Inuit Qaujimajatuqangit of Climate Change in Nunavut 2005

A Sample of Inuit Experiences of Recent Climate and Environmental Changes in

Pangnirtung and Iqaluit, Nunavut

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Executive Summary

In 2001-2003, the Department of Environment (formerly the Dept. of Sustainable Development) Government of Nunavut, initiated a multi-phase project to gather information on climate change across Nunavut and completed a report on Inuit Qaujimajatuqangit of Climate Change in Nunavut.

This report covers information collected from the South Baffin Region and includes comments and insights from the individuals of the communities of Iqaluit and Pangnirtung, so as to provide examples of experiences from people of the South Baffin region. Ten interviews were conducted in each community, in Inuktitut and tape recorded, using a semi-directed interview method. Tape recordings were transcribed into English and observations made by the participants were tabulated and analyzed for each community and also in comparison to the other community.

The majority of interviews used for this summary of observations from the South Baffin were provided by the Department of Environment from work completed in Iqaluit and Pangnirtung by a separate contractor, in January to March of 2002. The recordings and transcripts were provided to Nikittuittuq Ltd. In October 2002, to review, compile and analyze as part of a report on the North Baffin region already being completed simultaneously.

Due to the result of small sampling, no direct conclusions about Inuit observations of climate change can be made with the information collected. However, the study does conclude that Inuit observations provide valuable information to offer to any future studies of climate change. Inuit observations and knowledge of climate and environmental changes in Nunavut should be explored further with communities.

Through the scientific work done by others and through community research, it has become clear that the Arctic climate and environment is changing and it is important to understand that the recorded changes are not uniform between communities. In this report, there are particular observations regarding climate and environmental changes between the two communities that could be coincidental but there are noted phenomena observed by the majority of participants in the communities of Iqaliut and Pangnirtung.

Similar observations pertaining to snow accumulation, sea ice, weather, and winds are recorded in both communities but other observations, such as those related to land changes, wildlife, vegetation, season, or insects, no indication of a common experience between the two communities, and in some cases, within the communities themselves are noted.

The collection of Inuit Qaujimajatuqangit for this report is reflected in a variety of specific terms and observations. For example, a question regarding snow, posed to twenty participants in the South Baffin Study, resulted in 9 detailed observations plus numerous other references relating to other indicators. Specifically, observations about snow, related to less snowfall, less accumulation of deep snow, harder snow, change in the properties of snow, snow melting earlier and quicker, less snow cover, different snow formation, snow arriving later and more avalanches in the past. In Iqaluit seven participants observed less snowfall and less accumulation of deep snow while only one Pangnirtung resident observed less snowfall. However, 9 participants from Pangnirtung observed that there was less snow cover while no one from Iqaluit made this observation. We were unable to clarify if “less deep snow” in Iqaluit meant the same as “less snow cover” in Pangnirtung. The information has been recorded as it has been translated and the similarities and differences in observations are interesting.

The Department is encouraged to continue the collection of observations of *Inuit Qaujimajatuqangit* within Nunavut communities by developing a more collaborative and comprehensive approach with each community in Nunavut and by allowing the interview to focus on the key observations and concerns of individual communities.

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Acknowledgements

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Nikittuittuq Ltd. Of Clyde River, with consultation from Shari Fox (University of Colorado, Boulder City), was contracted by the Department to complete the report for the South Baffin.

We would like to thank our Interpreter, Joelie Sanguya and our translators, Joelie Sanguya and Gary Aipellee who assisted in the arduous task of transcribing the interviews.

1.0 Introduction

In September 2001, the Government of Nunavut, through the Department of Environment's Environmental Protection Services, released the first of three regional reports on 'Inuit Knowledge of Climate Change'. The first report focused on the communities of Baker Lake and Arviat, presenting a sample of Inuit experiences from the Kivalliq Region of Nunavut. This report is the second in the series and provides examples of Inuit observations of recent climate and environmental changes from communities in the South and North Baffin Regions. (North Baffin report prepared as a separate document).

This series of reports was completed in order to further the planning, development and implementation of Nunavut's 'Climate Change Strategy'. This Strategy parallel's Canada's 'National Implementation Strategy on Climate Change' and is guided by the following five themes:

- Encouraging Action
- Promoting Technology Development and Innovation
- Enhance Awareness and Understanding
- Government Leading by Example
- Investing in Knowledge and Building a Foundation

Under the theme 'Investing in Knowledge and Building a Foundation', the Department of Environment collected and documented *Inuit Qaujimajatuqangit* of climate change. The Arctic has been a focal point for scientific research on climate change for some time and recent research has focused on the cause and effects of climate change. The Arctic is a special case, because of its unique sensitivity, it is likely to experience impacts of climate change first, and potentially much more severely than other regions in the world.

Inuit have been noticing evidence of recent Arctic climate and environmental changes. Until recently, their knowledge has not been included in most studies of Arctic environmental and climate change. Their long-time knowledge and experience on the land makes them excellent observers of the environment and interpreters of how it is changing. Further, they may be best suited to help understand the impacts these changes may have on Arctic ecosystems and people.

In order to develop a Climate Change Strategy for Nunavut, there was a need to build and strengthen our knowledge base on climate and climate change in the north. *Inuit Qaujimajatuqangit* is an important part of this effort. Inuit knowledge will supplement and enhance scientific research, as well as provide important context regarding how climate change is observed and experienced at the community level and how communities and individuals in Nunavut may best deal with present and potential impacts of climate change.

2.0 Objectives

The objective of this study was to record *Inuit Qaujimajatuqangit* of climate change in the South Baffin Island communities of Iqaluit and Pangnirtung.

Specifically, the study was intended to collect information about:

- Whether or not climate change is occurring;
- First-hand experiences of climate change; and
- The impacts of climate change on Nunavummiut.

The personal experiences of climate change recorded for this report were meant to provide a sample of Inuit experiences of climate change in Nunavut to aid in the development of the Nunavut Climate Change Strategy. It is important to note that these are only samples and cannot be representative of entire communities or Nunavut as a whole.

3.0 Information Collection and Background

3.1 Report Background

The majority of interviews used for this summary of the South Baffin were provided by the Department of Environment from work completed in Iqaluit and Pangnirtung, by a separate contractor. In January to March of 2002, the recordings and transcripts were provided to Nikittuittuq Ltd. In October 2002, they were provided to review and analyze as part of the North Baffin work being completed. Details of the North Baffin Study are included under a separate report.

3.2 Semi-Directed Interviews – South Baffin

The main method used for collecting Inuit knowledge and observations related to climate change was the semi-directed interview. This style of interviewing involves using an interview guide to help the interviewer move through certain topics. In some cases, a participant's answer can lead to discussions on other subjects – both within and outside of the interview topic. In this report, we included only information related to climate and environmental change.

Information for South Baffin, represented by the communities of Pangnirtung and Iqaluit, was provided by the Department of Environment. The Department provided transcripts of six interviews in Pangnirtung, and 10 interviews in Iqaluit.

