



INUIT QAUJIMAJATUQANGIT OF  
**CLIMATE CHANGE**  
2005 IN NUNAVUT

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A SAMPLE OF INUIT EXPERIENCES OF CLIMATE CHANGE IN NUNAVUT  
BAKER LAKE AND ARVIAT, NUNAVUT

GOVERNMENT OF NUNAVUT  
DEPARTMENT OF ENVIRONMENT  
ENVIRONMENTAL PROTECTION DIVISION  
NOVEMBER 2005

# EXECUTIVE SUMMARY

In February and March, 2001 a study of the Inuit knowledge on climate change was conducted with the residents of Baker Lake and Arviat, Nunavut. The study was completed under contract to the Government of Nunavut, Department of Environment, Environmental Protection Division to aid in the development of a Nunavut Climate Change Strategy. The experiences of the community were recorded during semi-directed interviews, workshops and radio phone-in programs. The resulting data reveals that within the last decade the residents of Baker Lake and Arviat have experienced:

- Warmer temperatures year-round;
- Changes in the length and timing of the Inuktitut seasons;
- Unpredictable weather and winds;
- Stronger winds;
- A change in the direction of the prevailing wind;
- Reduced snowfall in *ukiaq* (early winter);
- Reduced and more compacted *Aput* (snow cover) on the land;
- Later and slower freezing of the lakes, rivers and the ocean;
- Earlier and more rapid melting of ice and snow inland and on the ocean;
- Reduced rainfall in *upinngaaq* (spring);
- Reduced water levels in the lakes and rivers;
- Impaired growth of edible/fruit-bearing plants;
- Increased growth of willows and birch;
- Movement of the tree-line northward;
- Undernourished and diseased species for example caribou and fish;
- Polar and grizzly bears encountered over longer time period and in new areas;

- Loss of some existing bird species and new insect, bird and mammal species being sighted.

Participants indicated that the changes observed and experienced present many challenges to modern subsistence land users. They noted that:

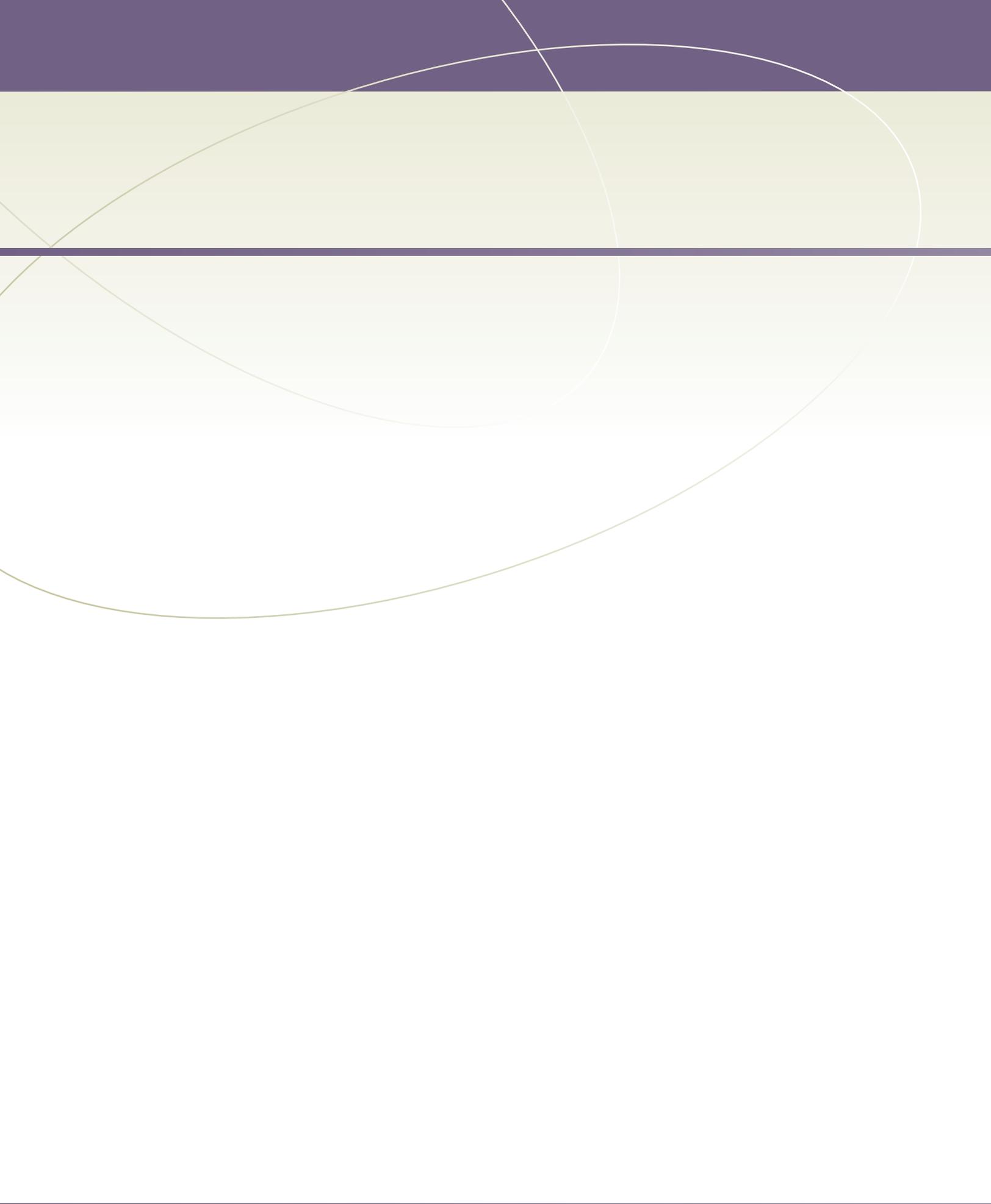
- > Changes in season timing, duration and environmental conditions have resulted in a change in the activities that would occur.
- > Late ice development, rapid melting, increased area of dangerous ice conditions, and new areas of dangerous ice conditions prevent access to resources, dangerous travel conditions and a loss of traditional travel routes.
- > Low water levels are creating dangerous travel conditions, preventing access to resources, causing damage to equipment and rendering some traditional travel routes unusable.
- > Sudden wind changes, increase in wind strength and the unpredictability of the weather are increasing risk to health and safety during traditional activities.
- > High winds and more frequent encounters with polar and grizzly bears make land users more vulnerable when tent camping.
- > Sudden storms in *ukiuq* (winter) are a threat to land users, the lack of snow for shelters, and loss of traditional navigation methods increases risk during traditional activities.
- > Safety concerns given the loss of traditional navigation methods, unpredictability of the weather, loss of traditionally safe travel routes and shelter, and encounters with wildlife.

- > Loss of, or reduction, in species available for hunting, fishing and gathering activities.
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***Inuit Qaujimajangit* provides information about impacts that may be a result of climate change. Residents of Baker Lake and Arviat provided many examples of adaptation, or changes in their activities, due to experiences associated with these impacts. Many of these adaptation techniques are based on awareness and being more vigilant when engaged in day to day activities. Some examples include:**

- being prepared for a change in the weather,
  - wearing sunscreen,
  - observing water levels and ice conditions,
  - using other navigation methods and
  - caching meat later in the year.
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Study participants noted that the nature and magnitude of climate change and its associated impacts have rendered *Inuit Qaujimajatuqangit* inadequate on its own in certain circumstances. As a result, new strategies and knowledge must be advanced for adaptation to the impacts. Since this study indicates climate change impacts are occurring and that adaptation is, and will be, necessary, it is important that the Government of Nunavut address adaptation within the Climate Change Strategy for Nunavut.



