Inuit Perspectives on Polar Bears (*Ursus maritimus*) and Climate Change in Baffin Bay, Nunavut, Canada

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Abstract

Scientific research has demonstrated negative effects caused by climate change on three of 19 polar bear populations' worldwide (Stirling et al. 1999; Aars et al. 2006). As a result the status of polar bears has been uplisted by the IUCN/SSC to vulnerable (Schliebe et al. 2006). At the same time, Inuit hunters in many areas of the Canadian arctic have reported increased sightings of polar bears and have received hunting quota increases (Aars et al. 2006). One of the areas where quotas were increased in 2004 is the Baffin Bay polar bear population. Scientific studies indicate a decline in this population (Aars et al. 2006). This paper reports on interviews conducted during the spring of 2005 in the three Canadian Baffin Bay hunting communities. All three communities reported similar environmental changes but provided different information on polar bear numbers and different interpretations for observed changes in polar bear behaviour. A north-south gradient was identified, with more polar bears and bears signs being encountered in the north-western part of Baffin Bay. The reason for increased Inuit sightings of bears and bear signs when scientific studies indicate a declining population in Baffin Bay is unknown. Possible explanations for this phenomenon include 1. Immigration from an abundant adjacent population (Lancaster Sound) has increased numbers in the northern area, 2. Scientific studies underestimated the population, and 3. Climate change induced changes in bear have increased densities along the coast. This question cannot be resolved with the information available at present.

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Introduction

In Canada's most northern territory of Nunavut, wildlife management is conducted using a co-management system involving both scientific studies and *Inuit Qaujimajatuqangit* (IQ) which includes both traditional ecological knowledge (or TEK) and other non-empirical cultural understandings of the natural world (see Keith 2005; Usher 2000; Wenzel 1999, 2004). Recently, the struggle to integrate these two knowledge systems has been further complicated by the new problem of human-induced climate change; a challenge which itself includes both scientific and cultural dimensions.

Inuit living in Nunavut retain the right to harvest wildlife, and some species, such as the polar bear, are managed under a quota system. Canada is home to 13 populations of polar bears and each is studied according to a 15-year rotational inventory to evaluate status and estimate appropriate rates of harvest in order maintain healthy polar bear populations (Aars et al. 2006). The Nunavut Inuit hunting quota for each population is based on the research information and on consultation with Inuit and then the quota is distributed among the communities that hunt in that population area (Government of Nunavut 2005).

The Baffin Bay (BB) polar bear population is shared between Nunavut and Greenland. In 2004 Nunavut used IQ to increase the polar bear total allowable harvest (TAH) from 64 to 105 for the Nunavut communities that share this population (Government of Nunavut 2005). In February, 2005 the Federal-Provincial-Territorial Polar Bear Technical Committee of Canada received information indicating that the Greenland harvest had increased from 68 per year (average harvest from 1993-1997) to 185 per year (last two years average) (Born 2005). In 2006 Greenland instituted a quota system to reduce their harvest to approximately 100 animals. The estimated combined harvest of Nunavut and Greenland continues to be well above what population modeling suggests is sustainable (approximately 88 bears) (Taylor et al. 2005). Co-management discussions between Nunavut and Greenland are on-going.

Simulation modeling suggests the BB population has declined from 2074 bears in 1998 (Taylor et al. 2005) to 1700 in 2004 due entirely to legal over-hunting. During 2004 and 2005 undocumented information from both Greenlandic and Nunavummiut hunters was to the effect that the Baffin Bay population of bears was increasing. Many biologists and managers hypothesize this paradox to be due to changes in the distribution and behaviour of polar bears caused by climate change (Stirling and Derocher 1993; Stirling and Parkinson 2006). A similar situation is also on-going in the polar bear population area of Western Hudson Bay (around the 'Polar Bear Capital of the World', Churchill, Manitoba). In that area recent scientific information documents a decline while Inuit knowledge reports an increase in encounters (Stirling and Parkinson 2006).

Inuit Qaujimajatuqangit and similar indigenous knowledge systems have been used in other investigations of recent changes in the arctic environment and wildlife and have demonstrated that IQ is a detailed and holistic worldview that stresses observation of the natural world (Ferguson et al. 1998; Huntington et al. 1999; Krupnik and Jolly 2002; Omura 2005). Previous reports of IQ relating to polar bears have mainly investigated Inuit hunting techniques and polar bear denning (Keith 2005; Van de Velde et al. 2003; Wenzel 1983). This paper focuses on changes in polar bears and climate observed by Inuit over the past 10 to 15 years in the Baffin Bay area of Nunavut. Both quantitative and qualitative methods were used to reveal both statistically significant differences in responses and to allow for the expression of observations as they were reported by Inuit. Parallel analyses allowed for a consideration of Inuit TEK in the context of scientific investigations and also allowed respondents to express a deeper *Inuit Qaujimajatuqangit*, or cultural, context for TEK data.