Additional information was needed in Pangnirtung and Joelie Sanguya of Nikittuittuq Ltd. conducted four additional interviews in October 2002.

3.3 Limitations to Review and Summary

Although Nikittuittuq Ltd. confirmed the recordings and transcripts, it is important to note that another firm conducted the Iqaluit and the majority of the Pangnirtung interviews; therefore Nikittuittuq did not have control over the methods used in those interviews. Associated with this is the inability to clarify the information being provided by the participant, particularly in the use of specific Inuktitut terms and phrases describing environmental and seasonal conditions, in the identification of locations and in the differences in vocabulary.

The information analyzed is mainly what an individual is reporting as his or her own observation and experience. For example, observations reported, as "what I have heard" are not included in this summary. It is also important to note that the participants have their own land use history and their observations are specific to their experiences in a certain area while others may have moved throughout an area and have not maintained a permanent residence.

3.4 Literature Review

A bibliography of the literature review for this report is found in Appendix A. Sources documented are only those that directly address Inuit knowledge of climate change. Other subjects (e.g. traditional ecological knowledge, environmental knowledge of other groups, Arctic climate change, etc.) are beyond the scope of this report. While Inuit knowledge of climate change has only been investigated within the last decade, a number of useful studies have documented Inuit observations across the Canadian Arctic and/or discussed the present and potential impacts of climate change on Inuit activities and well being.

3.5 Glossary

Inuktitut terms for phenomena related to climate change were collected from interviews and identified within the body of the document along with their definitions. Events, processes and environmental characteristics related to environmental change were often described and associated with an Inuktitut

term. These terms are throughout the text, in italics, and are defined as:

Anuivak	permanent snow patches that remain all year
Pukajaaq	snow crystals under the snow
Qiqsuqqaqtug	a thin melt layer forms on the surface of the snow in spring and re-freezes at night. This means to form a crust.
Natiruviaq	a very low snow cover that is moving across the ground by wind

4.0 Interviews

The semi-directed interviews were reviewed for first-hand observations of climate change indicators. Transcripts of each interview were read and each response was 'coded' by categorizing the information. For example, a response may contain information about changing wind patterns. This response would be categorized with the code, 'wind' and the specific information recorded. Specific information may also result in further coding, for example, 'changing wind direction'. Exact quotes that contained information explaining an indicator were recorded and used in the Discussion Section (of each community) to illustrate individual observations and knowledge (organized by topic). Interviews were kept together in their original communities so that information with the same code could be grouped together. This helped to create the 'Observed Indicators' tables (Tables 1, 2 and 3). The topics (indicators) in the tables were created from the information contained in the interviews themselves.

4.1 Summary of Observations

Table 1 summarizes the observations noted in Pangnirtung and Iqaluit.

Indicator	Observation	Iqaluit	Pang
		n=10	n=10
Snow			
	Less snowfall	7	1
	Less accumulation of deep soft snow	7	
	Snow harder	3	4
	Change in properties	3	
	Snow melts earlier and quicker		3
	Less snow cover		9
	Snow formation different		3
	Snow comes later		1
	More avalanches in past	1	
Blizzards and Storms			
	Snowfalls are less in duration	1	
	Less blizzard	7	
	More blizzards		1
Land and Permafrost			
	Land drier than usual	1	
	Areas that are usually boggy are drier	1	1
	Some slumping due to more rain	1	
	Beaches have changed		1
	Permafrost melting		3

Indicator	Observation	Iqaluit	Pang
		n=10	n=10
	Landslides due to permafrost melting		2
Glaciers			
	Melting/receding/smaller/less	4	3
Anuivat (snow patches that remain all year)			
	Disappearing	4	
Weather			
	Increased variability	3	5
	Unpredictable	2	5
	Less "bad weather"/more calm and fair	2	1
	Less storms in 2002	1	
	More lightning	4	
	Less thunderstorms/lightning	1	1
	More rain	3	
	Rain in winter	2	
	Rainier in past/less rain	1	2
	No longer ice fog	2	
	Warmer (overall)/used to be colder		2
Wildlife			
	More hooded seals	2	
	Harp seals staying all year	1	
	No more schools of cod seen in last few years	1	
	Hard to find seals in 2002	1	
	Fish went up river earlier in 2001 due to the amount of rainy days	1	
	Small birds that sift through beach, never seen before	1	
	More birds in fall	1	
	Ducks move inward to bay	1	
	More seabirds, especially eider ducks	1	
	Gulls over-winter (new)	1	
	New species of birds in summer	1	
	Less seals		2
	Seals skinnier		2
	Seal skins seem to be unusual colour in fall – skins have different texture		2
	Unusual bird sightings		4
	More loons		1
	Birds arrive earlier		1
	Birds that stay and don't migrate		2
	Some birds staying later		1
	Some fish taste different		1
	Less fish		1
	Change in fish		1
	Caribou thinner this summer due to lack of rain		1
	Caribou thinner		1
	Ptarmigan thinner		1

Indicator	Observation	Iqaluit	Pang
		n=10	n=10
	Unusual tissue on caribou lungs and unusual conditions of ligaments		1
	Caribou seem sicker, lots of caribou found dead from natural causes		1
	Rabbits are fatter		1
Sea Ice			
	Thinner	3	6
	Less multi-year ice pans	1	
	Uniform thickness of 1ft. last few years	1	
	Forming unusually late	6	7
	Formed normally in 2002	2	1
	Melting earlier approx.. last 3-5 years and quicker	6	7
	Colour in spring is whiter, not bluish		1
	Forms differently/break up different		3
	Sea ice softer		4
	Sea ice is rougher		3
	More packed ice, crumbled		1
Seasons			
Overall	Changed timing		2
Winter	Winter temperatures rising	4	
	Winter temperatures colder	3	
	Winter temps colder and moister	1	
	Shorter winter	1	4
	Winters less stormy	1	
	More ice fog in past		1
Spring	Warmer spring	1	
	Spring warmer in past/colder now		1
	Faster spring melt	5	2
	Spring comes earlier	2	2
	Spring longer	1	
	Spring shorter		1
Summer	Summer longer	2	3
	Summers hotter	3	2
	Summers more humid		
Fall	Longer open water season	5	
	Fall comes later	4	
	Fall longer		2
	Fall not as cold		2
Vegetation			
	Plants not ripening	1	
	Not growing as fast	1	
	New plants	1	2
	Plants growing taller and faster	2	1
	More flowers	1	
	Dandelions now	1	