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# ACKNOWLEDGEMENTS

The Government of Nunavut, Department of Environment would like to thank the participants of Baker Lake and Arviat for their enthusiastic and generous contribution to this study. They show great concern for the changes they have observed in the environment and for the welfare of future generations who must adapt to these changes.

This study was completed under contract by Darren Keith of Meridian Geographic Consulting and Joan Scottie of Inland Inuit Consulting. The literature review was completed by Andrew Stewart of Andrew Stewart Consulting.

# 1.0 INTRODUCTION

The Government of Nunavut, through the Department of Environment, undertook this study to further the planning, development and implementation of the *Nunavut Climate Change Strategy* where various climate change issues could be addressed. The Strategy is guided by the following five themes, which parallel Canada's National Implementation Strategy on Climate Change:

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

Under the theme of *Investing in Knowledge and Building a Foundation*, the Department of Environment collected and documented *Inuit Qaujimajatuqangit* (Inuit knowledge) on climate change. This study constitutes the preliminary effort towards a Nunavut-wide sample of Inuit experiences of climate change.

Climate change is one of the most significant environmental issues facing Canada's northern territories. Although Canada's three territories combined produce less than 1% of Canada's greenhouse gases (GHG), - the gases that contribute to global warming - they will suffer the most significant effects. A Nunavut Climate Change Strategy will concentrate on mitigating impacts, determining methods of adaptation to potential impacts, and implementation of potential mitigation measures.

There is a need for building on our knowledgebase in the north to study climate change. Nunavut is presently initiating discussions with the Federal Government on the development of programs that will allow for building on and strengthening our scientific capacity and the use of *Inuit*

*Qaujimajatuqangit* (traditional knowledge) in the North to study this issue. Traditional information would assist scientists to focus on issues that are of concern to Nunavummiut and would also provide a link between what is being recorded scientifically and how such findings have been interpreted and observed by Nunavummiut.

## 1.1 WHAT IS *INUIT QAUJIMAJATUQANGIT*?

Debate, both inside and outside of Nunavut, has focused on finding an appropriate term and definition for the knowledge of indigenous people. This knowledge has been labeled indigenous knowledge (IK), traditional knowledge (TK), local knowledge (LK), traditional ecological knowledge (TEK), traditional environmental knowledge (TEK), folk ecology, ethno-ecology, customary law and knowledge of the land (Johnson 1992).

The Government of Nunavut has recognized this knowledge and is committed to preserving, promoting and integrating this knowledge into all programs, services and policies (Government of Nunavut 1999). To meet this commitment, the Department of Environment developed a Climate Change Strategy that works for Nunavummiut based, in part, on *Inuit Qaujimajatuqangit*. This study worked within the bounds of IQ as the objective is to collect and document information related to climate change. It is recognized that many Nunavummiut continue to participate in subsistence activities (for example hunting, fishing and gathering activities) and it is an important component of the cultural identity. As a result, it is difficult to collect and document information related to climate change and its impacts without also documenting the culture.

*Inuit Qaujimajatuqangit* (IQ) is recognized through obtaining first-hand knowledge and experience from experts and knowledgeable Inuit Elders pertaining to the following areas:

- Language
- Culture
- Values & Beliefs
- Survival Skills
- Use of Resources
- Humane & Sustainable Harvesting
- Understanding of Society, Ecology and Environment

This broad description of IQ is distinguishable from the more specific concept of traditional ecological knowledge (TEK). Modern commentators on the study of TEK identify it as being a subset within TK or IQ (Usher 2000;Wenzel 1999). Usher (2000) provides the following definition of TEK:

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**“TEK refers specifically to all types of knowledge about the environment derived from the experience and traditions of a particular people.”**

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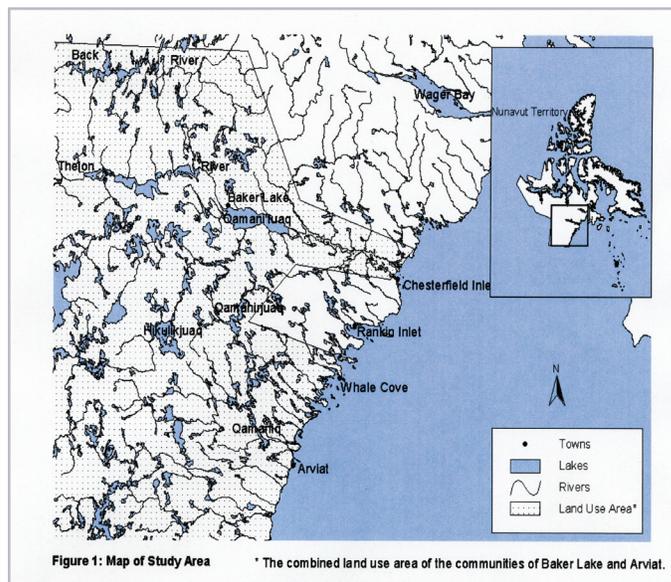
## 1.2 OBJECTIVES

The objective of this study was to record *Inuit Qaujimagatuqangit* of climate change in the Nunavut communities of Baker Lake and Arviat (See Figure 1 for Study Area).

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 during the study were meant to provide a sample of the Inuit experience of climate change in Nunavut and to aid in the development of the Nunavut Climate Change Strategy.



## 2.0 STUDY METHODOLOGY

This study consisted of six components: literature review; compilation of a glossary; semi-directed interviews; a community workshop; community radio phone-in show; and analysis.

### 2.1 LITERATURE REVIEW

In the literature review, English-language social science literature was surveyed back to 1993 to identify studies of Traditional Ecological Knowledge (TEK) and environmental change, internationally. This survey supplements and does not duplicate references included in the report prepared for the Northern Climate Exchange study in October 2000 (Thorpe et al. 2000).

### 2.2 GLOSSARY

A glossary of climate change terminology (Appendix B) was developed over the course of the study. Each time a relevant term arose it was added to the glossary. It includes terms from the scientific study of climate change, and Inuktitut terminology used by Elders during interviews, workshops and radio shows. Scientific terminology was defined opposite the nearest corresponding Inuktitut term or terms in a tabular format, allowing for cross-reference. The purpose of the glossary is to provide working definitions for terminology used in the study, and for future use by the Department of Environment.

### 2.3 SEMI-DIRECTED INTERVIEWS

The main method of recording the personal experiences of residents of Baker Lake and Arviat, related to climate change, was the semi-directed interview. As Usher (2000) points out, the semi-directed interview has been a key method in TEK data collection during recent studies (Nakashima 1990; Ferguson and Messier 1997; Fienup-Riordan 1999; Huntington 1998). Personal interviews were conducted in each community and recorded on audio mini-disc. Semi-directed interviews are to

be distinguished from a questionnaire approach to interviewing. Rather than asking a standard set of questions in a specific order, the interviews are framed by an *interview guide*. An effort was made to ask interviewees open-ended, non-leading questions. Subject areas in which the interviewee has knowledge and interest were emphasized, and the interview guide was used to ensure that all subject areas were probed during the course of the interview. Study participants made a clear distinction between statements of personal experience and repetition of the statements of others. The interview guide was developed together with the Department of Environment and was tested in Iqaluit in January 2001.

