990s (e.g., 1985–1990 mean of 19.6 bears/year; Taylor *et al.* 2002).

A 5-year moratorium on hunting in the Viscount Melville Sound was enacted in 1994/1995 through community agreements. Hunting resumed in 1999/2000 with an annual quota of 4 bears that rotated between Ulukhaktok and Cambridge Bay. In 2004 this was increased to 7 bears per year (NWT 4, Nunavut 3) based on a population viability analysis indicating this harvest would still allow the subpopulation to grow. Current harvest of this subpopulation averages less than 5 bears per year (Environment and Natural Resources 2011a; Table 8, p.84). This subpopulation should be increasing under this harvest regime (COSEWIC 2008; PBSG 2010). Vital rates for this subpopulation are now almost 20 years old, however, a new 3 year population inventory started in the spring of 2012 and will evaluate the efficacy of current protections.

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Authorities contacted

ABORIGINAL ORGANIZATIONS AND WILDLIFE MANAGEMENT BOARDS

Amy Thompson	Executive Director; Gwich'in Renewable Resources Board, Inuvik, NT.
Bruce Hanbidge	Resource Biologist; Wildlife Management Advisory Council (NWT), Inuvik, NT.
Mardy Semmler	Director; Gwich'in Tribal Council, Lands Administration and Resource Management, Inuvik, NT.
Steven Baryluk	Resource Management Coordinator; Inuvialuit Game Council, Inuvik, NT.

TERRITORIAL GOVERNMENT CONTACTS

Dr. Brett Elkin	Wildlife Biologist, (Wildlife Health); Environment and Natural Resources (Headquarters), Yellowknife, NT.
Marsha Branigan	Manager, Wildlife Management; Environment and Natural Resources (Inuvik Region), Inuvik, NT.
Rob Gau	Wildlife Biologist, Species at Risk; Environment and Natural Resources (Headquarters), Yellowknife, NT.
Robert Mulders	Wildlife Biologist, Carnivores/Furbearers; Environment and Natural Resources (Headquarters), Yellowknife, NT.

FEDERAL GOVERNMENT CONTACTS

Donna Bigelow	Species at Risk Biologist; Environment Canada, Yellowknife, NT.
Evan Richardson	Polar Bear Research Biologist; Environment Canada, Edmonton, AB.
Ian Stirling	Wildlife Biologist; Canadian Wildlife Services, Edmonton, AB.
Linh Nguyen	Western Arctic Field Unit; Parks Canada, Inuvik, NT.
Nick Lunn	Research Scientist; Wildife Research, Environment Canada, Edmonton, AB

OTHER EXPERTS

Dr. Andrew Derocher	Biology Professor and past IUCN Polar Bear Specialist Group Chair; University of Alberta, Edmonton, AB.
Eric Regehr	Wildlife Biologist, USFWS Marine Mammals Management, Anchorage, AK.
Dr. François Messier	Retired Biology Professor (University of Saskatchewan).
Lily Peacock	Research Wildlife Biologist; USGS Alaska Science Center, Anchorage, AK.
Marty Obbard	Research Scientist; Ontario Ministry of Natural Resources, Peterborough, ON.
Mitch Taylor	Retired Polar Bear Biologist (Government of Nunavut).
Stephen Atkinson	Acting Polar Bear Biologist, Government of Nunavut, NU.
Steven Amstrup	Senior Scientist, Polar Bears International.

Biography of Preparer

Dr. Philip D. McLoughlin is an Associate Professor of Biology in the Department of Biology at the University of Saskatchewan in Saskatoon, Canada. Philip's main interests with respect to polar bears are in conservation and the analysis of demography and population viability, and the role of harvesting and sex-biased harvesting in population management. Philip has published numerous papers on the ecology of grizzly bears, polar bears, and several ungulate species. He resides in Warman, SK, with his wife Tamara and son Finn.