Methods

The data were collected using a semi-directed interview format that has proven useful to other researchers working in the North American arctic with aboriginal groups (Ferguson and Messier 1997; Huntington 1998). The questions were developed after consultation of the Igloolik Oral History Archive, government wildlife managers and Inuit hunters. Survey participants were recruited through two means: 1) consultation with the Nunavut

Department of Environment and local Inuit organizations; and 2) recommendation by earlier participants.

Forty-eight interviews were conducted from April to June 2005 in the Baffin Bay communities of Pond Inlet, Clyde River and Qikiqtarjuaq. Participants ranged in age from late 20s to early 80s, with most over age 50. The majority of participants were men who engaged in harvesting activities on either a part time or full time basis, or else were retired from harvesting. Interview participants were generally unprompted with regards to possible explanations of their observations. This was done to allow them to express their own views. Participants were asked two sections of questions. The first was regarding polar bear population, behaviour and health, the second was regarding climate change and any linkages to changes in polar bears. Due to the semi-structured design of the interviews, some participants were asked supplemental questions or they offered further explanation for their answers. When themes were revealed in these discussions they were coded into new variables for the quantitative analysis.

Quantitative analysis was completed using SPSS (SPSS© for Windows version 11.0.1). Responses to questions were broken down into their smallest units and coded into a data table. The results are provided as frequency tables. To analyze these results, respondents were categorized by 3 criteria: community, age, and sex. Fisher's exact test (2-sided) (SPSS© for Windows version 11.0.1) was used to look for categorical differences in participant responses based on community and sex. I tested for age effects using an ANCOVA categorical regression approach entitled 'optimal scaling' (SPSS© for Windows version 11.0.1). I report the observed significance and discuss possible causes and implications for responses with observed level of significance (*p*-hat) less than 0.100.

The semi-directed nature of the interviews allowed participants to expand on their answers and express information that was not specifically queried, but which they considered important. These qualitative responses added considerably to the information gained. In the results section, qualitative comments are provided where they help to further explain the responses. Where differences between groups of respondents were

found to be statistically different (p-hat < 0.100) the qualitative data are divided by the same criterion. A list of the questions asked during the interviews can be found in Appendix 1.

Results

There were no significant differences in responses between male and female participants (sex) and no significant differences in responses based on age. The results for some questions showed a significant difference between communities (Table 1). Following this are tables summarizing the frequency of responses to questions and qualitative comments offered by participants. For the questions where a significant difference between communities was observed, further tables break down the results by community and qualitative comments from each community are shown.

Table 1. The observed level of significance (Fisher's exact test, SPSS© for Windows, version 11.0.1) is listed by the category of community (Pond Inlet, Clyde River and Qikiqtarjuaq) for each question or topic discussed by participants during the survey that produced a significant result. Questions 3c and 3d were not asked of participants but rather illustrate themes of answers given to a general question on damage caused by polar bears (question 3a).

Question	Community p-hat
1) Has the bear population increased, decreased or stayed the same over the past 10-15 years?	**0.010**
2) Are there more, fewer or the same number of bears coming to town now compared to 10-15 years ago?	**0.021**
3d) Is the reason for increased damage that there are more bears?	**0.092**
3e) Is the reason for increased damage that there are more people and more things left out?	**0.043**

Section 1

Polar bear population dynamics and behaviour

The responses to question 1 'Has the polar bear population increased, decreased or stayed the same over the past 10 to 15 years?' were significantly different between communities with all Pond Inlet participants reporting an increase but only 60% of Qikiqtarjuaq participants doing so (Table 2). Over half of participants who stated an increase offered

the type of observation they had made to reach this conclusion (Table 3), but no significant difference between communities was found.

Table 2. Cross tabulation of question 1'Has the bear population increased, decreased or stayed the same over the past 10-15 years' and Community (p-hat = 0.01).

			Community			Total
			Pond Inlet	Clyde River	Qikiqtarjuaq	
Has the bear population changed?	Increased	Count	14	16	9	39
		% within Has the bear population changed?	35.90	41.03	23.08	100.00
		% within Community	100.00	94.12	60.00	84.78
		% of Total	30.43	34.78	19.57	84.78
	Same size	Count		1	3	4
		% within Has the bear population changed?		25.00	75.00	100.00
		% within Community		5.88	20.00	8.70
		% of Total		2.17	6.52	8.70
	Don't know	Count			3	3
		% within Has the bear population changed?			100.00	100.00
		% within Community			20.00	6.52
		% of Total			6.52	6.52
Total		Count	14	17	15	46
		% within Has the bear population changed?	30.43	36.96	32.61	100.00
		% within Community	100.00	100.00	100.00	100.00

Table 3. Twenty-eight participants who stated polar bear numbers had increased gave reasons for their answers. The frequency of specific responses and the percent of total responses are listed.