The participants that were selected for the interviews and workshop were chosen because of their depth of experience of environmental observation due to their activities on the land. All the participants continue to be active land-users. A list of Elders was made from those with a local knowledge of their community. The Hunters and Trappers Organizations (HTOs) for both communities were consulted and participants were then drawn from the resultant lists based on availability and willingness to participate.

Interviews were conducted in Inuktitut (2 exceptions) and recorded on minidisk. The recordings reside at the Department of Environment, Resource Centre in Iqaluit.

### 2.4 COMMUNITY WORKSHOP

In addition to interviews, a full day workshop was also held in each community. The workshop was conducted such that each individual could comment on the subject under discussion after which the floor was open. When discussion stalled the interview guide was used to ask questions of the participants, and again discussion began with each person commenting in turn and then opening the floor. The workshop discussions were recorded on audio mini-

disc and these recordings reside at the Department of Environment, Resource Centre, in Iqaluit.

## 2.5 PHONE-IN RADIO SHOWS

In both Baker Lake and Arviat, one evening was spent broadcasting a phone-in show on the subject of climate change. The shows began with an explanation of the purpose of the study, and by asking **“Do you think the weather has changed since you were a child?”** to open discussion. Callers phoned in to share their experiences on air. The radio shows were recorded on audio disc and these recordings will reside at the Department of Environment, Resource Centre in Iqaluit.

## 2.6 ANALYSIS

Data from the semi-directed interviews, workshops and radio phone-in shows were reviewed for first-hand observations of climate change indicators.

Table 1 illustrates how many study participants observed each of the indicators during interviews, workshops and radio shows in Baker Lake and Arviat. Although confidence can be inferred from the widespread observation of specific indicators, this presentation of the data is not meant to deny the legitimacy of the observations of an individual participant.

Each individual in the study has different land use history and their observations in one geographic area are based on their individual experiences. Each of the indicators is addressed in the discussion section of the report under subject headings that were found to be most appropriate for communication of the results. Indicators treated in the following discussion reference data collected during interviews, workshops and radio shows.

**TABLE 1 - OBSERVATIONS OF CLIMATE CHANGE INDICATORS**

INDICATORS	BAKER LAKE			ARVIAT		
	S-dl (10) <sup>1</sup>	WkSh (7)	RaPh (25)	S-dl (10) <sup>2</sup>	WkSh (5) <sup>2</sup>	RaPh (2)
<b>Weather</b>						
Unpredictable weather	7	3	-	4	1	-
<b>Temperature</b>						
Warmer temperatures year-round	10	6	6	6	4	-
Areas of permanent ice melting	3	-	-	-	-	-
<b>Winds, Storms, Skies</b>						
Sudden wind shifts	5	3	-	3	1	-
Stronger winds	3	3	-	3	4	-
Less calm weather	2	3	-	2	1	-
Less clear skies	2	2	1	2	2	-
Change in prevailing wind direction	5	2	3	5	3	-
Change in cloud types	1	1	-	1	1	-

INDICATORS	BAKER LAKE			ARVIAT		
	S-dl (10) <sup>1</sup>	WkSh (7)	RaPh (25)	S-dl (10) <sup>2</sup>	WkSh (5) <sup>2</sup>	RaPh (2)
Sun is higher and brighter in <i>ukiaq</i>	-	-	-	2	1	-
<b>Snow</b>						
Less snowfall in <i>ukiaq</i>	4	-	1	2	1	-
Reduced and more compacted <i>Aput</i>	7	6	5	5	2	1
Snowfall in <i>ukiuq</i>	2	1	3	1	1	-
<b>Rain</b>						
Less rain in <i>upinngaaq</i> and <i>aujaq</i>	3	3	1	2	1	-
Fewer thunderstorms	-	-	-	3	3	-
<b>Sea Ice/Freshwater Ice</b>						
Later and slower freezing of lakes, rivers and ocean	5	4	-	6	3	-
Thinner ice throughout the year on lakes, rivers and oceans	-	2	-	2	1	-
Change in aukarniit/piqtait in lakes, rivers and ocean	4	2	1	2	1	-
Earlier and more rapid melting of the ice (lakes, rivers and oceans)	6	1	1	4	4	-
<b>Rivers and Lakes</b>						
Lower water levels in lakes and rivers	7	3	5	6	3	-
<b>Vegetation and land</b>						
Dry vegetation	4	-	1	3	-	-
Impaired growth of edible/fruit-bearing plants	3	4	-	5	-	-
Increased growth of willows and birch	1	3	-	3	-	-
Movement of the tree-line northward	-	-	-	2	2	-
Erosion	1	-	1	-	-	-
More tundra fires	-	1	-	-	-	-
<b>Wildlife</b>						
Caribou undernourished	7	2	2	1	-	-
Caribou diseased	2	1	2	2	-	-
Caribou skins in poor condition	2	1	-	1	1	-
Polar bears encountered in new areas	-	-	-	3	2	-
More grizzlies	1	2	-	1	-	-
More ravens	-	1	1	-	1	-
Fish undernourished	-	1	1	-	-	-
Fewer fish	1	1	-	2	-	-
New species being sighted	3	3	2	4	-	-
<b>Health</b>						
Sunburns now common	2	1	1	1	-	-

S-dl= semi-directed interviews WkSh=workshop RaPh=radio phone-in show

<sup>1</sup> The numbers in the brackets indicate the number of individuals participated

<sup>2</sup> Including a written submission from L. Angalik

## 3.0 DISCUSSION

### 3.1 LITERATURE REVIEW

The literature review completed for this study is intended to supplement, not duplicate, the references compiled as part of the work completed by Thorpe et al. (2000). For this study, sources searched for traditional knowledge and environmental change included English-language social science literature included in the University of Toronto libraries. The literature review completed for this study consists of an annotated bibliography and can be found in Appendix A of this report.

Studies included as part of the literature review for this study provide critical perspective on the relationship between ecological knowledge and “western” science. Most emphasize the distinction of the two through differences in scale and worldview and underscore the commonalities and convergences (Berkes et al., 1998; Murdoch and Clark, 1994; Snively and Corsiglio, 2001). The identified documents also provide insight into the reliability of traditional ecological knowledge (Costo-Neto, 2000), the cultural and economic conditions under which traditional ecological knowledge is sustained (Benz et al., 2000) and a criticism of the modern use (Nadasty, 1999) and non-use (Clark and Murdoch, 1997) of traditional ecological knowledge.

Additional references, not included in Thorpe et al (2000), were also identified. Two focus on Canadian Inuit communities in the eastern Arctic (O’Neil et al., 1997; Pellerin and Grondin, 1998) addressing the perception of ecosystem health. The third covers the Hudson Bay area (McDonald et al., 1997) and documents environmental changes to the region attributed to natural and human influences.