Status and ranks

Region	Coarse filter (Ranks) To prioritize	Fine filter (Status) To provide advice	Legal listings (Status) To protect under species at risk legislation
Global	G3 - Vulnerable (NatureServe 2008)	A3c - Vulnerable (IUCN 2008)	Schedule II (CITES)
Canada	N3 – Vulnerable (NatureServe Canada 2008) Sensitive (Canada General Status Ranking Program 2010)	Special Concern (COSEWIC 2008)	Special Concern (SARA 2011)
Northwest Territories	Sensitive (NWT General Status Ranking Program 2011)	Special Concern (SARC 2012)	**To be determined**
Adjacent Jurisdictions			
Yukon	S2 – Imperiled (NatureServe Canada 2008) May be at Risk (YT General Status 2010)		
Nunavut	Sensitive (NU General Status 2010)		
Manitoba	S2 - Imperiled (NatureServe Canada 2008) At Risk (MB General Status 2010)	Threatened (Endangered Species Advisory Committee – 2008)	Threatened (Manitoba Endangered Species Act - 2008)
Ontario	S3 – Vulnerable (NatureServe Canada 2008) Sensitive (ON General Status 2010)	Threatened (COSSARO - 2009)	Threatened (Ontario Endangered Species Act - 2009)
Quebec	S2 – Imperiled (NatureServe Canada 2008) May be at Risk (QC General Status 2010)		Vulnérable (Loi sur les espèces menacées ou vulnérables – 2009)
Newfoundland and Labrador	S2 - Imperiled (NatureServe Canada 2008) Sensitive (NL General Status 2010)	Vulnerable (Species Status Advisory Committee – 2008)	Vulnerable (NL Endangered Species Act – 2008)
Saskatchewan	Vagrant (SK General Status 2010)		

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Appendix A: Endnotes with additional details

1 “Olokhaktokmiut” refers to people from the community of Ulukhaktok (Holman) on Victoria Island.

2 Three dialects are spoken in the Inuvialuit Settlement Region. Siglit is spoken in the coastal communities of Tuktoyaktuk, Paulatuk and Sachs Harbour. Uummarmiut is spoken in the Delta communities of Aklavik and Inuvik. Inuinnaqtun is spoken in the community of Ulukhaktok (Holman) on Victoria Island.

3 Lowe 2001.

4 Lowe 2001.

5 “The polar bear is the most intelligent animal in the wild that I have ever encountered” (R. Kuptana in CWS 2010: 14).

6 Lowe 2001.

7 “Polar bear could swim for hundreds of miles without ice, but it’s got to hunt in the ice floes” (D. Nasogaluak in Slavik *et al.* 2009).

8 “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 in Slavik *et al.* 2009).

9 W. Kuptana in Nagy 1999.

10 “Near Nelson Head, however, the floe is always near shore, for whenever an 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 Kanhiryuarmiut” (Stefansson 1914: 49-50).

11 “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 in Berger 1976h: 4239-40).

12 “Banks Island, that pressure ridge on the west side. I’ve been there. Seal kills every few feet” (D. Nasogaluak in Slavik *et al.* 2009).

13 Haogak pers. comm. 2011.

14 Nagy 1999.

15 “Around Cape Parry and southern Banks Island, however, they were quite common on occasion” (In Barr 1996: 69).

16 “Banks Island, that pressure ridge on the west side. I’ve been there. Seal kills every few feet” (D. Nasogaluak in Slavik *et al.* 2009).

17 “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 in Berger 1976h).

18 Lowe 2001.

19 Haogak pers. comm. 2011.

20 Haogak pers. comm. 2011.

21 “I meet some guys near Nelson head, out on the ice. Nelson Head get a lot of polar bears. 2400 feet! Polar bears go den there” (D. Nasogaluak in Slavik *et al.* 2009).

22 Lowe 2001.

23 “There was no 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 in Parks Canada 2004: 45).

24 “There’s a massive pressure ridge from Cape Perry to Holman Island sometimes. You could follow that, both sides, end of March” (D. Nasogaluak in Slavik *et al.* 2009).

25 “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 in Slavik *et al.* 2009).

26 S. Tiktalik in Nagy 1999.

27 “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 in Berger 1976e, p. 3943).

28 “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 in Berger 1976e).

29 “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 11/2 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 in Berger 1976e).

30 “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).

31 “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 in Slavik *et al.* 2009).

32 Haogak pers. comm. 2011.

33 “You know, Melville Island is here. I don’t have to go there but I want to know the country, the land, where the bears go. I’ve been down here and there’s bear tracks. One time I saw over fifty bears in here. Around Melville Island” (P. Ekpakohak in Slavik *et al.* 2009).