Response	Frequency	Response Percent
Bears are less afraid of people now	1	3.57
More polar bears are coming to our town	6	21.43
Elders say there are more bears	1	3.57
I've seen fewer tagged bears and more signs	2	7.14
I've seen more bear tracks and or signs	18	64.29
Total	28	100

Comments:

Pond Inlet

"There were not many bears around Pond Inlet when I was growing up. We used to have caches of muktuk and seal. The polar bears only bothered them once in a while. Now

there are lots of polar bears! I never suspected there would be polar bears in the western fiords and now there are. There are fewer seals there, but the bears are probably looking for food over there."

Clyde River

"There are too many bears. Before, when we went dog teaming for hunting we didn't come across many bears. We were getting 45 a year anyway. The government says that's too many. We should be able to get more now since we were able to get that when they were scarce."

Qikiqtarjuaq

"I don't know. The polar bears are usually at the floe edge and the sea. But this year they are not really down at the sea. They are more by the land. Probably there is not enough to harvest there [not enough food at floe edge]. And there are walruses by the floe edge so the seals are probably more close to land."

"I can't answer, but I think they increased, but it could be due to change of weather or the polar bears are following their prey. We say they have increased because the weather got warmer and probably the polar bears have come nearby the communities. They are coming more to the community."

Responses to question 2 'Are there more, the same or fewer bears around town now than 10-15 years ago?' are given in Table 6. The responses varied significantly between communities with all Pond Inlet participants reporting an increase but only half of Qikiqtarjuaq participants reporting an increase.

Table 4. Cross tabulation of question 2 'Are there more, fewer or the same number of bears coming to town now compared to 10-15 years ago?' and Community (*p*-hat = 0.021).

			Community			Total
			Pond Inlet	Clyde River	Qikiqtarjuaq	
Are more, fewer or the same number coming to town?	More	Count	8	15	3	26
		% within number coming to town?	30.77	57.69	11.54	100.00
		% within Community	100.00	93.75	50.00	86.67
		% of Total	26.67	50.00	10.00	86.67
	Same number	Count		1	3	4
		% within number coming to town?		25.00	75.00	100.00
		% within Community		6.25	50.00	13.33
		% of Total		3.33	10.00	13.33
Total		Count	8	16	6	30
		% within number coming to town?	26.67	53.33	20.00	100.00
		% within Community	100.00	100.00	100.00	100.00

Comments:

Pond Inlet

8 people responded to this question all said more bears are coming now. Even though many people used the presence of bears in town during the fall as an indication that their population had increased, some respondents gave more textured answers:

"It seems to be that more are coming to the community. When the polar bears are hunting they are not so careful because of the noises they always hear. Even dogs' barking damages their ears. Polar bears come to the community to find food as they are not successful at hunting"

"They started coming to town in the 1960s, early 1970s. Polar bears can think like a person, they won't forget things right away. If they come and find food around here, people chase them away and the polar bear will come again the next year. They will remember where they found food. If a bear is chased away from town, it will come back at night when things have quieted down."

Clyde River

"More are coming to town, because there are more bears, not because they are extra attracted to town. It's a different bear almost every time, but skinny ones keep coming back."

"In the fall they seem to be hungry, they've been lying around for a long time. The town bears are also more likely to be young ones."

Qikiqtarjuaq

"Back then we only saw them (around the community) when there was no ice. Now even in the winter they come around."

Responses to question 3 'Is there more, less or the same amount of damage to cabins, meat caches and other equipment?' showed no significant difference in groups of respondents (Table 5). However, participants expanded on their responses in a number of ways and the results are divided up here. First is Table 6 summarizes the answer to the first part of the question. Participants were then asked the follow up question 3b 'If there is more damage, why is that?' or explained their answer to 3a unprompted. Their responses are broken down into three themes: 3c changing bear behaviour, 3d bear numbers, and 3e changing human behaviour,. These themes are phrased as questions in the summary tables (Tables 6, 7 and 8) but were not asked of the participants. Questions 3d and 3e showed significant differences between communities. Tables 7 and 8 gives the cross tabulation of responses. Pond Inlet felt that increased damage was caused by more bears and not by the presence of more people or more things being left out. The other two communities gave mixed responses.

Table 5. Twenty-nine participants responded to question '3a) 'Is there more, less or the same amount of damage caused by bears now compared to 10-15 years ago?'. The frequency of specific responses and the percent of total responses are listed.

Response	Frequency	Response Percent
More	27	93.10
Same	1	3.45
Don't know	1	3.45
Total	29	100.00

Table 6. Twenty-six participants responded to question 3c) 'Is this increased damage caused by a change in bear behavior?' The frequency of specific responses and the percent of total responses are listed.