With the work completed by Thorpe et al (2000) and this study, 34 document sources of traditional knowledge of climate change were found. This relatively low number reflects:

- Recent interest in the climate change issue;
- Recent empowerment of community members through the validation of their knowledge through the land claims process; and
- Increase in available funds to document traditional knowledge

The literature containing traditional knowledge of climate change reviewed for this study can be placed in one of the following categories:

1. observations embedded in long-term, locally based studies or journals of land use;
2. perceptions associated with extreme weather events;
3. aboriginal narratives of traditional knowledge;
4. climate and weather variations from historical records (accounts of exploration; journals; fur trade records; proxy environmental data from cores);
5. evidence of current climate change and associated impacts;
6. difficulties associated with aboriginal, scientist and government communication and collaboration; and
7. difficulties of adaptation to climate change.

A detailed empirical study to document traditional knowledge on climate change is limited across the North. In Nunavut, the best examples to date are work completed by Fox (1996; 1998; 2000a and 2000b), Thorpe (2000) and McDonald et al. (1997). However, since the time of this report, there have been additional studies initiated on documenting IQ relating to climate change.

## 3.2 GLOSSARY

The glossary of climate change terminology forms Appendix B of this report and includes information that was obtained during the course of this study. Terms such as those representing various types of storms, snow cover, and other environmental components were key to the discussion of climate and climate change. The absence of Inuktitut terms for newly encountered species is also indicative of change relative to climate. Inuktitut phrases and terms are used throughout this text. For ease of reading this report, Appendix B is available at the end of this report defining these terms and phrases.

## 3.3 INTERVIEWS/WORKSHOPS/RADIO SHOWS

The indicators that were observed by study participants are summarized in Table 1; they will be discussed in greater detail in the pages to follow. Many of the study participants have observed the same climate change indicators and there is a general belief that significant climate change has occurred in recent years. The exact timing of the onset of these changes was difficult to establish for the participants as several Elders reported that the changes have occurred gradually. Only when the normal conditions were altered enough to affect

subsistence activities was change recognized. Generally most of the Elders place the advent of significant climate change in the last five to ten years. In specific instances, however, where Elders provided estimates for the onset of specific indicators, this detail was included in the discussion.

### 3.3.1 SEASONS

Climate change was discussed by study participants within the context of the Inuit understanding of normal seasonal conditions. In the sections that follow, **specific climate change indicators will be discussed using the Inuit seasons rather than western seasons.** In the dialects predominant in Baker Lake and Arviat, the year is broken up into six seasons. Each season is described in Table 2 as it has been traditionally observed. The usual or expected duration of these seasons are included, however it is important to emphasize that the **Inuit seasons are associated with a set of environmental conditions and subsistence activities, and not with dates on a calendar.** Where the Table shows seasons overlapping in time, this represents the variability of the beginning, end and duration of any particular season. The changes observed in each of the seasons are summarized in the right column.

**TABLE 2 – INUKTITUT SEASONS AND OBSERVED CHANGES**  
**SEASON TRADITIONAL DESCRIPTION OBSERVED CHANGES**

SEASON	TRADITIONAL DESCRIPTION	OBSERVED CHANGES
<i>Ukiaqhaaq</i> Mid - September to early October	<ul style="list-style-type: none"> <li>• "Beginning or signs of <i>ukiuq</i>".</li> <li>• Signs of winter.</li> <li>• Puddles and smaller lakes are frozen in the morning.</li> <li>• Snows, though it may melt.</li> <li>• Before the ocean froze there were calm days in the past.</li> </ul>	<ul style="list-style-type: none"> <li>• Season begins later.</li> <li>• Fewer calm days.</li> </ul>

SEASON	TRADITIONAL DESCRIPTION	OBSERVED CHANGES
<p><i>Ukiaq</i> Late September to early November</p>	<ul style="list-style-type: none"> <li>• “Small <i>ukiuq</i>”.</li> <li>• Lakes freeze, but are still dangerous and snow begins to cover the land.</li> <li>• No longer able to travel by boat on the lakes.</li> <li>• Lake ice becomes okay for travel during this period, while the ocean is still open.</li> <li>• Ocean freezes over during this period.</li> <li>• Lots of snowfall.</li> <li>• First blizzard arrives before the lakes freeze over.</li> <li>• <i>Aput</i> conditions are suitable for <i>iglu</i> building.</li> <li>• Many calm days are expected during this season.</li> </ul>	<ul style="list-style-type: none"> <li>• The season is of a comparable duration but begins later – October 15 to November 30.</li> <li>• Boats can be used on the lakes into <i>ukiaq</i> now.</li> <li>• Ocean freezes over later.</li> <li>• Ice does not freeze to safe thickness as early.</li> <li>• Lakes and ocean form ice at the same time</li> <li>• Not as much snowfall.</li> <li>• More common, and more severe, windy days</li> <li>• Used to have many calm days before freeze-up. Now <i>ukiaq</i> is often windfilled.</li> </ul>
<p><i>Ukiuq</i> Early November to Early March</p>	<ul style="list-style-type: none"> <li>• Temperature severely cold.</li> <li>• Cold enough to freeze flesh in seconds and frost accumulates in the liner of <i>kamiks</i>.</li> <li>• Liquid poured on to the snow or ice freezes immediately.</li> <li>• Snow fall in January and February is rare.</li> <li>• Severely cold with little wind; ideal conditions for the formation of a layer of <i>Patuk</i> (frost) on the surface of the snow and ice.</li> <li>• Snow continues to accumulate from blizzards, and when the <i>Patuk</i> has formed there are longer storms called <i>talimanguhijjuq</i> that last 5 days.</li> <li>• Easy to find proper snow for <i>iglu</i> building, and there are many <i>qimugjuut</i> (snowdrifts) formed.</li> <li>• A light layer of <i>qaniut Aput</i> (fresh fallen snow) normal.</li> <li>• <i>Pukaq</i> (granular snow) small</li> <li>• A soft layer on top of the snow with a thin icy surface that was difficult to travel on for the dogs as their limbs would go through (<i>maujaagtut</i>).</li> </ul>	<ul style="list-style-type: none"> <li>• This season is shorter – December to February – it starts later and ends earlier.</li> <li>• Cracking noise from pouring water on the snow and ice is gone.</li> <li>• Snow accumulation is not settling on the ground and there is less snow cover.</li> <li>• <i>Patuk</i> (frost) has not been experienced for over 10 years.</li> <li>• Blizzards are not resulting in big snow accumulations as expected.</li> <li>• Snowstorms are not as they used to be.</li> <li>• Impossible to find proper snow type to make a snow shelter.</li> <li>• Not as many <i>qimugjuut</i> (snowdrifts) and they are oriented differently due to a shift in the prevailing wind.</li> <li>• Large amount of <i>qaniut aput</i> and heavy snowfall</li> <li>• <i>Pukaq</i> (granular snow) very big.</li> <li>• Soft layer on top of the snow with a thin icy surface is no longer seen.</li> </ul>