Indicator	Observation	Iqaluit	Pang
		n=10	n=10
	Berries more sparse	2	
	Berries plentiful this year		2
	Plants and berries same		2
Lakes and Rivers			
	Seem to overflow more/more spring melt	2	1
	Lakes freeze later	3	
	Lake ice thinner	5	3
	Lakes melt earlier	1	2
	Water levels dropping	2	1
	Small lakes and ponds that used to form after spring melt disappearing	1	3
	Lake ice the same/thickness the same		4
	Rivers flow differently		1
	More lakes that have sediment and silt, more algae in small lakes		1
	Lake ice open longer		1
	Lake ice is softer		2
Winds			
	Getting stronger	2	1
	Winds more unpredictable	4	2
	Shift more	2	
	Winds weakened	1	1
	More frequent winter	1	
	More frequent spring	1	
	More frequent in general	1	3
	Shifted dominant direction	1	1
	Strong in fall	1	1
Insects			
	Less mosquitoes	3	
	Different types of bees observed	1	
	New insects affecting caribou	1	
	Warble fly population exploding	1	
	Insects same		2
	More insects		1
Tides			
	High tide higher	1	
	Low tide further out	1	
	Tidal area now dries out completely	1	
	Areas that used to be bare no longer showing at low tide (during neap tide)	1	1
	Tidal pools get warm		1
Floe edge			
	Closer to town last few years	3	2
	Further down the bay	1	

Indicator	Observation	Iqaluit	Pang
		n=10	n=10
	Floe edge same		1
	Not in right spot due to shearing		2
Sun			
	Sun is warmer/stronger/brighter	2	6
	Stronger sun is burning pelts and animals do not bask in the sun (e.g. seals)		1
Health			
	Warmer temperatures make it hard to breathe (not really meaning change, just an observation)		1

We suggest that the greater the number of people who discuss a particular indicator, the greater importance this phenomenon may have in the community, or the more widespread the phenomenon might be. However, observations of individual participants are extremely valuable. These observations are especially important if the individual is discussing a certain area outside the community, for example, in a location where other participants might not be familiar with the local climate and environment. While the indicator tables are useful to gain an overall view of the participants' observations, each interview should be considered in the context of the individual – every person has his or her own history, experiences on the land, methods of observing and concerns about the environment.

For reporting purposes, the focus will be observations and experiences reported by most of the participants under each category of indicator in the Discussion section in both communities.

5.0 South Baffin

This South Baffin report includes observations from the communities of Iqaluit and Pangnirtung.

Each participant in the interviews had their own observations and experiences of climate and environmental changes in their community and in the areas they travel on the land. Taken together, there are some patterns that can be seen in the types of indicators that have been noticed. These patterns can be seen by reviewing and comparing the Observed Indicators Tables which show the numbers of people that had information to share about a particular topic. In the section, quotes are used to help illustrate the details of these topics and how some Inuit have dealt with the impacts of climate and environmental changes.

5.1 Observations - Iqaluit

Iqaluit is located in the mouth of Frobisher Bay at the south of Baffin Island. The land surrounding the community has a gentle rolling topography and people can travel great distances by boat or over land for recreational pursuits and subsistence hunting.

Table 2: Observed Indicators for Iqaluit

Indicators (Iqaluit)	# of participants who observed this phenomenon (n=10)
Snow	
Less snowfall	7
Less accumulation of deep soft snow	7
Snow harder	3
Snowfalls are less in duration	1
Change in properties	2
Blizzards and Storms	
Less blizzards	7
Land	
Land drier than usual	1
Areas usually boggy area drier	1
Some slumping due to more rain	1
More avalanches in past	1
Glaciers	
Receding	2
Smaller	1
Less	1
Anuivat (Permanent snow patches that remain all year)	
Disappearing	4

Indicators (Iqaluit)	# of participants who observed this phenomenon (n=10)
Weather	
Increased variability	3
Unpredictable	2
Less “bad weather”	1
Used to be more fair	1
Less storms in 2002	1
More lightning	4
Less thunderstorms	1
More rain	3
Rain in winter	1
Rainier in past	1
No longer any ice fog	2
Wildlife	
More hooded seals	2
Harp seals staying all year	1
No more schools of cod seen in last few years	1
Hard to find seals in 2002	1

Indicators (Iqaluit)	# of participants who observed this phenomenon (n=10)
Fish went up river earlier in 2001 due to the amount of rainy days	1
Small birds that sift through beach, never seen before	1
More birds in fall	1
Ducks move inward to bay	1
More seabirds, especially eider ducks	1
Gulls over-winter (new)	1
New species of birds in summer	1
Sea Ice	
Thinner	3
Less multi-year ice pans	1
Uniform thickness of 1ft. last few years	1
Forming unusually late	6
Formed normally in 2002	2
Melting earlier approx. last 3-5 years	6
Seasons	
Winter temperatures rising	4
Winter temperatures colder	3
Winter temps colder and moister	1
Short winter	1
Winters less stormy	1
Warmer spring	1
Faster spring melt	5
Spring comes earlier	2
Spring longer	1
Summer longer	2
Summers hotter	3
Summers more humid	
Longer open water season	5
Fall comes later	4
Vegetation	
Plants no ripening	1
Not growing as fast	1

Indicators (Iqaluit)	# of participants who observed this phenomenon (n=10)
New small plant with red flowers observed	1
Plants growing taller and faster	2
More flowers	1
Dandelions now	1
Berries more sparse	2
Lakes and Rivers	
Seem to overflow more	2
Lakes freeze later	3
Lake ice thinner	5
Lakes melt earlier	1
Water levels dropping	2
Small lakes and ponds that used to form after spring melt disappearing	1
Winds	
Getting stronger	2
Winds more unpredictable	4
Shift more	2
Winds weakened	1
More frequent winter	1
More frequent spring	1
More frequent in general	1
Shifted dominant direction	1
Strong in fall	1
Insects	
Fewer mosquitos	3
Different types of bees observed	1
New insects affecting caribou	1
Warble fly population exploding	1
Tides	
High tide higher	1
Low tide further out	1
Tidal area now dries out completely	1

Indicators (Iqaluit)	# of participants who observed this phenomenon (n=10)
Areas that used to be bare no longer showing at low tide (during neap tide)	1
Floe edge	
Closer to town last few years	3
Further down the bay	1
Sun	
Feels hotter	2

5.1.1 Discussions

The following section discusses the findings for each section as identified in the Iqaluit Indictors Table.

5.1.1.1 Sea Ice

Another topic that was discussed by the majority of participants was changes in sea ice. Of these changes, the two most common observations were; sea ice forming unusually late, and sea ice melting/ breaking up earlier. In the case of earlier sea ice break-up and melt, this change seems to have been noticed in the last 3-5 years, though two participants made it a point to note that the ice did form normally in 2002.

> "(Sea ice) has really changed, big time. I recall (in my youth) that the ice never used to go out until July. Then the ice would soon reform within a matter of two months. It used to get cold quite early even before November. I recall that we would have ice, really thick ice by November. Usually, but the first week of November, the ice was unseable and we could go places. There would be quite a bit of snow on the ground, prior to the ice freezing over. Now, these days, the ice does not form until December and I think that we are all aware that the ice is forming later each year, those of us who grew up in Iqaluit" (Johnny Nowdlak, March, 2002).

> "Sometimes the ice would not melt away until late summer, other years it would melt a little earlier, always within the time frame identified by the elders. It used to melt off in July and sometimes in late July here in Iqaluit when we first came here. Other years sometimes it reached into August. I recall one year where it did just that. The ice left in august that year, but nowadays, these last few years, the ice is no longer staying to June even. These days now some families are bringing their boats as the ice now stays only for a short time and then leaves" (Henry Boaz, March, 2002).