Response	Frequency	Response Percent
No	15	57.69
Yes	11	42.31
Total	26	100.00

Table 7. Cross tabulation of question 3d) 'Is the reason for increased damage that there are more bears?' and Community (*p*-hat = 0.092).

			Community			Total
			Pond Inlet	Clyde River	Qikiqtarjuaq	
Is the reason more bears?	No	Count	1	8	4	13
		% within Is the reason more bears?	7.69	61.54	30.77	100.00
		% within Community	14.29	61.54	66.67	50.00
		% of Total	3.85	30.77	15.38	50.00
	Yes	Count	6	5	2	13
		% within Is the reason more bears?	46.15	38.46	15.38	100.00
		% within Community	85.71	38.46	33.33	50.00
		% of Total	23.08	19.23	7.69	50.00
Total		Count	7	13	6	26
		% within Is the reason more bears?	26.92	50.00	23.08	100.00
		% within Community	100.00	100.00	100.00	100.00

Table 8. Cross tabulation of question 3d) 'Is the reason for increased damage that there are more people and more things left out?' and Community (*p*-hat =0.043).

			Community			Total
			Pond Inlet	Clyde River	Qikiqtarjuaq	
Is the reason for increased damage more people and more things left out?	No	Count	7	9	2	18
		% within more people	38.89	50.00	11.11	100.00
		% within Community	100.00	69.23	33.33	69.23
		% of Total	26.92	34.62	7.69	69.23
	Yes	Count		4	4	8
		% within more people		50.00	50.00	100.00
		% within Community		30.77	66.67	30.77
		% of Total		15.38	15.38	30.77
Total		Count	7	13	6	26
		% within more people	26.92	50.00	23.08	100.00
		% within Community	100.00	100.00	100.00	100.00

Comments:

Clyde

"There seems to be more damage, but you have to take into consideration that we're leaving more stuff out on the land than 15 years ago. But if you leave meat caches they are pretty much guaranteed to be gone."

"We used to cache 4 or 5 seals in a row, covered them just with gravel. Used to never be touched. But now it disappears even if we put rocks on it. Polar bears don't like to use their claws and scratch them (wear them down), so they stayed away from the gravel. They wouldn't dig it. Now they do."

Qikiqtarjuaq

"The bears are more hungry. There is a problem with the ice. The rough ice makes it hard for them to find seals, but there is the same number of seals."

"The only change I've noticed is when I was growing up the polar bears would scare easily and run away. Even when they were around shacks they didn't break windows or do damage but now they are not afraid. They used to avoid communities before and now they don't."

Participants were queried about bear condition in question 4 'Is there more, less or no trend in skinniness of polar bears over the past 10-15 years?' Responses did not indicate a strong observation that condition had decreased (Table 9).

Table 9. Twenty-four participants responded to question 4) 'Is there more, less or no trend in skinniness of polar bears over the past 10-15 years?' The frequency of specific responses and the percent of total responses are listed.

Response	Frequency	Response Percent
More skinny	11	45.83
No trend	13	54.17
Total	24	100.00

Section 2

Climate Change and Polar Bears

In question 5 the participants discussed a number of different environmental features when asked the general question "Have there been any changes in the sea ice over the past 10-15 years" (Table 10) and then general follow up questions such as "how do you know?", or "what has changed exactly?". The number of responses varies. In some cases a low number of responses may indicate that although the respondents thought about that aspect of the environment they had not noticed changes and therefore did not say anything because they were specifically asked about changes. Most interviews were translated and it is likely that the translators sometimes prompted participants with a list of ice features, which solicited negative or uncertain responses. The responses to questions 5, 6 'Is there any evidence of climate change in this area?' and 7 'Could climate change contribute to what you have observed about polar bears?' are summarized in Table 10. Tables 11-15 summarize the information on specific sea ice features discussed in question 5. The tables are followed by comments offered for questions 6 and 7.

Table 10. The frequency of specific responses and the percent of total responses to questions 5, 6 and 7 are listed.

	Yes	No	Don't know	Total Responses
Q 5 Have there been any changes in the sea ice over the past 10-15 years?	25 (83.33)	4 (13.33)	1 (3.33)	30
Q 6 Is there any evidence of climate change in this area?	21 (63.64)	9 (27.27)	3 (9.09)	33
Q 7 Could climate change contribute to what you have observed about polar bears?	5 (41.67)	3 (25.00)	4 (33.33)	12

Q 5 Have there been any changes in the sea ice over the past 10-15 years?

Comments:

"The salt water doesn't freeze as hard as before. Every year we chip the ice at seal breathing holes, today it is not as hard, not as brittle. Now in June the bottom of puddles [on the ice] is not slippery, it's not melting from the top, it's melting from everywhere through the ice, like the inside of a bone. Today the ice is also thinner. People used to

say when the leads opened they looked tapered going down in them because of the thickness. They no longer look tapered."