SEASON	TRADITIONAL DESCRIPTION	OBSERVED CHANGES
<i>Upinngaqhaaq</i> March, April, May	<ul style="list-style-type: none"> <li>• “Beginning or signs of <i>upinngaaq</i>”.</li> <li>• <i>Patuk</i> (frost) melts in the sun on a surface.</li> <li>• Sun is high.</li> <li>• Snow accumulation from snowfall and blizzards - this creates a soft layer of wet snow that freezes on the surface.</li> <li>• Land begins to become uncovered.</li> <li>• During March skins left outside become so dry they turn white. The weather is then said to be <i>qaqurnaqtuq</i>.</li> <li>• Periods of clear skies would interrupt the ice/snow melt causing it to happen gradually.</li> </ul>	<ul style="list-style-type: none"> <li>• Season is of about the same duration but begins earlier.</li> <li>• Snow cover is much harder.</li> <li>• During March there is more blowing snow and cloudy periods.</li> <li>• Clouds are ever present now in the spring and the clouds are bigger.</li> <li>• More cloudy skies cause the ice/snow melt to be continuous and to happen more rapidly.</li> </ul>
<i>Upinngaaq</i> June to early August	<ul style="list-style-type: none"> <li>• “In full bloom”.</li> <li>• Things don’t freeze anymore. Snow and ice melts gradually.</li> <li>• Ice on the large lakes goes out earlier than the ocean ice. Sea ice goes out in July and lake ice goes out in June.</li> <li>• Arviat loses <i>tuvak</i> earlier than Rankin Inlet.</li> <li>• Geese arrive.</li> <li>• Flowers are out and things are growing.</li> <li>• Hottest period of the year.</li> <li>• Lots of rain, especially in early <i>upinngaaq</i> when the ice is still on the lakes.</li> <li>• Severe thunderstorms. The first thunderstorm sometimes occurs during the time of “<i>tuvak</i>” (rough deteriorating ice).</li> <li>• Rain showers with sunny periods in between.</li> <li>• Mosquitoes come out.</li> </ul>	<ul style="list-style-type: none"> <li>• Quick melting of snow and ice.</li> <li>• Lakes and ocean are open at the same time.</li> <li>• Rankin Inlet and Arviat lose <i>tuvak</i> at the same time. Sea ice goes out in June (early).</li> <li>• More wind like <i>ukiaqsaaq</i> – continuous and strong winds.</li> <li>• Less rain and fewer thunderstorms.</li> </ul>
<i>Aujaq</i> mid-August to late September	<ul style="list-style-type: none"> <li>• Temperature starts to get cool and the leaves turn color.</li> <li>• Berries ripen and young birds start to fly.</li> <li>• Black flies come out.</li> <li>• Thunderstorms occur associated with a shifting of the wind to the northwest.</li> <li>• Caribou are hunted in order to acquire clothing skins and to cache meat beginning in mid-August.</li> </ul>	<ul style="list-style-type: none"> <li>• Warmer temperature.</li> <li>• Berries ripen earlier.</li> <li>• Less rain, but when it does rain, it often rains too much and there are strong winds.</li> <li>• Certain cloud formations (rain clouds) are hardly seen anymore.</li> <li>• Thunderstorms are no longer dependable predictors of wind direction</li> <li>• Caribou caching moved to early to mid September.</li> </ul>

The Elders that participated in the project explained that generally the seasons are changing in their duration. This change was recognized through reference to traditional benchmarks such as the expected environmental conditions and subsistence activities associated with a season. For instance, *caribou caching and the collection of clothing skins always occurred at the same time in the middle of August*. This event has been one of the main criteria for declaring the onset of the *aujaq* season.

Another thing is the timing of the seasons. They don't connect anymore. We used to know what season something would occur. For example when you feet would sink through the snow. You knew when the *aujaq* or *upinngaaq* would happen. Using our traditional knowledge you would know what was going to happen when, but you just can't predict anymore. People like me are confused. In the early fall sometimes there will be a freeze of the lake and the ponds, and then after that it would take several weeks to have the ice finally safe enough to travel on (Donald Uluadluaq, Arviat Interviews).

The applicability of traditional Inuit season terms has become uncertain due to changes in the environmental conditions normally associated with different times of the year. This fact alone is a strong indicator of climate change, as season names are based on the observation of climatic and environmental patterns for untold generations.

### 3.3.2 WEATHER

There was a consensus among Elders that current weather patterns are unstable compared to past experience. The instability of the weather is seen in temperature fluctuations, wind shifting and intensity, and storm behaviour. These unstable conditions have lead to a breakdown in traditional methods of weather forecasting, and have resulted in a lack of confidence in the traditional knowledge related to weather forecasting.

Many study participants referred to the lack of calm stable weather characterized by no wind, clear skies and sunshine.

When I was young I remember nice days, good days, beautiful days. If it had to be cold it was expected. When it was expected to be cold it was cold in certain seasons. From my observations and from other people talking, just recently I noticed that the weather patterns have started to change. Suddenly the weather may be bad but then it becomes nice again. I noticed that this is happening more than was usual earlier in my life (unnamed #1, Baker Lake Interviews).

My observations are more in *upinngaaq*. Years ago the weather was always much calmer, calm days, especially in the early morning. It was expected in the morning for it to be calm. But this is not so anymore. Whatever you expect it to be, it always turns out to be windy. Even in the morning. There are always sudden winds. Usually I don't observe what is happening due to the climate change, but it is generally talked about how things have changed climate wise. It is even said to be that this is to be the case. We accept that it is going to get worse, as this is how it is supposed to be and so that is how we accept this change (Unnamed #1, Baker Lake Interviews).

I have noticed from my younger days, as a hunter, especially the winters, there are extreme weather changes during the winter. The extreme cold followed by days of warmth (John Avaala, Baker Lake Interviews).

Historically, it was understood that the wind blew from a certain direction for an extended period and then shifted gradually and predictably. This was also true of storm behaviour. The onset and duration of a blizzard was predictable, and the direction of the wind during a blizzard was constant. Recently this stability and gradual change of wind direction has been lost.

Today, the wind shifting has become very sudden. Even within a day now you can experience shifting of the wind a couple of times during the day. Years ago if you had a north wind, blowing snow it used to last several days. It would gradually change to the south for example. These were predictable wind shifts. Now that is not the case. Also blizzards - even during a blizzard there are sudden changes in the wind direction.

Without any calming down the wind may switch directions (Jacob Ikinilik, Baker Lake Interviews).

Unstable weather has become common, and has resulted in a decline in the efficacy of traditional weather forecasting methods.

I have a strong respect for the people before me who were experts - especially at predicting the weather. Just by observing the sky and the clouds they were able to know what the weather would be the next day. And they were always accurate in their predictions. But today someone may make a prediction of how it will be by observing and you might think you are right because you are observing certain signs, but because the weather changes so suddenly now, your prediction is more often wrong. It might be a very nice calm day and then you would get a storm. Or the other way, you might be having a storm and suddenly it would become very nice again. The weather has become very unpredictable (Jacob Ikinilik, Baker Lake Interviews).

When I was younger and when I was a mature man we were able to predict the weather - how it is going to be the next day. Today you can't do that. You try to forecast how the weather is going to be but all of a sudden it would change. There are so many weather changes it is impossible to tell what weather you are going to end up with - even for tomorrow. Years ago the only two unpredictable months were June and July. During those months we used to closely observe the weather patterns. These two were difficult months to predict. Now all the seasons are unpredictable (Moses Akilak, Baker Lake Interviews).