34 “Along the Artic 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).

35 “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).

36 Hart and Amos 2004.

37 “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).

38 Hart and Amos 2004.

39 “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 out 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).

40 Hart and Amos 2004.

41 Hart and Amos 2004: 166.

42 Hart and Amos 2004.

43 Hart and Amos 2004.

44 Hart and Amos 2004: 166-7.

45 Hart and Amos 2004: 175.

46 Hart and Amos 2004.

47 Baillie Island HBC Post, Hart and Amos 2004: 177.

48 Hart and Amos 2004: 167.

49 “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 in Slavik *et al.* 2009).

50 Hart and Amos 2004: 181.

51 “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 in Slavik *et al.* 2009).

52 Lowe 2001.

53 Hart and Amos 2004.

54 Hart and Amos 2004.

55 Hart and Amos 2004.

56 Hart and Amos 2004.

57 "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 in Slavik *et al.* 2009).

58 "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 in Slavik *et al.* 2009).

59 "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 in Slavik *et al.* 2009).

60 "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 in Slavik *et al.* 2009).

61 Hart and Amos 2004.

62 Lowe 2001.

63 "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 in Hart and Amos 2004: 76).

64 "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 make shortcuts over land, and that's when you see bear dens inland in the fall time, in October. Sandy knows better than me" (F. Wolki in Slavik *et al.* 2009).

65 "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 in Slavik *et al.* 2009).

66 "They considered the Northern and Southern Beaufort Sea subpopulations to be a single subpopulation as they pointed out that polar bears frequently move between both areas" (Summary of Aklavik Consultation in CWS 2010: 15).

67 “They do not feel the Beaufort Sea polar bears should be divided into two distinct subpopulations” (Summary of Tuktoyaktuk Consultation in CWS 2010: 16).

68 “People feel that the Northern and Southern Beaufort Sea subpopulation should be one subpopulation” (Summary of Ulukhaktok Consultation in CWS 2010: 16)

69 “Participants felt the Northern and Southern Beaufort Sea subpopulations should be one unit” (Summary of Paulatuk Consultation in CWS 2010: 17).

70 “They stated that the Northern and Southern Beaufort Sea subpopulations should be a single population because polar bears frequently move between the two” (Summary of Sachs Harbour Consultation in CWS 2010: 17).

71 “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 in Slavik *et al.* 2009).

72 “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 in Slavik *et al.* 2009).

73 “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).

74 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 pers. comm. 2011).

75 “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 in Slavik *et al.* 2009).

76 “Our hunting area has shrunk…” (L. Amos in Slavik 2011).

77 “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).

78 “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 in Slavik *et al.* 2009).

79 Lowe 2001.

80 “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 in Slavik *et al.* 2009).

81 “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 in Slavik 2011).

82 “Nobody hunts out, way out anymore… don’t go for 2 weeks like they used to” (D. Haogak in Slavik 2011).

83 “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 so see close-by. A good number!”(J. Keogak in Slavik 2011).

84 “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 bears healthy or bears are healthy. The ones they’re 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 in Slavik 2011).

85 “[The ice] used to be about 15-20 feet thick. Now it’s lucky to be 4 or 5 feet” (R. Kuptana in Slavik 2011).

86 “The ice still looks the same, but the thickness and the strength of it [decreased]” (F. Lennie in Slavik 2011).

87 “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 in Slavik *et al.* 2009).

88 Lowe 2001.

89 “It doesn’t take very much wind or very much current to break up the ice anymore” (R. Kuptana in Slavik 2011).

90 “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 in Reidlinger 2001:62).

91 “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 in Slavik *et al.* 2009).

92 “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 in Reidlinger 2001).

93 “[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 in Slavik 2011).

94 “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 in Slavik *et al.* 2009).

95 “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 in Slavik *et al.* 2009).

96 “…that’s the first I start hearing of bears going inland like that [as far as Aklavik and Deline]” (F. Wolki in Slavik *et al.* 2009).

97 “It’s new I think, when the bears was around Aklavik, we’ve never seen that before” (E. Storr in Slavik *et al.* 2009).