Table 11. Twenty-one participants discussed the location of the floe edge (where the land-fast ice meets the open sea or pack ice). The frequency of specific responses and the percent of total responses are listed.

Response	Frequency	Response Percent
The location is the same	3	14.29
The floe edge is closer to land	16	76.19
Don't know	2	9.52
Total	21	100.00

Participants who discussed the floe edge were asked to draw its present and past (10-15 years ago) location in late winter on topographical maps. Figure 1 gives their composite map.

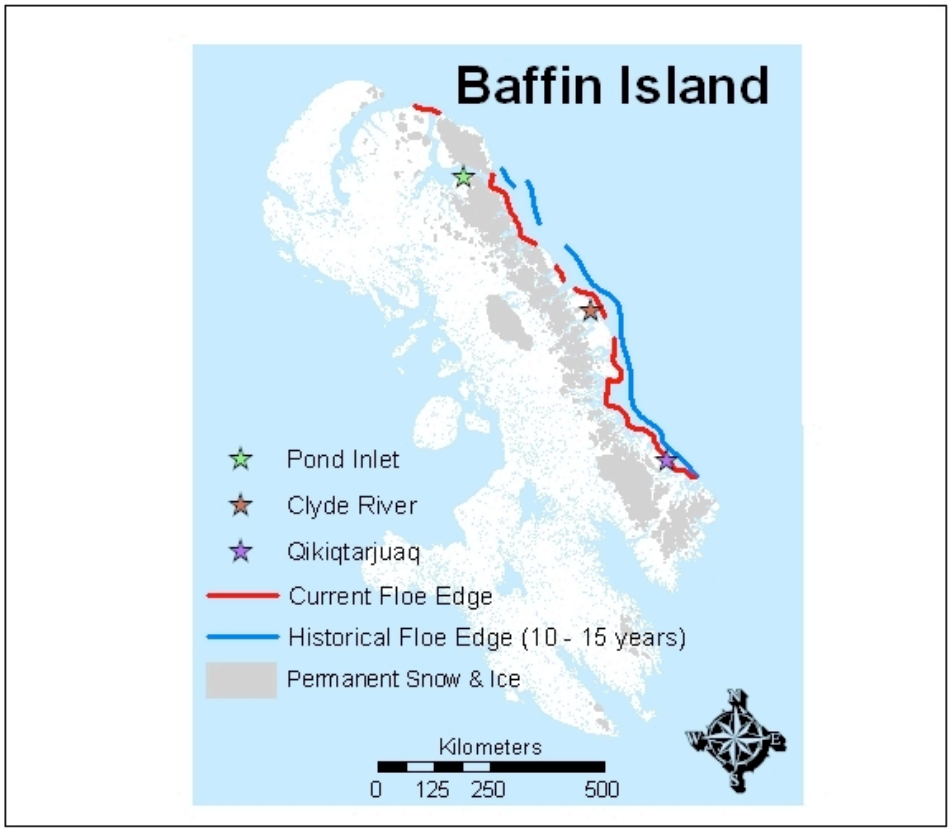

Figure 1. Map of Baffin Island showing present floe edge and past (10-15 years ago) floe edge as reported by participants in the survey.

Comments:

"The floe edge is closer to the land and there are hardly any icebergs. That's why the floe edge is close by. The icebergs keep the ice from going anywhere. They are like plugs."

Table 12. Fourteen participants discussed the thickness of the sea ice over the past 10-15 years. The frequency of specific responses and the percent of total responses are listed.

Response	Frequency	Response Percent
It is thinner	12	85.71
It is variable	2	14.29
Total	14	100.00

Comments:

"I went bear hunting all the way to the Dewline on Durban Island and the ice there was moving up and down. That was 4 years ago in March. It was not like that there when I was growing up. It was solid."

Table 13. Thirty-three people discussed the number of icebergs grounding around their community over the past 10-15 years. The frequency of specific responses and the percent of total responses are listed.

Response	Frequency	Response Percent
Fewer icebergs are grounding	27	81.82
No trend	6	18.18
Total	33	100.00

Comments:

"The icebergs are like nails, they hold the ice in. Since there are fewer icebergs there (around Button Point) the ice edge is closer."

"When I'm flying to and from Clyde River [from Pond Inlet], there are not a lot of icebergs and the floe edge is closer to the land. In the Clyde River area, way back, when there were lots of icebergs, the floe edge was further out. Recently there are strong winds from the south so the icebergs left and the floe edge came in closer. The icebergs come from Greenland (between Greenland and Ellesmere Island) and they go into Clyde and the coast just north of it. The current is from the north and from Lancaster Sound coming

east… The ice changes in Baffin Bay mean less ice patches so the bears come to land to hunt. Because polar bears can swim, but when they are tired they go to land."

Table 14. Thirteen participants discussed the timing of sea ice break-up over the last 10-15 years. The frequency of specific responses and the percent of total responses are listed.