A smaller number of people interviewed have noticed the sea ice is thinner, though it is not clear if this is overall or in certain areas. Also, one participant pointed out that there are less multi-year ice pans and another that the ice seems that have been of a uniform thickness of one foot in the last few years, again, the locations are unclear.

5.1.1.2 Snow

Snow was an important point of discussion for many of the participants from Iqaluit. While there were a number of observations, the majority of people have observed less snowfall and less accumulation of snow, particularly deep soft snow.

> "Most of the areas that we use for our travel are not as useable and due to the lack of snow, they are not really navigable. It has really affected some of the hunters as the lack of snow is hindering the harvesters. Although we would want to go hunting inland, it was getting tiresome waiting for the snow to arrive so that we could use our snow machines to go hunting with. It was quite an unnerving experience especially since this is so unusual to not have snow on the ground for weeks at a time" (Mosesee Tiglik, March, 2002).

> "The snow is really hard now. Although it would not seem to be hard, it would still be all drift snow. And, the snow crystals you would expect to find under this snow, pukajaaq there seems to be no more occurrences anymore. Perhaps this is due to the wind. Although we find some crystals,

> they are not the same. Generally, you find them in areas where there is some wind, but also some protection. There is hardly any more pukajak snow" (Simeonie Kownirq, March 2002).

Along with less snowfall, the majority of participants noted that there are fewer blizzards and they distinguished between the types of blizzards and storms that occur today with the 'real' blizzards of the past.

> "I have noticed the changes and especially this last year. It has not really snowed at all this year. In that I mean a real snowstorm and we have yet to experience a blizzard this winter. There are reports of blizzards on the radio, but that is only "natiruviaq", a small blizzard, not a real one" (Mosesee Joamie, February, 2002)

Changes in snow properties were also observed. For example, the process of 'qiqsuqqaqtuq' does not occur anymore. Usually in this process, a thin melt layer that forms on the surface of the snow in spring re-freezes at night – qiqsuqqaqtuq is not happening anymore according to Elaiya Mike (March, 2001). Also, several people have been noticing that the snow is harder than it used to be in the past.

5.1.1.3 Weather

About half of the participants in Iqaluit agreed that there is an increase in weather variability and/or the weather is unpredictable. As in other Nunavut communities, the unpredictability of the weather has caused some problems for Inuit who have always followed weather patterns and have been able to predict the weather using traditional skills.

> "It is getting more unpredictable as to what will happen; because the signs are misleading the Inuit who are used to weather that follows these signs' (Sytukie Joamie, March, 2002).

Other changes in weather include more lightning and more rain at present, though one person did observe that there was more rain in the past.

> "…perhaps 1975, there was a lightning storm that I experienced for the first time further down the bay…nowadays, there are lightning storms every summer down the bay" (Sytukie Joamie, March, 2002).

> "We now get these really rainy days that are just like the southern showers that we experience down south. These rains stem from heavy, deep, dark clouds that hold a lot of rain and it is just as strong as down south. We never used to get those kinds of storms, where there was so much rain that everything is covered with water. These storms also produce the occasional thunder and lightning storm" (Johnny Nowdlak, March, 2002).

Though considered an indicator for a number of phenomena other than weather (e.g. changes in temperature, wind, etc.) changes in the incidence of ice fog was also observed.

> "…in the winter, you used to see the ice fog that would form when it got really cold, past –40C. That is what does not occur as much. It used to be common from January and February. Whenever the wind dies down, the cold would produce ice fog. It never gets that cold in Iqaluit anymore, not for the long stretches that it used to" (Johnny Nowdlak, March, 2002).

5.1.1.4 Aniuvat

Permanent snow patches that remain in the hills around Iqaluit all year are one of the indicators that Inuit use to monitor environmental changes. In recent years, these permanent snow patches have reduced in size.

> "It is a lot warmer now and these aniuvat are long gone prior to summer. They used to remain all summer, but they melt now and you can see where the old aniuvat used to be, because those sites are bare of vegetation and they are lighter than the surrounding area. They melt completely now" (Johnny Nowdlak, March, 2002).

5.1.1.5 Seasons

Participants in Iqaluit noted a number of changes in seasonal characteristics of the climate and environment. Of these, the majority claimed that they have been observing earlier spring melt and a longer open water season in recent years. Earlier

spring melt has implications for travel and has been a problem for some people who rely on snowmobile travel, yet an advantage for people who own boats. The same is the case with a longer open water season which is partly due to earlier breakup and earlier spring conditions, as well as the fall season with freeze up taking longer to set in.

> "We are experiencing very short springs where the snow melts right away. This affects our ability to hunt in the spring with snowmobiles. Before, we used to be able to snowmobile on the land and ice until late spring around late June. Nowadays, the ice is always melting and we cannot go camping for as long as we want" (Elaiya Mike, March, 2002).

> "It is very obvious that spring is a lot earlier than before. The month of April is one where I can cite an example of the changes, perhaps by many other Inuit. The month is generally used for the Toonik Time spring festivities. It was towards the end of the month when the festivities were held prior to the new century, but these last few years, due to earlier spring, the festivities have to be moved up by two weeks" (Jacapoosie Peter, March, 2002).

> "Back then, snow would not melt until late June, but today snow melts way earlier. As a matter of fact, the ice is late and we can boat until the end of November, even me, I went boating during this period. If this were the old days, we would not need a boat at that time. As a matter of fact, these last couple years we have been boating until the end of November and even into December, Inuit were still boating around in the bay hunting seals…I guess there are drawbacks, but for the Inuit who like boating, it is right up their alley. It is beneficial to them. But the people who do not have boats are affected in that they cannot go hunting until the ice forms" (Situkie Joamie, March, 2002).

As noted above, seasons seemed to have changed in their duration. Both spring and summer feel warmer and last longer, "feels like summer already during springtime, during what we traditionally call spring…" (Henry Boaz, March 3, 2002). Winter too seems to have changed, but there is disagreement among the participants exactly how it has changed. Four of 10 participants note that winter temperatures seem to be rising. However, almost as many (three) have observed that winter temperatures are colder.

5.1.1.6 Wildlife

Of the 10 participants in the Iqaluit set of interviews, there were no patterns of consensus in animal changes. Table 2 lists a number of individual observations, however, including:

- more hooded seals
- harp seals staying all year
- no more schools of cod seen in the last few years
- difficulty in findings seals in 2002
- fish went up river earlier in 2001 due to (increased) amount of rainy days
- small birds that shift through the beach seen that had never been seen before
- more birds in fall
- ducks move inwards towards the bay (unclear when and where)
- more seabirds (especially eider ducks)
- gulls over-winter now
- new species of birds in summer

5.1.1.7 Lakes and Rivers

In Iqaluit, fishing is a popular activity. As a result, many of the residents are familiar with the history and characteristics of nearby lakes and rivers. The majority of participants in this report have noticed lake ice is thinner in recent years and several have also observed that lakes freeze later than usual.