98 Haogak pers. comm. 2011.

99 S. Lucas in Slavik 2011.

100 “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 in Berger 1976h).

101 “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 in Berger 1976e).

102 “There aren’t as many polar bears close to town because there is less summer ice” (Tuktoyaktuk Consultation in CWS 2010: 85).

103 “It’s very seldom that a bear that would come into town- once every ten or twelve years, right Fred? But the past ten years, you’re right, we’ve had a few more” (F. Pokiak in Slavik *et al.* 2009)

104 “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 in Slavik *et al.* 2009).

105 “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 in Slavik *et al.* 2009).

106 “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 in Slavik 2011).

107 “There haven’t been any polar bears migrating through our area this year; they are moving further north” (Tuktoyaktuk Consultation in CWS 2010: 84).

108 “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 in Slavik *et al.* 2009).

109 “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- to warm for them. They go further north where the ice is” (D. Nasogaluak in Slavik *et al.* 2009).

110 “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 in Berger 1976i :4433).

111 “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 it’s 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 there food is, that's why we don't see them much anymore" (F. Wolki in Slavik *et al.* 2009).

112 "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 1ot 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 in Reidlinger 2001: 64).

113 "It's not only the female bears that use dens; when the males get too fat sometimes they go 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).

114 F. Lennie in Slavik 2011; M. Kudlak in Slavik 2011; L. Amos in Slavik 2011; W. Gully in Slavik 2011.

115 "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 in Slavik *et al.* 2009).

116 "… a lot of the dens I see are on the east banks. We used to get a lot of wind from the west, bowing 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 along the banks across form 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 in Slavik *et al.* 2009).

117 "I see them denning along the banks and also in some ravines in some areas I seen bear dens" (J. Pokiak in Slavik *et al.* 2009).

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

119 Lowe 2001.

120 L. Carpenter in Slavik 2011; R. Kuptana in Slavik 2011.

121 Lowe 2001.

122 Lowe 2001.

123 "Well, it really depends on the way the ice form too. Sometimes when the ice comes in, it's 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 when there's plenty of bears because the ice is not moving and they're hunting in those cracks" (F. Wolki in Slavik *et al.* 2009).

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

125 "If it opens up and then freezes over and there's lots of breathing holes. That's the one!" (D. Nasogaluak in Slavik *et al.* 2009).

126 “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 in Slavik *et al.* 2009).

127 Lowe 2001.

128 “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 one’s or beyond. So those slushy conditions I found were really good hunting conditions for the bears too!” (J. Pokiak in Slavik *et al.* 2009).

129 “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 bear tracks coming from both directions. And not only that, but a lot of times 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 in Slavik *et al.* 2009).

130 “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 in Slavik *et al.* 2009).

131 Lowe 2001.

132 “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 in Slavik 2011).

133 “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 in Slavik *et al.* 2009).

134 “Polar bear could swim for hundreds of miles without ice, but it’s got to hunt in the ice floes” (D. Nasogaluak in Slavik *et al.* 2009).

135 J. Keogak in Slavik 2011; G. Wolki in Slavik 2011.

136 “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 in Slavik *et al.* 2009).

137 "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. in Reidlinger 2001: 60).

138 "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 in Slavik *et al.* 2009).

139 "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 of with the ice. They go with the floe once the ice take of, most of the seals. But I don't know where the float take them- might be straight out" (F. Wolki in Slavik *et al.* 2009).

140 "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" (J. Nasogaluak in Hart and Amos 2004: 76).

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

142 "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 in Slavik *et al.* 2009).

143 "Nowadays too, you notice that we have a lot of different winds that 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 in Slavik *et al.* 2009).

144 "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 in Slavik 2011).

145 "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 in Slavik *et al.* 2009).

146 "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 in Slavik *et al.* 2009).

147 “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 in Slavik *et al.* 2009).

148 “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). One woman described how the pressure ridges now are smaller, likely in the same sense” (Reidlinger 2001: 62).

149 “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” (Paulatuk Consultation in CWS 2010: 92).

150“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 in Slavik *et al.* 2009).

151 “So much wind and warm weather…[started to change] around the 80s. Late eighties I guess” (P. Ekpakohak in Slavik *et al.* 2009).

152 “[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 in Slavik *et al.* 2009).