Response	Frequency	Response Percent
It is occurring earlier	12	92.31
Same time	1	7.69
Total	13	100.00

Four people specified break-up as being about 2 weeks earlier than 10-15 years ago.

Table 15. Eight participants discussed the timing of sea ice freeze-up over the last 10-15 years. The frequency of specific responses and the percent of total responses are listed.

Response	Frequency	Response Percent
No trend	2	25.00
It is occurring later	6	75.00
Total	8	100.00

Five people specified the change and said freeze-up occurs a couple of weeks later now.

Q 6 Is there any evidence of climate change in this area?

Comments:

"Yes, it has affected our area. In the past we could hunt for different animals further. Now we can't go further, we have to hunt nearby on the ice." [This comment seemed to refer to the difficulty of traveling on the ice.]

"I am experiencing it. In winter there are usually cracks from the points of land and I can put my [fishing] net under water. But now there are hardly any cracks so I can't fish for char any more."

Q 7 Could climate change contribute to what you have observed about polar bears?

Comments:

"No, because polar bears can go and follow the seals further, so they won't have trouble hunting. Also the snow covers the [seals'] breathing holes but polar bears can still hunt, it's just for people."

"Seems like yes because polar bears are getting skinnier. If it gets warmer it will affect polar bears. They like to be cold."

"Yes, it could affect the polar bear's food, even with small amount of temperature change, the food will change. These days some livers [of seals] don't look good. Also the shedding of the seal fur, molting is this time of year usually. Now you sometimes find ones that are molting in other times of the year."

"There is more rough ice, more thin ice. But it won't affect polar bears' hunting."

"It may be. There are not enough icebergs and the denning areas have less snow and it is melting in summer. The bears are more hungry. There is a problem with the ice. The rough ice makes it hard for them to find seals, but there are the same number of seals."

"Maybe the ice in the sea is melting and the bear have no where to go. It is very noticeable, they will go to land. There are no icebergs for them to go to."

Discussion

The results for section two concerning climate change did not show any significant difference between groups of participants, suggesting all areas are experiencing similar changes in climate. There is a general consensus that the sea ice is thinner now, open water season is longer (earlier break-up and later freeze-up) and there are fewer icebergs now than in the past. As a result in the decrease in icebergs, the floe edge is closer to the land. Interview participants did not have a clear idea of how, or if, this was affecting bears.

No significant differences between groups of participants based on age or sex were detected. This may have been due to small sample size of female respondents, and the fact that young hunters were hesitant to make comments due to their lack of experience.

There was however a significant difference between communities regarding interpretation of the causes of increased polar bear damage of human goods and polar bear numbers generally. A north-south gradient existed with Pond Inlet (the most northern community) and Qikiqtarjuaq (the most southern) having different answers while Clyde River was intermediate between the two.

Most respondents (93.1%) in all communities responded that there is more damage caused by bears today than 10-15 years ago. Pond Inlet participants attributed the increased bear damage to an increased polar bear population, while the other communities did not agree as strongly that this was the cause of the increased damage. The gradient of responses to interpretive questions may represent a gradient in communications between the communities, since people from Clyde River interact with both of the other communities more than Pond Inlet and Qikiqtarjuaq interact with each other. If one or a small number of people in a small community come up with a hypothesis it might quickly spread to the community at large as well as to visitors. The variable, and at times conflicting, explanations for bear behaviour, even within the same community suggest that IQ may not converge on a single perspective, especially when there are geographical differences in experiences.

A significant difference between communities was also observed regarding the number of polar bears. Only 60% of respondents in Qikiqtarjuaq felt the bear population had increased over the past 10-15 years, compared to over 90% of respondents in the other two communities. Likewise, only 50% of respondents in Qikiqtarjuaq felt more bears are coming to town today than 10-15 years ago whereas again, over 90% of respondents in the other communities thought more bears were coming. Scientific studies on polar bears in the area offer hypotheses to explain this difference.

The Baffin Bay (BB) polar bear population borders on the Lancaster Sound (LS) polar bear population to the northwest. The boundary between LS and BB is relatively leaky compared with boundaries between other polar bear populations, such as the boundary between Baffin Bay and Davis Strait to the south (Taylor et al. 2001). The Lancaster Sound ecosystem is relatively productive (Welch et al. 1992). The LS polar bear population is well managed and productive, and could serve as a source of immigrants to Baffin Bay (Schweinsburg et al. 1982; Taylor and Lee 1995; Taylor et al. 2007). Pond Inlet hunters utilize the boundary area between BB and LS for a variety of harvesting activities, whereas Clyde River and Qikiqtarjuaq hunters spend the majority of their time in Baffin Bay only. It is possible that the Pond Inlet area is experiencing more polar bears due to changes affecting one or both populations that increase the density of polar bears in the boundary area and northern Baffin Bay.