This lack of confidence in traditional knowledge has caused at least one hunter to suggest that this is a time for individual hunters to adapt to the new weather patterns.

Things have changed so much it is hard to rely on what you knew traditionally anymore. What happened years ago is different than what it is today. I feel that each individual must do their own observing and use their own experience to understand the change. You may ask an expert

what his knowledge is but his knowledge is not going to apply to what is happening today (Hugh Tularialik, Baker Lake Interviews).

Unstable weather patterns and unpredictable changes to the weather have resulted in a lack of confidence in using traditional knowledge to forecast weather. This fact has implications for the safety of land users during hunting, fishing and other subsistence activities.

Today we don't seem to be prepared for the changes that affect everyday life. People are dying of exposure and they are not prepared for the unpredictable weather (John Nukik, Baker Lake Workshop).

### 3.3.3 TEMPERATURE

Study participants agreed that, in general, the temperature has become warmer throughout the year. The weather is warmer later in *aujaq* and therefore the seasons of *ukiaqhaaq* and *ukiaq* are occurring later, with *ukiaq* conditions persisting into November. The temperature seems to be decreasing gradually in *ukiaq* as evidenced by the slow onset and growth of ice on the lakes and the ocean. Ice coverage is taking much longer to become safe for travelling. This subject is further discussed under the section on Freshwater Ice.

The season of *ukiuq* is defined by its association with severely cold temperatures. A Baker Lake Study participant estimates that there have been warmer temperatures during *ukiuq* up to the last fifteen years (Thomas Mannik, Baker Lake Interviews). The severity of *ukiuq* temperatures in the past was illustrated through different observations made by the participants. For instance, in the past the extremely cold temperatures were associated with sounds carrying over great distances.

Years ago I noticed when living out in the *iglu*, when we expected someone we would go out in the porch. It was dark you wouldn't see and so you had to listen. You could hear every little thing from that traveller with his dog team- the movement of the sled; the person whipping the

whip, the yelp of the dogs, and you could actually hear the commands of the person. Things were so clear because this was created from the coldness of the air. When temperatures are so cold things seem to be clearer. In the instance I was talking about, the traveller was at a great distance. You would even get tired of waiting for them to appear because they were so far. As they got closer, the noise seemed to disappear. This is something that I noticed and it is no longer for this type of thing - the clearness of the sound (Jacob Ikinilik, Baker Lake Interviews).

Very low temperatures were also responsible for a haze of *pujuq* (water vapor) being emitted from sources of moisture that were warmer than the air, such as areas of open water, or from the breath of animals and people. This *pujuq* is no longer seen.

When I was a child I saw a big *pujuq* out in the distance and it was travelling and I asked my mother "what's that"? She said that it was a dog team. This was very common, years ago you would see this and you would know what it is. When they are far away you could see them from the *pujuq*. When you come to an open water in the winter too you would see the same thing. This used to happen during the extreme cold. We still do get cold spells but there is not a sustained season of extreme cold. Open water used to really *pujuq*, one time I used to think that they were people. That was the first time where I saw open water like that at *Iglurjualik* [traditional open water area] I was very scared because I associated this *pujuq* with either human beings or animals (Caller #4, Baker Lake Radio Show).

During the Arviat Workshop, a local resident also mentioned the prevalence of *pujuq* during those very cold winters. When they had dog teams, the breath from their dogs created so much fog that they couldn't see their dogs from the *qamutik* (sled).

Land also produced a *pujuq*-like fog (*pujurat*).

Winter used to have days of calm clear skies with very severely cold temperatures. These days were common and the ground used to produce *pujurat* during calm windless days (Louis Angalik, written submission).

*Ukiuq* in the past was also marked by the ease with which one could get frostbite. One method of gauging the severity of the weather was by sticking one's hand through an opening in the *iglu* to see if one would feel the sting of the onset of frostbite.

Starting between 1939 to about mid-50s the weather used to be extremely cold in *ukiuq* with your skin freezing in seconds. Actually feeling your exposed flesh getting hard from the cold. Actually feel like you are being poked with a pin. It is very painful freezing of the flesh within seconds. This used to happen to your face or if you took off your mitts, you would feel this pain. This was common and expected in these years in *ukiuq*. I remember it was difficult to shoot in the winter. Your fingers would turn white right away from touching the metal. It is the opposite of hot but it is just as bad when you touch it. It used to happen a lot. It was difficult to shoot with bare hands. It froze your thumb and index finger (Henry Isluanik, Arviat Interviews).

Another observation related to the colder temperature was that the lake ice would crack very loudly and often.

Also when you were camping out in an *iglu*, we would have the *iglu* by the lake. There was this constant cracking of the ice. It was non-stop and very loud like thundering. You don't hear that anymore. It might do that once in a while but during those years you heard it all the time (Henry Isluanik, Arviat Interviews).

*Ukiuq* was also associated with the formation of a layer of *Patuk* (frost) on the snow and ice. This seems not to occur recently due to the general warming in *ukiuq*.

During the cold winter months the *Patuk* used to be there. It is a layer of frost on top of the snow, but it is soft enough for the lemmings to leave footprints. This used to occur in the cold, cold months, but it is not happening anymore (Donald Uluadluak, Arviat Interviews).

The *Patuk* was so thick at times that even on bare patches of ice one could not slip in *kamik*s (boots)

due to the traction provided by the rough texture of the *patuk*. The significance of the absence of *patuk* formation in recent winters will be discussed in the next section on “Winds, Storms and Skies”.

In *ukiuq* the temperature continues to reach extremely cold temperatures, but what was in the past a consistently cold period is now broken intermittently by warm periods.

I have noticed from my younger days, as a hunter... there are extreme weather changes during the winter. The extreme cold followed by days of warmth. The sudden changes of the weather (John Avaala, Baker Lake Interviews).

The extent of the warm spells that are being experienced was underlined by the observation of rain just before the arrival of the study consultants to Baker Lake in early February.

Yes, I have noticed about the rain. For example last Sunday [January 28th] there was this slight rain. This was very strange. You didn't get this type of rain in the middle of winter. I have noticed that the winter has changed. It is not as cold as it used to be. In the earlier days at this time of year the weather was very cold, much colder (Moses Akilak, Baker Lake Interviews).

Warm spells in *ukiuq* have also been responsible for rainfall after there is snow accumulation, which causes difficult feeding conditions for the caribou.

In *ukiuq* there will sometimes be a wet rain and cause an ice cover on the snow pack. This could have a very negative impact on the caribou. They may not be able to feed with the ice and it could be devastating (Johnny Karetak, Arviat Workshop).

The difference between the extreme temperatures of the past and the warm periods of today is illustrated in the clothing needs of today's land users.

Today we don't even have to wear a *qulitaq* [caribou outer coat], which was very essential to survival in the winter. Now you can wear *qablunaaq* style clothes and you can work with your mitts off for a few minutes and you don't

experience that [frostbite] anymore (Henry Isluanik, Arviat Interviews).

Another thing is that earlier in my life we were using more traditional clothing. It was severe weather so we needed to wear *kihik* [sea mammal skin clothing], we were constantly wearing traditional clothing during the winter (Philip Kigusiunaaq, Arviat Interviews).