153 “… 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 in Slavik *et al.* 2009).

154 “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 in Slavik *et al.* 2009).

155 A. Carpenter in Slavik 2011; F. Lennie in Slavik 2011; L. Wolki in Slavik 2011.

156 “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 in Slavik *et al.* 2009).

157 “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 in Slavik 2011).

158 “A few times I have seen triplets, a few times. Quite a few times north of Ulukhaktok.Most of the time they have two. Sometime, only very little times, they got one” (P. Ekpakohak in Slavik *et al.* 2009).

159 “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 in Slavik 2011).

160 “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. in Slavik 2011).

161 “…if you saw a sow with 3 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 in Slavik 2011).

162 “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 beard for food if it’s starving or kill cubs in order to mate that female” (J. Pokiak in Slavik *et al.* 2009).

163 “I get some bears on the North side of Banks Island, they look different like that [weasel bear]” (D. Nasogaluak in Slavik *et al.* 2009).

164 “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 in Slavik *et al.* 2009).

165 MPEG 2006: 11-31.

166 “If people start seeing the seal population crashing, we know the bears will soon follow, cause that’s their main diet” (F. Raddi in Slavik 2011).

167 “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 in Slavik *et al.* 2009).

168 “So spring time, when the seal pups are out there, are when they do most of their hunting” (L. Carpenter in Slavik 2011).

169 Lowe 2001.

170 “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 lots of arctic fox where there’s polar bear” (F. Wolki in Slavik *et al.* 2009).

171 “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 in Slavik 2011).

172 “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” (F. Wolki in Slavik *et al.* 2009).

173 “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 in Slavik *et al.* 2009).

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

175 "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 in Berger 1976g: 4146).

176 "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 in Berger 1976f: 4030).

177 "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 in Berger 1976f: 4031).

178 "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 in Berger 1976b 113).

179 "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 in Berger 1976f: 4031).

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

181 P. Raddi in Slavik 2011; F. Lennie in Slavik 2011; M. Kudlak in Slavik 2011.

182 P. Raddi in Slavik 2011; L. Wolki in Slavik 2011.

183 M. Kudlak in Slavik 2011.

184 Hart and Amos 2004.

185 "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 in Slavik *et al.* 2009).

186 "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 in Slavik *et al.* 2009).

187 Lowe 2001.

188 "... 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 in Slavik 2011).

189 “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. in Slavik 2011).

190 E. Esau in Slavik 2011; F. Raddi in Slavik 2011.

191 Hart and Amos 2004.

192 “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 in Slavik *et al.* 2009).

193 Hart and Amos 2004.

194 “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 in Slavik *et al.* 2009).

195 Hart and Amos 2004.

196 “And bowhead one time, there was a lot of bears on that... we seen over thirty bears there” (J. Lucas Sr. in Slavik 2011).

197 D. Haogak in Slavik 2011.

198 Hart and Amos 2004.

199 “They always go at the back, eh, where they can’t get them with the tusk. And the bears kill it by chewing on it’s 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 in Slavik 2011).

200 Lowe 2001.

201 “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 in Slavik 2011).

202 “Well, it’s always been known that, if they’re hungry, they’ll eat another bear” (R. Kuptana in Slavik 2011).

203 “...some big males, they always try to eat cubs too” (G. Wolki in Slavik 2011).

204 “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 in Slavik *et al.* 2009).

205 “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 in Slavik *et al.* 2009).

206 “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 that bear looked] really healthy!”(Geddes Wolki in Slavik 2011).

207 A. Carpenter in Slavik 2011.

208 “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 in Slavik *et al.* 2009).

209 “There was five bears in one place. They were hunting seals all together in the same place and they were lying down” (C. Pokiak in Slavik *et al.* 2009).

210 L. Carpenter in Slavik 2011.

211 “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 in Slavik *et al.* 2009).

212 “Due to the season longer. And even grizzlies going to the North of Banks Island right now” (D. Nasogaluak in Slavik *et al.* 2009).

213 Grizzlies have also recently been observed on Melville Island, which is even further north than Banks and Victoria (Doupé *et al.* 2007: 271)

214 “[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 in Slavik *et al.* 2009).