Studies of polar bear movements in Baffin Bay also show a weak differentiation between sub-groups of bears in north and south Baffin Bay due to the currents and movement of pack ice (Dunlap and Tang 2006; Taylor et al. 2001). Changes in the environment that affected polar bears in only one of these areas would thus be noticed in the either the north or south part of the bay (by either Pond Inlet or Qikiqtarjuaq respectively), but not necessarily both. Clyde River is located near the boundary of these two groups and would likely report mixed observations of a change.

Recent studies of the ice in Baffin Bay suggest changes are occurring (Born 2005; Moore 2006; Stirling and Parkinson 2006). Stirling and Parkinson (2006) report a significant trend to earlier break-up in the sea ice of Baffin Bay between 1979 and 2004, resulting in break-up occurring roughly 2.5 weeks earlier than during the 1970s, which agrees with the observations of the participants in this study. However, Born (2005) detected a trend to earlier break-up only in the eastern (Greenland) side of the bay after 2001 and no trend from 1979 to 2001. Baffin Bay polar bears spend the summer open water season on the west side of the bay, in Nunavut (Taylor et al. 690). If the bears are suffering from climate change effects on the ice they will be forced onto land for longer periods and suffer reduced condition due to a longer fasting period in the summer and a shorter

hunting period in the spring (Stirling and Derocher 1993; Stirling and Parkinson 2006). Such a change has been observed in the polar bears of Western Hudson Bay (Aars et al. 2006), but has not yet been observed in Baffin Bay. It is expected that should such changes in condition occur, they will appear first in the Nunavut side of Baffin Bay, but Inuit observations on condition reported in this paper were mixed.

The question remains as to why many Inuit have observed more polar bears in the Baffin Bay area when population modeling suggests a decline. Stirling and Parkinson (2006) suggest more bears are in poor condition due to the trend to earlier spring break-up and thus they seek out food near humans, increasing the encounter rate between the two species. While Inuit participants in this study stated more polar bears were coming to town, the majority also stated that they felt the population had increased because of general signs of bears everywhere, not just near the community, which does not support Stirling and Parkinson's argument. Another possibility is that the scientific population estimates (Aars et al. 2006) under-represent the actual population. If that is the case the population may not be in an over-harvest situation, but might in fact be stable be growing despite the increased harvests by both Nunavut and Greenland hunters. Current scientific information and Inuit knowledge are insufficient to resolve the apparent paradox.

This study illustrates the usefulness of applying 2 analytical perspectives to better understand information provided in semi-directed interviews. The quantitative analysis revealed an important gradient in the responses of different communities regarding polar bears, while the qualitative information added context and exhibited the depth of knowledge held by the interview participants. In this study IQ was useful in developing multiple perspectives and was a very good source of information for directly observable events. Its value as a guide for the construction of further research questions, and as a review process by which scientific results may be evaluated, will become more apparent in the future.

Appendix 1 Interview Questions

Q 1. Has the polar bear population increased, decreased or stayed the same over the past 10 to 15 years?
Supplemental questions: How do you know? Why has the population increased?

Q 2. Are there more, fewer or the same number of bears coming to town now compared to 10-15 years ago?

Q 3a. Is there more, less or the same amount of damage to cabins, meat caches and other equipment? Follow up question: 3b If there is more damage, why is that?

Q 4. Is there more, less or no trend in skinniness of polar bears over the past 10-15 years?'

Q 5. Have there been any changes in the sea ice over the past 10-15 years?

Q 6. Is there any evidence of climate change in this area?

Q 7. Could climate change contribute to what you have observed about polar bears?

REFERENCES

Aars, J., N.J. Lunn and A.E. Derocher. 2006. *Polar Bears, Proceedings of the 14th Working Meeting of the IUCN/SSC Polar Bear Specialist Group*. 20-24 June 2005, Seattle, Washington, U.S.A. Gland, Switzerland and Cambridge, U.K.: IUCN.

Born, E.W. 2005. *The Catch of Polar Bears in Greenland, 1993-2004*. Report to the Federal-Provinicial-Territorial Polar Bear Technical Committee of Canada Meeting, Edmonton, Canada, 7-9th February.

Dunlop, E. and C.C.L. Tang. 2006. Modelling the mean circulation of Baffin Bay. *Atmosphere-Ocean* 44(1): 99-110.

Ferguson, M.A.D. and F. Messier. 1997. Collection and analysis of traditional ecological knowledge about a population of arctic tundra caribou. *Arctic* 50(1): 17-28.

Ferguson, M.A.D., R.G. Williamson, and F. Messier. 1998. Inuit knowledge of long-term changes in a population of Arctic tundra caribou. Arctic 51(3): 201-219.