> "The ice thickness has changed. I do not go out as much as before, so I can only tell you what I have heard from those who are still fishing in the winter. From their words, the ice is way thinner than the normal levels. When we used to fish the lakes for food, when we were chipping away at the ice, sometimes it would be over our heads. That is how thick it was. Luckily, no one ever drowned in one of the holes. It used to be really

thick in those days when all we had were hand chippers. As well, when we lived in a camp near Kimmirut, the ice used to be really thick. Up there, the Inuit living in the shadows apparently required steps to climb out of the holes they were chipping for their nets. That is how thick they were" (Henry Boaz, March, 2002).

"The lakes and rivers are starting to get mushy earlier and they become impassable in only a few days. Even before the traditional time of ice melting, the ice is getting dangerous to traverse. The lakes have thinner ice and does not hang around. These days the ice metls earlier and becomes crystallized way earlier where you cannot stand on it" (Elaiya Mike, March, 2002).
"(Lakes) seem to be freezing later and every year as the weather seems to be stuck on fall for a long time. That is what I know because when the time has reached the traditional freezing period, the lakes would freeze. These last few years the lakes have not frozen at the usual time because the weather has not been normal" (Simeonie Kownirq, March 2, 2002).

"The ice formation timing has changed dramatically. Nowadays, in what would traditionally have been early winter, there was still no frost on the ground of water bodies (bodies of water). It was not until later on that we were able to see the water freezing over in the creeks and rivers. Usually, the ice forms immediately in the fall in the shallow creeks and lakes, but they did not freeze over until close to the new year" (Mosesee Tiglik, March, 2002).

Other changes in lakes and rivers seem to be related to changes in seasons – particularly spring and summer. For example, participants have observed that some rivers they are familiar with seem to overflow more and this is related to the sudden spring melt of recent years. One participant noted that lake ice seems to melt earlier and a few others have observed that water levels in lakes and rivers has dropped with some small ponds that used to form after spring melt disappearing altogether.

5.1.1.8 Wind

No consensus could be reached on the changes in the direction of the wind and in most cases showed conflicting observations, but each of the observations did in fact say that there was a change in the direction.

Four people mentioned that winds are more unpredictable now than in the past.

"The weather seems to be a little less sure, but all I can say is that the weather always changes and is unpredictable year to year, because some days, some seasons and years do not behave exactly as the years before them" (Henry Boas, March, 2002).
"…the upcoming wind is harder to predict and the fact that the winds are now not as steady in their direction is noticeable, such as the fact that the winds are now very shifty and continually move" (Sytukie Joamie, March, 2002).

"…every time I go along on a trip, I am scared of the wind because I do not know from when it will come now" (Jimmy Koomarjuk, March, 2002).

"Nowadays we are getting wind from everywhere. The winds are shifty and constantly changing their point of origin. The weather signs point towards a clear calm day, but the winds suddenly whips up and that is how it seems to operate in this day and age" (Elaiya Mike, March, 2002).

5.1.1.9 Other

The remaining topics as identified in Table 2 by Iqaluit participants have been listed here and although noted from the interviews, may have:

- only been mentioned by one or two people;
- mentioned with no discussion;
- or were topics that showed conflicting observations.

These topics are land (permafrost), glaciers, insects, tides, floe edge and sun.

5.2 Pangnirtung

Pangnirtung is a marine community located in the Pangnirtung Fiord, whose water contributes to Cumberland Sound. It is a mountainous region, with peaks reaching 2200 meters on the Cumberland Peninsula.

The population of the community is approximately 1,300 and marine life has played an important role in the past and present history of Pangnirtung.

Table 3: Observed Indicators for Pangnirtung

Indicators (Pangnirtung)	# of participants who observed this phenomenon (n=10)
Sea Ice	
Forms later	7
Years of 2001-2002 normal	1
Breaks up earlier	6
Sea ice leaves suddenly	1
Colour in spring is whiter, not bluish	1
Forms differently due to warmer temperatures	1
Sea ice softer	4
Sea ice is rougher probably from winds and currents	3 2
Sea ice thinner	6
Breaks up differently	1
Forms differently	1
More packed ice, crumbled	1
Snow	
Melts earlier	2
Snow melts quicker	1
Snow is harder (observed in travel and making igloos)	3
Hard to build igloos, snow layers inconsistent	1
More blizzards	1
Less snow on ground	7
Less snow on sea ice	2
Snow sounds different now when you walk on it	1
Snow formation different	1
Snow formed by wind different	1
Less snow falling	1
Snow arrives at a later time	1
Tides	
Tidal pools get warm	1
Neap tide is stronger than usual	1
Wildlife	
Less seals	2
Seals skinnier	2
Seal skins seem to be unusual colour in fall – skins have different texture	2
Unusual bird sightings	4
More loons	1
Birds arrive earlier	1
Birds that stay and don't migrate	2
Some birds staying later	1
Some fish taste different	1
Less fish	1
Fish change	1
Caribou thinner this summer due to lack of rain	1
Caribou thinner	1

Indicators (Pangnirtung)	# of participants who observed this phenomenon (n=10)
Ptarmigan thinner	1
Unusual tissue on caribou lungs and unusual conditions of ligaments	1
Caribou seem more sick, lots of caribou found dead from natural causes	1
Rabbits are fatter	1
Seasons	
Warmer in summer	2
Changed timing	2
Spring/summer arrives too early	1
Spring earlier	1
Spring melt quicker	2
Cold period of winter shorter (only Jan and Feb really cold)	4
More ice fog in past	1
Spring shorter	1
Spring warmer in past	1
Summer longer	3
Fall longer	2
Fall not as cold	2
Sun	
Sun is warmer	4
Sun stronger	1
Stronger sun is burning pelts and animals do not bask in the sun (e.g. seals)	1
Sun in brighter	1
Weather	
Difficult to predict weather now	5
Increased variability	5
Weather in past more calm	1
Winds	
Less strong winds	1
Winds stronger	1
Used to get more north winds, now more south	1
Change direction more frequently	2
Winds more unpredictable	3

Indicators (Pangnirtung)	# of participants who observed this phenomenon (n=10)
Windier	1
Windier in fall	
Lakes and Rivers	
Lake ice same	2
Lake ice melts earlier	2
Lake ice thinner	3
Lake ice thickness same	2
Rivers flow differently	1
Less water in rivers recently	1
Small lakes have dried up	3
Smaller lakes and rivers overburdened die to faster spring melt	1
More lakes that have sediment and silt, more algae in small lakes	1
Lake ice open longer	1
Lake ice is softer	2
Glaciers	
Glaciers melting	3
Vegetation	
Berries plentiful this year	2
Berries same	1
Plants grow bigger	1
Plants same	1
New species of plants	2
Temperature	
Used to be colder	1
Warmer (overall)	1
Rain	
Lack of rain recently	1
More rain than in the past	1
Lightning	
Less lightning in spring	1
Lightning same	1
Floe edge	
Floe edge same	1
Floe edge closer to community	2
Not in right spot due to shearing	2
Land and permafrost	
Beaches have changed	1

Indicators (Pangnirtung)	# of participants who observed this phenomenon (n=10)
Permafrost melting	3
Landslides due to permafrost melting	2
Wetlands drying out	1
Insects	
Insects same	2
Increase in insects	1
Health	
Warmer temps make it hard to breathe (not really meaning change, just an observation)	1

5.2.1 Discussion

5.2.1.1 Sea Ice

Of all the topics discussed by participants in Pangnirtung, sea ice was discussed most often. The most discussed changes in sea ice were later freeze up and earlier break up. Changes in the timing of the sea ice season have an effect on hunting and traveling and residents of Pangnirtung have been changing their travel schedules around the sea ice changes. Changes in the timing also seem linked to changes in sea ice condition such as sea ice not forming in areas it is expected.