The traditional clothing of the past was needed due to the *huvirnaqtuq* conditions.

*Qablunaaq* (Euro-Canadian) style clothing and fabrics would have been unacceptable in these conditions. Even a poorly sewn garment, or a worn *kamik* (boot) sole would allow the cold to penetrate to the body.

The temperature is getting warmer earlier in the year now so that *upinngaqhaaq* and *upinngaaq* are beginning earlier. A significant difference in these seasons today is that what used to be a gradual melting period with intermittent melting is now characterized with a quick and sustained melting. Warmer temperatures in conjunction with cloudier skies have caused this sustained melting. In the past overcast, warmer weather was interrupted by clear skies when the melting would stop. This sustained melting period has resulted in earlier snow-free and ice-free conditions.

When the spring is approaching, instead of gradually warming up there are sudden warm spells (Eugene Niviatsiak, Baker Lake Interviews).

The lack of sunshine associated with the increase in overcast days, and perhaps the warmer temperatures have led to difficulties in the preparation of caribou *nipku* (dried meat) in *upinngaqhaaq*.

Another thing is that we dry *nipku* every spring. Not only in the community but also in our spring campsites. These days what we are drying is not drying fast enough. What is causing it not to dry as it used to. Not only my family but also the other families are reporting the same thing (Donald Uluadluak, Arviat Interviews).

Later in *upinngaaq* and in *aujaq* the temperature has become extremely hot within the last ten to fifteen years.

I just wanted to comment on the hotness of the weather. It used to be hot, warm summers, but what we used to think was hot has been surpassed. When it gets hot it is too extreme now. For example, when I was growing up, in the month of July it was cool enough to keep meat outdoors and it didn't rot too bad. But now, today, you can't leave the meat outdoors, either the bugs will get to it or it will simply rot, it will go bad (Eugene Niviatsiak, Baker Lake Interviews).

... in this area the weather has changed quite a bit. The temperatures are much warmer and very hot during the summer months July, August. Even the month of August there are times when the weather is just too hot... I remember in 1988 the weather in this whole area – Baker Lake, Ferguson Lake area. I was in the Ferguson Lake area and there were dead caribou, dead animals everywhere. We only went to certain areas and we weren't looking for dead caribou, but everywhere we went during the day we would at least see 10. Anywhere from 10 to 15 dead caribou carcasses and if we don't see them we can smell them 200 yards away. That summer was really, really hot. We seem to be getting a lot of those very hot summers. It is probably in the records. Even the Baker Lake, Ferguson Lake area - the inland *Kivalliq* we are sometimes the hottest spot in Canada. This is kind of weird. I don't remember having...you know we might have one hot day, but not for a whole month... [this] seemed to start happening sometime in the 80s. Middle of 80s maybe or late 80s, I really can't say (Joan Scottie, Baker Lake Interviews).

Estimates of the advent of noticeably hotter temperatures range from ten to fifteen years, to "not even 10 years ago" (Hugh Tulurialik, Baker Lake Interviews).

Warmer temperatures in the summer have transformed the landscape. There are areas that have historically been known to have ice throughout the

year. One of these locations on the lower Thelon River is called *Nilalik*, is reported to have melted recently. The other areas of year round ice are located at *Nilalirjuaq* to the northwest of *Hikulikjuaq* (Yathkyed Lake), and *Nilallaq* to the southeast of *Hikulikjuaq*.

When I used to go up the river in my earlier years it was very visible. For the last 3 years that ice has disappeared. I have noticed that it became very small and it melted. During the hot spring the caribou used to go there when there were lots of bugs to cool off, but there are no caribou hanging around there now. When we first started going up the river it used to be quite large that chunk of ice (John Avaala, Baker Lake Interviews).

The outlet of Baker Lake into Chesterfield inlet, referred to as "The Channels" was an area well known for its cooler ambient air temperatures during *upinngaaq*, but now it has become indistinguishable from the surrounding landscape.

Traditionally the hunters knew that during June and July- during the hot months - the further up inland you go the temperature is much hotter. And the animals are not very healthy. They are running around bothered by the bugs and they are not eating right. Or they're too hot and sometimes they are just skin and bones. The experienced hunters used to go down into the channels where traditionally the caribou there have big fat on them just like *ukialiit* (fall caribou). Now you go down there to hunt looking for healthy caribou and they are not as healthy as they used to be. They are being bothered by the heat. I know this from my own experience that this has been happening (Hugh Tulurialik, Baker Lake Interviews).

... the areas around the channels were considered cool places. They were known as cool places. Now they are just as hot as inland areas (Eugene Niviatsiak, Baker Lake Interviews).

**Hotter temperatures in *aujaq* have had an impact on the traditional seasonal activities for both Baker Lake and Arviat land users. Traditionally**

**the time to begin caching meat coincided with the time caribou skins were the right quality for use as clothing skins. This event marked the beginning of *aujaq*, which started in mid-August. Due to the warmer temperatures in August land users have had to delay the caching period, almost a month later, in September. Adaptation to the impact of higher temperatures on the caching period has occurred over the last three to five years (Johnny Karetak, Arviat Workshop; John Avaala, Baker Lake Interviews).**

Traditionally we didn't have calendars to go by so we observed the nesting of the birds... when they are able to fly that is the time when it is time to start hunting for caribou for clothing skins and to start caching the meat. But now in the month of August you can't do your caribou meat caching - it is too warm (Eugene Niviatsiak, Baker Lake Interviews).

Traditionally when we do the caribou caching - this is where we would put away the meat to pick up later in the winter - we would start our caribou caching in August - the middle of August. It was safe to start your caribou caching, but now it is just too warm. Either the meat is just going to rot, or the maggots are there. Even last summer for example we were out there in the channels in the second week of September where I was with sports hunters and they wanted to bring some meat and caribou antlers and capes. The flies were there, you know the *qupilruq* [maggots] were still there. The weather was too warm. It was really weird. Like I said we would normally do our caribou caching starting in the middle of August, but now it is just too warm, unless you bury it way down near the permafrost, or somewhere very cool, otherwise it is just a waste of meat. Also in the middle of August, it was already - like in the 70s - it was already quite cold. It would be snowing, but the snow wouldn't stay. But now we can travel [by boat] right until the end of September. We would still be boating. We are something like almost a month behind in some summers (Joan Scottie, Baker Lake Interviews).

When we were on the land we heavily depended upon caribou caching for human consumption and for the dogs. We began in mid-August storing meat for our families and dogs. This was a traditional time to start preparing for winter. For several years now I have not cached meat in the middle of August. The extreme heat, especially in the spring. It is far too hot when it shouldn't be (Jacob Ikinilik, Baker Lake Interviews). The last three years I started caching in September. Before that, I tried to cache in August but they rotted (John Avaala, Baker Lake Interviews).

As mentioned earlier, the caribou caching time for Baker Lake and Arviat hunters is up to a month later than the traditional start of this activity, due to the intensity and longevity of the warm temperatures in August. Johnny Karetak of Arviat experienced this 5 years ago when he cached in August and went back to get it later in the winter and it was rotten. John Avaala of Baker Lake started caching in September 3 years ago after having the same experience.

In addition to the loss of meat, this change has meant a shorter period for hunters to cache winter meat stores.