215 “You know, today, there are more grizzly bears on [Victoria] island. It’s like they’re coming in from the mainland. And sometimes we seen their track on the ice hunting seal, hunting seal just like the polar bear” (P. Ekpakohak in Slavik *et al.* 2009).

216 “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 in Slavik 2011).

217 “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 in Slavik *et al.* 2009).

218 “Even wolves kill polar bears out on Banks” (D. Haogak in Slavik 2011).

219 “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 in Slavik *et al.* 2009).

220 “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 in Slavik *et al.* 2009).

221 “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 in Slavik *et al.* 2009).

222 “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).

223 “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 in Slavik *et al.* 2009).

224 “Polar bears will migrate long distances between subpopulation boundaries and through a range of different government jurisdictions” (Tuktoyaktuk Consultation in CWS 2010: 83).

225 “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 in Slavik *et al.* 2009).

226 “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 in Slavik *et al.* 2009).

227 “When I did the interviews for polar bear denning areas, he said that you might not see any bars 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 they you could shoot it as a nine feet” (C. Pokiak in Slavik *et al.* 2009).

228 “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 remember the country very well then” (M. Kuneyuna in Berger 1976e: 3981-82).

229 “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 in Berger 1976i: 4520).

230 “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 in Slavik *et al.* 2009).

231 “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 in Slavik *et al.* 2009).

232 “It was early in December around December 10 or 11. And the days were quite dark… 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 from the west. For some reason bears we just hit it right on and bears - I saw 11 bears that day” (L. Emaghok in Slavik *et al.* 2009).

233 “Caribou migrate this way, then they head back when the time comes. Same thing with polar bears. They migrate back, then head straight out I guess, cause they can’t stay where there’s water. Only some of them when there’s 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… And they only start coming later when the ice start getting thicker. That’s when they start coming- sometime in February or January. And they come, when they finally come they’re all there- You know there’s a big difference, if there’s ice that’s steady there would be lots of bears” (F. Wolki in Slavik *et al.* 2009).

234 P. Raddi in Slavik 2011.

235 “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 Liot point… March and April and May, they start really migrating” (G. Wolki in Slavik 2011).

236 J. Lucas Sr. in Slavik 2011.

237 W. Gully in Slavik 2011.

238 “You have to know different times of years. 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 in Slavik *et al.* 2009).

239 “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 in Slavik *et al.* 2009)

240 F. Lennie in Slavik 2011; L. Carpenter in Slavik 2011.

241 J. Lucas Sr. in Slavik 2011.

242 W. Gully in Slavik 2011; J. Lucas Sr. in Slavik 2011.

243 A. Carpenter in Slavik 2011.

244 J. Lucas Sr. in Slavik 2011.

245 “You know polar bears weigh about 8,000 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 in Slavik *et al.* 2009).

246 “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 in Slavik *et al.* 2009).

247 “This female bear that was tagged and swan 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 in Slavik *et al.* 2009).

248 “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 in Slavik *et al.* 2009).

249 “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 in Slavik *et al.* 2009).

250 “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 in Slavik *et al.* 2009).

251 “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 in Slavik *et al.* 2009).

252 "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 call 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 Bank Island, Victoria Strait, from Jenny Lind Island north to Gateshead Island, the northern part of Prince" (Barr 1996: 183-184).

254 "…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).

255"Sometimes one year only, sometimes nothing. Next year it could be full of bears" (F. Wolki in Slavik *et al.* 2009).

256 "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 in Slavik *et al.* 2009).

257 "[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 in Slavik 2011).

258 "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 so see close-by. A good number!"(J. Keogak in Slavik 2011).

259 "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 in Slavik *et al.* 2009)

260 "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" (Tuktoyaktuk Consultation in CWS 2010: 85)

261 "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 in Slavik 2011).

262 "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" (P. Ekpakohak in Slavik *et al.* 2009).

263 "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 in Slavik *et al.* 2009).

264 "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 in Slavik 2009).

265 J. Keogak in Slavik 2011.

266 "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 in Slavik *et al.* 2009).

267 "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 in Slavik *et al.* 2009).

268 "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 in is the blubber of the seal. You know. Sure they'll eat meat and that, but they prefer the oil and blubber" (F. Lennie in Slavik 2011).

269 "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 in Slavik 2011).