> "The changes I've seen on ice are that before 1962 the ice conditions were good those years. The ice condition changed after 1962. As a hunter, I started noticing that ice was starting to form very late. Around 1960 the ice used to form early. When it had formed the ice conditions were good those days, but after 1960's even though the ice has formed, it was still not good to use. Those days the ice used to form completely during January. The ice at that time is completely formed as we can go just about everywhere to hunt/camp. The other changes I've seen on the ice condition is that during April, the ice seems like it would be good to use but it usually started breaking earlier. There was even a time when it was may the ice wasn't useable. It wasn't like that before. We even used to come to Pangnirtung with our dog teams in June those years but these days it's impossible. We even have started boating around May. That's how it had changed since before, with the paths we used when we go hunting/camping" (Abraham Keenaiak, October, 2002).

> "Sea ice does not form in places where it used to, as if there were strong currents there, but these have not changed, ice forms about two months behind and breaks up earlier then usual… polynyas all over the place now and polynyas occurring in April, that never happened in the past…it's too early…" (Mosesee Novaqilik, 2002).

One participant also explained how the break up process is different.

> "…even when (the sea ice is) quite thick and seemingly solid and land fast, sometimes (it) shears off in great blocks – (it) never used to do that" (Jaypeetee Qarpik, 2002).

Thinning sea ice has also caused a problem for travel as areas have now become dangerous.

> "The area where I live, the ice condition is good, lots of snow. But those days the path used to be easy to use as a routine but these days we have to use the area close to the beach because the conditions gets dangerous. These areas weren't dangerous before. There is this island close to my camp that I can use an an example. The path is usually good to use in winter seasons but these days, it's kind of impossible to use. The point of the island's ice condition used to be useable but these days the ice condition is usually thin, even during winter season. If you don't know the area, it is considered dangerous because you don't know the area" (Moses Qijuaqjuk, 2002).

5.2.1.2 Snow

Another topic discussed by many of the Pangnirtung participants was changes in snow. The most popular observations was less snow on the ground, but other indicators on this topic included less snow on the sea ice, snow melts earlier and quicker, and less snow falling,. Taken together, there seems to be, overall, not as much snow as Pangnirtung Inuit are used to.

> "The way snow forms these days is a lot lesser than before. We used to get lots of snow, but nowadays we get less. The snow on the ground melts quicker these days. Those days the snow didn't melt that quick like today. It is probably due to not enough snow on the ground. It used to be good for our sleds, when the snow was good for longer periods of time. These days, it is still good but only for a shorter period of time" (Solomonie Nauyk, October, 2002).

> "The snow condition was kind of a difficult those days because of lots of soft snow on the ice. There used to be lots of soft snow, it was difficult for our dog teams to use. There was even a time when people had to make paths for the dogs to use because the snow was too soft. These days there is hardly snow anymore. And those days the ice had lots of pads but these days there aren't that many any more due to not much snow on the ice. That's how much it has changed" (Moses Qijuaqjuk, 2002).

Another observation about snow, which was identified by a few participants, was a change in its condition. Namely, the formation of snow is different. Two participants noted that he snow is harder than usual and another person said that snow layering is inconsistent these days, making igloo building difficult. The snow also seems to sound different when walk on (one participant) and is formed differently by the wind (one participant).

5.2.1.3 Weather

All of the participants who talked about weather variability noted in some way that the weather is more variable or unpredictable than in the past.

> "The weather is completely different now. The winter is a lot shorter in terms of timing and months. The changes are quite obvious and the way spring arrives now, with a rush and the way the snow has melted off the land so quickly, including all of the ice on the water, these are changes that are different from the past" (Mosesee Novaqilk, March, 2002).

> "These days, even without these signs (traditional indicators), the weather changes all of a sudden, without the weather preparing a warning. The wind picks up, the storm starts and once it starts to go, then it proceeds right away these days. It is not as ambivalent as in the past" (Mosesee Novaqlik, 2002).

5.2.1.4 Winds

Along with weather changes are changing winds. Winds are more unpredictable than the past, changing direction more frequently and sometimes coming from directions other than those expected by experienced observers. The shifting winds seem to have an impact on the weather patterns. For example, changing winds change the temperature more quickly (*Moses Qijuaqjuk*, March, 2002) and also on travel.

> "These days, when we go boating, we have to be more prepared and have to watch our boats when using them. These days the winds tend to appear more unexpectedly. We have to bring more equipment that could be used for emergency purposes. Most people bring these kinds of equipments but there are still some people who don't" (Joanasie Manniapik, October, 2002).

> "Nowadays, the weather is quite different according to my observations as I said I am no academic professor, but the wind seems to spring out of nowhere and when the clouds start to change, it is immediate and the wind springs up right away, even during the spring" (Ipeelee Uniuqsaagaq, 2002).

5.2.1.5 Sun

Another topic discussed by the majority of participants was changes in the sun, particularly in the strength of the sun. Some participants described that the sun felt warmer (the sun's rays), other noted impacts of a stronger sun such as burning fur pelts. Other's used works like 'stronger' and 'brighter' and another participant has observed that animals do no seem to be basking in the sun as much as usual.

> "In terms of the sun intensity, the sunrays are a lot stronger nowadays. To use an example, four our hands or faces, the intensity of the sun is quite a

lot stronger but it is hard to describe other than it is a lot hotter and causing more problems for our skins. It is causing sunburns today and that is what I have noticed" (Levi Evic, March, 2002).

"…it is noticeable that the sun is stronger in it's intensity. These are not real burns, but they are a result of the drying out of the skin. It (skin) starts to peel more. Before, we would only get a suntan. Nowadays, some people start to burn and peel. There are more problems now with the skin cracking and peeling." (Mosesee Novaqilk, March, 2002).

5.2.1.6 Seasons

There are several different observations that, although not all focused on one specific change, show that seasons are different from what they have been. There are several different observations of that. Four persons have stated that the cold period of winter has been shorter recently and only January and February have been really cold.