Government of Nunavut. 2005. *Polar Bear Management Memorandum of Understanding Between Nativak HTO (Qikiqtarjuaq), Namautaq HTO (Clyde River), Mittimatalik HTO (Pond Inlet), Qikiqtaaluk Wildlife Board and the Departement of Environment for the Management of the "Baffin Bay" Polar Bear Population*. March 9th.

Huntington, H.P. 1998. Observation on the utility of the semi-directive interview for documenting traditional ecological knowledge. *Arctic* 51(3): 237-242.

Huntington, H.P., and the Communities of Buckland, Elim, Koyuk, Point Lay, and Shaktoolik. 1999. Traditional knowledge of the ecology of beluga whales (*Delphinapterus leucas*) in the Eastern Chukchi and Northern Bering Seas, Alaska. Arctic. 52(1): 49-61

Keith, D. 2005. *Inuit Qaujimaningit Nanurnut/Inuit Knowledge of Polar Bears*. Edmonton: Canadian Circumpolar Institute.

Krupnik, I. and D. Jolly, eds. 2002. The Earth is Faster Now: Indigenous Observations of Arctic Environmental Change. Fairbanks, Alaska: Arctic Research Consortium of the United States.

Moore, G.W.K. 2006. Reduction in seasonal sea ice conditions surrounding southern Baffin Island 1979-2004. *Geophysical Research Letters* 33: L20501.

Omura, K. 2005. Science against modern science: The socio-political construction of otherness in Inuit TEK (Traditional Ecological Knowledge). In Kishigami, N., and Savelle, J.M. eds. Indigenous use and management of marine resources. Senri Ethnological Studies 67. Osaka, Japan: National Museum of Ethnology. 323-344.

Schliebe, S. Ø. Wiig, A. Derocher, and N. Lunn. 2006. *Ursus maritimus*. In: IUCN 2006. *2006 IUCN Red List of Threatened Species.* <www.iucnredlist.org>. Downloaded on 07 January 2007.

Schweinsburg, R.E., L.J. Lee and P.B. Latour. 1982. Distribution, movement and abundance of polar bears in Lancaster Sound, Northwest Territories. *Arctic* 35(1): 159-169.

Stirling, I. and A. Derocher. 1993. Possible impacts of climatic warming on polar bears. *Arctic* 46(3): 240-245.

Stirling I., and C.L. Parkinson. 2006. Possible effects of climate warming on selected populations of polar bears (*Ursus maritimus*) in the Canadian arctic. *Arctic* 59(3): 261-275.

Stirling, I., N. J. Lunn and J. Iacozza. 1999. Long-term trends in the population ecology of polar bears in Western Hudson Bay in relation to climate change. *Arctic*. 52(3): 294-306.

Taylor, M.K. and J. Lee. 1995. Distribution and abundance of Canadian polar bear populations: a management perspective. *Arctic* 48(2): 147-154.

Taylor, M.K., S. Akeeaguk, D. Andriashek, W. Barbour, E.W. Born, W. Calvert, H. D. Cluff, S. Ferguson, J. Laake, A. Rosing-Asvid, I. Stirling and F. Messier. 2001. Delineating Canadian and Greenland polar bear (*Ursus maritimus*) populations by cluster analysis of movements. *Canadian Journal of Zoology* 79: 690-709.

Taylor, M.K., J. Laake, P.D. McLoughlin, E.W. Born, H.D. Cluff, S.H. Ferguson, A. Rosing-Asvid, R. Schweinsburg and F. Messier. 2005 Demography and viability of a hunted population of polar bears. *Arctic* 58(2): 203-214.

Taylor, M.K., J. Laake, P.D. McLoughlin, H.D. Cluff, F. Messier. 2007. Population ecology of polar bears in Lancaster Sound and Norwegian Bay. *Journal of Wildlife Management* in press.

Usher, P.J. 1999. Traditional Ecological Knowledge in environmental assessment and management. *Arctic* 53(2):183-193.

Van de Velde, F., I. Stirling and E. Richardson. 2003. Polar bear (*Ursus maritimus*) denning in the area of the Simpson Peninsula, Nunavut. *Arctic* 56(2): 191-197.

Welch, H.E., M.A. Bergmann, T.D. Siferd, K.A. Martin, M.F. Curtis, R.E. Crawford, R.J. Conover and H. Hop. 1992. Energy flow through the marine ecosystem of the Lancaster Sound Region, Arctic Canada. *Arctic* 45:343-357.

Wenzel, G.W. 1983. Inuit and polar bears: cultural observations from a hunt near Resolute Bay, N.W.T. *Arctic* 36(1):90-95.

Wenzel, G.W. 1999 Traditional Ecological Knowledge and Inuit: reflections on TEK research and ethics. *Arctic* 52(2): 113-124.

Wenzel, G.W. 2004 From TEK to IQ: *Inuit Qaujimajatuqangit* and Inuit cultural ecology. *Arctic Anthropology* 41(2):238-250.