270 "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 in Berger 1976g: 4146).

271 "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 in Berger 1976f: 4042).

272 "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 in Berger 1976g: 4154-4155).

273 "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 in Berger 1976h: 4180-81).

274 “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 in Berger 1976h: 4175).

275 “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 in Slavik *et al.* 2009).

276 J. Wolki in Slavik 2011.

277 “…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 in Slavik *et al.* 2009).

278 “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 in Slavik *et al.* 2009).

279 “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 in Slavik *et al.* 2009).

280 “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 in Slavik *et al.* 2009).

281 “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” (Tuktoyaktuk Consultation in CWS 2010: 85-86).

282 “[In] Elders view research techniques (helicopter, collars) as invasive and may have adverse affects on polar bears so work should be done to improve techniques. Research is thought to harm bears, not help them” (3 communities; CWS 2010: 11)

283 “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” (S. Wolki in Slavik *et al.* 2009).

284 G. Wolki in Slavik 2011.

285 “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 in Slavik *et al.* 2009).

286 “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 in Hart and Amos 2004: 79)

287 “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 in Slavik *et al.* 2009).

288 “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 because when they go hunting they get nervous. That’s what my grandfather told me and my dad” (D. Nasogaluak in Slavik *et al.* 2009).

289 R. Kuptana in Slavik 2011.

290 “… polar bears are dangerous today because they are hungry and they haven't got enough food to go around” (W. Kuptana in Berger 1976f).

291 “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 in Berger 1976h: 4181).

292 “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 in Slavik *et al.* 2009).

293 A. Carpenter in Slavik 2011; E. Esau in Slavik 2011.

294 “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).

295 “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 in Berger 1976e: 3974-3975).

296 “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 in Slavik *et al.* 2009).

297 "[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 in Slavik *et al.* 2009).

298 "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 in Slavik *et al.* 2009).

299 "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 in Slavik 2011)

300 "A bear likes to walk around where there's thin ice. They're always walking around, looking for seals." (R. Kuptana in Slavik 2011)

301 "Ice conditions help a lot too for the polar bears. If the locals can't go out more than two miles" (W. Gully in Slavik 2011).

303 "A first generation male hybrid bear was harvested in 2006 near Banks Island (Gau 2006 cited in COSEWIC 2008) and a minimum second generation hybrid male bear was harvested in 2010 near Ulukhaktok providing evidence of offspring fertility in the wild (Gau pers. comm. 2011). More recently, in April 2012, there was a subsistence harvest of an adult polar bear female with what is now confirmed as two older first generation hybrid cubs, a sighting of a believed hybrid bear with a grizzly bear in late April 2012 south of Wynniatt Bay, and an additional sighting from a week later in the same area of what ENR Biologists in the field believe to be a small hybrid bear (ENR unpublished data)" (ENR 2012: 11).

304 "…the quotas in the NWT are set based on a sex ratio of 1 female to every 2 males and a maximum number of female harvests are defined under the quotas. Some [notes] on the proportion of females in the harvest and on patterns of sex selective harvesting [are] appropriate [here]. [Whereas] the ratios in the NWT have been higher than 33%, the number of females taken is below the total allowable harvest for females. It is important to note that this ratio is of particular concern when most or the entire quota is taken. ….while Brower *et al.* (2002) noted that the Polar Bear Management Agreement for the Southern Beaufort Sea (the Agreement) helped ensure that the harvest of adult females remained within what were thought to be sustainable limits, he also noted increased harvest monitoring and continued restraint in harvesting females were necessary to continue meeting the provisions of the Agreement. Reviews of the quotas happen annually, and in recent years the number of females harvested has been noted as a concern. ENR [Department of Environment and Natural Resources] is aware of this concern. Our work with our co-management partners has resulted in improvements to the 2011/2012 sex ratios" (ENR 2012: 2).

305 "Caution is needed with regard to the following statements: 'Furthermore, the cost of gas …potentially limiting the range of most harvesters.' This statement does not correlate with recent (2012) conditions whereby high prices for polar bear hides and the threat of a complete trade ban on polar bear hides have in fact spurred increased effort (both subsistence and sport hunting) and increased harvest levels (within the available quota)" (WMAC-NS 2012: 2).