"Those days when we had good weather during the spring, it used to be warm. These days it's not. I remember one time I was a young boy. The weather was absolutely beautiful and warm. The kind of temperature we have compares to those years are different. These days we get nice warm weathers once the ice have all melted. These days it's like summer season arrives, gets warm and then becomes cold. But right now it's supposed to get colder because it's a fall season, it's like it's getting warmer now even though it shouldn't be. All seasons' looks like all have been affected due to climate change." (Joanasie Manniapik, October, 2002).

"The seasons within the last few years have been changing and it is quite noticeable and today, the open water season has really increased big time. It has really lengthened in the last few years. The ice season is now very short and it has lost approximately two months." (Levi Evic, March, 2002).

"The winter is seemingly a shadow of its former self. It is quite short now and the dark period is when we had ice to travel on, at least starting from November we would be traveling by dog team on the ice. Nowadays, it is right up to December and even right up to Christmas that Inuit are out boating in the fiord. That is how much it has changed since my youth. You can now boat during the twelve days of Christmas. It was unheard of in the old days." (Jaypeetee Qarpik, March, 2002).

5.2.1.7 Land and Permafrost

There is not enough information but three participants have observed that the permafrost is melting.

"…it is noticeable that the permafrost is melting to a deeper level. Even if you are not looking for these signs, it is noticeable that the land is sagging, especially the areas that have glaciers." (Levi Evic, March, 2002)

"…I have witnessed the occurrence (landslide) not every year, but on occasion the areas that do not usually experience slides and are experiencing them now. I am sure that is it connected to climate change." (Mosesee Nozaqilk, March, 2002)

5.2.1.8 Others

The remaining topics as identified in Table 3 by Pangnirtung participants have been listed in this section and although noted from the interviews may have:

- only been mentioned by one or two people;
- mentioned with no discussion;
- or were topics that showed conflicting observations.

Tides

There was insufficient information to make any connections.

Wildlife

There are no real patterns of observations but four persons stated that there have been unusual bird sightings and two people stated that some migratory birds were staying and not migrating.

Lakes and River
Most of the information is contradictory and no conclusive observations can be made from the information. Three participants stated that the smaller lakes were drying up and that the lake ice was thinner but two participants stated that the thickness of the lake ice was the same.

Glaciers
There is limited information in this area with the exception that three participants stated glaciers were melting.

Vegetation
Observations such as size of plant and quantity are contradictory. Two participants stated that they have observed new species of plants.

Temperature
There is insufficient information.

Rain
There is insufficient information and the observation about the amount of rain is contradictory.

Lightning
There is limited information that is also contrary.

Floe edge
There is limited and contradictory information.

Insects
There is limited and contrary information.

Health
One person has observed that the warmer temperatures have made it harder to breathe.

6.0 Drawing connections

After each interview was reviewed and coded, and interviews from each community were organized by category of indicator, it was interesting to look at differences and commonalities of observations and experiences between communities.

While we do not consider these true 'comparisons' per se, nor conclusive by any means, we believe that it represents an exploratory attempt to link observations from different communities that are relatively proximate in order to see if there are any similarities or differences in indicators that stand out which might inform a regional study.

This was a very preliminary exercise based on limited interview data, however, it may provide a template for further inquiry as studies of *Inuit Qaujimajatuqangit* of climate and climate change continues, and it has assisted in the development of Nunavut's Climate Change Strategy that was completed in October 2003.

Although through scientific and community research it has become clear that the Arctic climate and environment is changing, it is important to understand that the changes are not uniform across Nunavut. Different communities are experiencing, and will experience in the future, different impacts. Because of this, research on a per-community basis is required in order to understand how impacts are being observed and experienced in that community, how community members interact with those changes, what resources are available for each community to deal with impacts, and what impacts are seen in need of immediate attention or further research.

We recognize that two communities cannot thoroughly represent the South Baffin region. Indeed, any connections may be coincidental. However, since the collection of *Inuit Qaujimajatuqangit* on this subject is a gradual undertaking, we present this initial South Baffin summary as one step in this process and suggest that further studies add their information to that presented here.

The two communities representing South Baffin in this report are Pangnirtung and Iqaluit. While each of the communities has particular observations regarding climate and environmental changes, there are a few phenomena that are observed by the majority of participants in both communities.

These observations pertain to; snow accumulation, sea ice, weather variability, and winds. As to other observations, for example, those related to land changes, wildlife, vegetation, season, or insects, there was no indication of a common experience between the two communities, and in some cases, within the communities themselves. The connections presented here are only those observations where the majority of people observed the same thing both within the original community and between the two communities (e.g. 6/10 people interviewed in Pangnirtung report sea ice forming later, so did 6/10 people interviewed in Iqaluit).

6.1 Snow

The majority of participants in both communities said they have observed less snow on the ground. In both cases, experience with travel helped to identify this change. For example, in Iqaluit, some usual travel areas and routes are no longer useable because there is not enough snow to travel by snowmobiles. In Pangnirtung, participants recalled how in the past, dog teams would have to create paths in order to get through deeper snow. These days this is not necessary and there are fewer paths.

While both communities seem to share the experience of less snow on the ground compared to the past, there is no shared observation as to its cause.

6.2 Sea Ice

According to the majority of report participants in both Pangnirtung and Iqaluit, sea ice has been forming later and breaking up earlier in the last 3-5 years. In Iqaluit, some families have been more interested in keeping boats rather than snowmobiles as the open-water season is longer. While Pangnirtung participants also observed thinning sea ice (5/8 participants), the majority interviewed in Iqaluit did not mention this (3/10). This and other observations detailed in the individual community summaries show that while there might be some general sea ice changes in South Baffin, local geography and bathymetry may affect some specific processes.

6.3 Water

Increased weather variability was observed in both communities, which is not surprising considering that this is the most common observation related to climate and environmental change in the North when one looks at other studies of Arctic indigenous observations across Nunavut and the NWT (see for example Fox, 2002; Jolly et al., 2002. Thorpe et al., 2002). Increased weather variability is expressed through such things as weather patterns changing suddenly, weather is no longer predictable (using traditional skills), and weather characterized as being more 'calm' or 'fair' in the past. Like other Arctic communities, Pangnirtung and Iqaluit find unpredictable weather a serious hazard. Hunting and travel parties can no longer predict when the weather will change and what that change will be. Accidents have happened as people are stranded in bad weather. One of the ways people are coping with the change is to pack extra food and supplies in anticipation of unexpected weather.

6.4 Winds

Closely associated with an increase in weather variability is a change in the winds. Both communities have observed that winds are more unpredictable. This unpredictability is seen through changes in wind frequency, direction, seasonality and strength. While is seems clear that both communities identify wind changes, the specific changes must be looked at individually (see Pangnirtung and Iqaluit summaries).

7.0 Recommendations

As a result of small sampling, no conclusions can be made with the information that has been collected, however, the observations collected in this report illustrate the fact that Inuit have valuable information to offer to any future studies and have valuable observations to contribute to any future work in climate change.

Inuit have lived in direct contact with the environment and have developed a vocabulary to describe each natural occurrence. Inuit have been encouraged from a very young age to observe the changes in their environment. As a child they are encouraged to get dressed and go outside to observe the environment by using their senses and these skills of observation have become part of their everyday life.

The Department is encouraged to continue the collection of observations of *Inuit Qaujimajatuqangit* within Nunavut communities and develop a more collaborative approach with each community in Nunavut on an individual basis. It is recommended that a Steering Committee be established within each community which would be compiled of those members of the community that have direct knowledge of the land and climate, similar to the criteria established for this cursory study. Through such a community-based collaborative approach, more observations like those presented here could be collected and monitored as Nunavut continues to implement its Climate Change Strategy.

The departmental work with the Steering Committee would include the development of a community questionnaire that addresses specific community issues at the commencement of the project and reviewing the results of the questionnaires with the community. The next level of discussions has to be within the community as a whole.

It will be important that there is consistency in a glossary of terms and that the Interviewer uses them correctly in the interpretation. Clarity is required that is consistent throughout all communities in Nunavut in order to identify any comparisons and similarities on a territorial, regional or community scale.

As illustrated and discussed earlier in this report, the issue of deeper snow vs. more snow may be that the phenomena has been observed differently by the participant or that it has been interpreted (the word chosen) by the translator based on his/her personal comprehension and understanding. It would be effective or the collection of *Inuit Qaujimajatuqangit* to develop a liaison within the Department that can develop and explain the succinctness of the Inukitut language and English language to a trained core of translators. This would ensure that the interpretation in the subtleties of the language is represented accurately.

A collaborative approach to data collection will ensure that a larger sampling is obtained so that the Department can better identify impacts, research needs and adaptation strategies related to climate and environmental change Nunavut in communities.

Appendix A:
Literature Review

This report presents a sample of Inuit observations of, and experiences with, environmental impacts of climate change. The information presented is taken from a collection of interviews conducted for this particular report in 2002. While we did not analyze these interviews in the context of other similar studies; it is useful to provide a brief review of what other literature is available on this subject.

For the purposes of this report, we only cite literature that deals directly with Inuit knowledge and/or observations of climate and environmental changes. While there is a vast amount of literature that addresses Inuit culture, climate change and indigenous knowledge more broadly, a review of this work is beyond the scope of this report.

Though extensive scientific research of Arctic climate change has been underway since the early 1990s, there is relatively little research on how Arctic indigenous peoples have observed or experienced climate and environmental changes. However, in the last few years, a number of studies have been working with Inuit communities to document their knowledge, and Inuit themselves have been active in trying to bring attention to their concerns over recent climate and environmental changes.

The following list provides references and resources that directly address Inuit knowledge of climate and environmental change in Nunavut. A brief annotation after each reference provides an outline of topics and communities covered in the reference:

Northern Climate ExChange (ongoing). Database of Climate Change Information Sources for Northern Canada. http://yukon,taiga.net/infosources/

- Searchable database (by place or topic) including literature that addresses indigenous knowledge of climate and environmental change in Nunavut and Northern provinces.

Elders' Conference on Climate Change, March 29-31, 2001, Cambridge Bay, Nunavut. http://www.polarnet.ca/ntilands/pdfdoc/elders.pdf.

- Minutes from the meeting, including summaries and full transcripts of elders' comments. Meeting included elders from 14 different communities in Nunavut.

Fenge, T. (2001). "The Inuit and climate change." Isuma **winter**: 79-85.

- Discusses policy and political implications for dealing with climate change – discusses role of the Inuit Circumpolar Conference.

Fox, s. (1996). The Potential Impacts of Arctic Climate Change on Inuit/Wildlife Relationships: A Case Study of Igloolik, NT and the Atlantic Walrus (Odobenus rosmarus rosmarus). Department of Geography, Faculty of Environmental Studies. Waterloo, University of Waterloo.

- Observations from Igloolik hunters and elders on climate and environmental changes, particularly in reference to walrus. Overview of walrus ecology and walrus hunting; implications of climate change

Fox, S. (1998). Inuit Knowledge of Climate and Climate Change. Department of Geography, Faculty of Environmental Studies. Waterloo, University of Waterloo.

- Observations of climate and environmental change from Igloolik and Iqaluit hunters and elders, including how communities and hunters deal with impacts.

Fox, S. (2000). Arctic Climate Change: Observations of Inuit in the Eastern Canadian Arctic. Boulder, Colorado, Arctic Climatology Project, Environmental Working Group Arctic Meterology and Climate Atlas, F. Fetterer and V. Radionov (eds.). Boulder, CO: National Snow and Ice Data Center, CD-ROM.

- Observations of climate and environmental change from Igloolik and Iqaluit hunters and elders, including how communities and hunters deal with impacts.

Krupnik, I. and D. e. Jolly (2002). *The Earth is Faster Now: Indigenous Observations of Arctic Environmental Changes:* Fairbanks, Arctic Research Consortium of the United States.

- Chapters are descriptions of various projects looking at Arctic indigenous observations of climate and environmental change – includes project methodologies and results. For Nunavut, look for chapters by Fox (ch. 1 – Igloolik, Iqaluit, Baker Lake, and Clyde River); Thorpe et al. (ch. 6 – Kitikmeot Region), also see other informative chapters on projects in Nunavik and Labrador, Sachs Harbour and the Inuvialuit Settlement Region, and Alaska.

McDonald, M., L. Arragutainaq, et al. (1997). *Voices from the Bay : Traditional Ecological Knowledge of Inuit and Cree in the James Bay Bioregion*. Ottawa, Canadian Arctic Resources Committee and Environmental Committee of the Municipality of Sanikiluaq.

- Inuit and Cree knowledge of environmental, weather and climate processes and changes in regions of Hudson and James Bays. Also discussion of development in these regions. Helpful maps and graphics.
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Reidlinger, D. and F. Berkes (2001). *Contributions of traditional knowledge to understanding climate change in the Canadian Arctic*. Polar Record 37(203): 315-328.

- Discussion of conceptual approach to linking scientific and traditional knowledge of climate change. Indigenous observations of changes from Sachs Harbour.

Reidlinger, D., S. Fox, et al. (2001). Inuit and Inuvialuit Knowledge of Climate Change in the Northwest Territories and Nunavut. Native Voices in Research: Northern and Native Studies. J. Oakes and R. Riewe. Winnipeg, Native Studies Press, University of Manitoba.

- Comparative look at indigenous observations of, and experiences with, climate and environmental changes across Eastern, Central and Western Canadian Arctic.

Thorpe, N. (2000). Contributions on Inuit Ecological Knowledge to the Understanding of Climate Change on the Bathurst Caribou Herd in the Kitikmeot Region, Nunavut. School of Resource and Environmental management.Vancover, Simon Fraser University.

- Observations of climate and environmental change in the Kitikmeot region with special focus on impacts and implications for caribou.

Thorpe, N., N. Hakongak, et al. (2001). Thunder on the Tundra : Inuit Qaujimajatuqangit of the Bathurst caribou. Vancover, Generation Printing.

- Includes chapter, "Caribou and our Warming Climate" (p. 157) on elders' observations of climate change impacts on caribou.