It might be just inconvenient for full time hunters, but for people like me who are full time employed we have only a certain time to do our caching. Because generally by the middle of September it starts to get cold so I have to try and squeeze in my caching time. It is causing an inconvenience for me as I am also a working person (John Avaala, Baker Lake Interviews). The thing that is affecting me most, not only me but also other occasional hunters who are employed. We have to rush to try and beat the weather, or work around the weather trying to beat it. If it is going to be bad then we have to rush. It is the rushing that is affecting me (Unnamed #1, Baker Lake Interviews).

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**This relatively brief window of opportunity to build up winter meat**

**stores has an economic cost if the lost meat stores must be replaced by purchased meat.**

**3.3.4 WINDS, STORMS AND SKIES**

There is a general consensus that in the past there were more, and longer, periods of calm. This lack of calm has been associated with the unpredictable shifting of the wind. Wind shifts are reported to be happening much quicker now and without an intervening calm period.

Normally when you wouldn't expect to have a snowstorm you have them. What seems to produce them is that there are so many sudden wind changes. The wind may be coming from one direction and then it can change within hours. This seems to produce more storms - unexpected storms - this seems to be happening a lot. [not seasonally specific but generally] I don't really understand these sudden wind changes and very severe strong winds. I try to understand it from my traditional knowledge, but this doesn't connect with my knowledge, I don't understand it (Eugene Niviatsiak, Baker Lake Interviews).

... even during a blizzard there are sudden changes in the wind direction. Without any calming down the wind may switch directions (Jacob Ikinilik, Baker Lake Interviews).

Also during the month of June, July and August down by the ocean, there were plenty of times when there were very calm waters that might last for a day. Now a day does not go by when the wind won't shift and become very windy. Now no one knows when the wind is going to change and come up. Just last year a boat went down due to high winds. The winds are very unpredictable (Henry Isluanik, Arviat Interviews).

Another change that I have noticed is the changes of the wind direction seem to occur within the same day. In the past we were able to predict the changing of the winds. We knew which way the winds were going to shift. I had an experience last summer when the wind was coming from the

southeast and I was travelling with sports hunter travelling along the southern shore of Baker Lake trying to get home. Suddenly the wind shifted to the northwest and we were caught out in the open water when we should have been out of the wind. In the past you knew in advance that it was going to take another day to shift. Between wind changes you usually have calm periods (Hugh Tularialik, Baker Lake Interviews).

Several respondents noted that the wind has also been blowing stronger than in the past. This has been connected with the harder *Aput* (snow cover) that the area has experienced in recent years. However, strong winds are not limited to *ukiuq*, or to the prevailing wind direction.

The only thing I have noticed is the intensity of the prevailing wind it is very severe. It is too strong (Tony Otuk, Arviat Interviews).

Out there on the mainland I think that there is still snow coverage but it just becomes too hard. But I noticed that on the ice there is hardly any snow coverage. I think the snow is just being washed off the ice because of the high winds. It is not settling on the ice. So there are a lot of lakes with very little snow coverage. And the snow coverage on the land becomes very hard. (Henry Isluanik, Arviat Interviews).

In late August or September when we are finally getting rain we would get hurricane winds with really hard rain. Often the wind would be coming from the north-east with something like 80 km/h winds and this would go on for 3 or 5 days and then it would quiet and then with wind would shift to a south, south-east wind or something like that and then another hurricane wind. This has been happening quite a bit. Hurricane winds from this wind direction. We expect north winds to be severe, but north-east winds with hurricane winds, this is.... sometimes we are not prepared for it, because all our tents would be set up for north winds, but hurricane winds from the north-east that is really, really bad (Joan Scottie, Baker Lake Interviews).

Question: When did you first notice this extreme weather from the northeast?

Maybe 10 years ago. Because this doesn't only happen in early September. Around in October the same thing would happen when we get the snowstorm we would always get the hurricane winds. It would last about the same length of time - 3-5 days from the same direction. Northeast winds. Early September and October (Joan Scottie, Baker Lake Interviews).

During the summer there seems to be a lot more winds from the southeast [*Nigiq*] then before. (Hugh Tularialik, Baker Lake Interviews).

Strong winds have become a problem for people staying out on the land in cabins or tents.

It is unsafe now towards *ukiaq* just before freeze up. There are a lot of high winds and we really have to secure the tents. It is scary to be in tents at that time of year (Louis Angalik, Arviat Workshop).

And the intensity of the wind has increased. Sometimes we worry about our cabins and belongings being blown away. These days things have to be secured. The wind is getting stronger than we used to experience before (Tony Otuk, Arviat Workshop).

As discussed under "Weather", the weather has become difficult to forecast using traditional methods, as forecasting is based on the direction of the wind and the appearance of the clouds.

We were able to predict the weather based on the direction of the wind at the time and the look of the clouds. We were able to predict where the wind was going to come from, or if the weather was going to be nice the next day. Now you don't know where the wind is going to come from and how strong it will be (Eugene Niviatsiak, Baker Lake Interviews).

Wind and storm behaviour in recent years have made traditional forecasting methods uncertain. This unpredictability of wind behaviour was only experienced in the month of September in the

past, but it is now seen throughout the year (Henry Isluanik, Arviat Interviews).

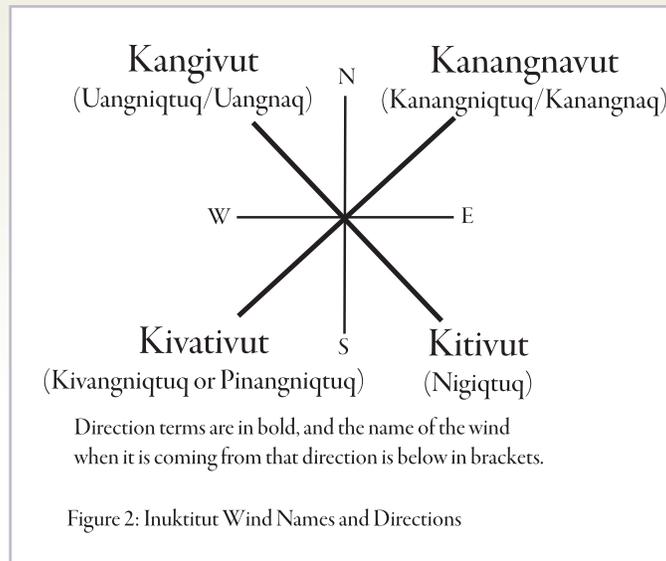
Usually when we get up the first thing in the morning we observe the weather. If it was drifting snow coming from any direction then you know what the weather will be like by the evening, but the result hasn't been what it should have been. That is how it has been lately (Luke Anowtalik, Arviat Interviews).

The frequency of stronger and rapidly shifting winds has created more stormy conditions during *ukiuq*. However, these stormy conditions have been described as not being true *piqhiq* as was experienced in the past. This has to do with the behaviour of the snow during the storm. In a true *piqhiq* the snow behaves in a certain way - *minguliqtuq*. Due to the strength of the wind that causes many of modern storms, the snow does not behave this way; it is blown more directly in the direction of the wind.

I noticed that there are less of the blizzards that were known where it was hard to see. These real blizzards are no longer there, with a lot of snow flying around (Philip Kigusiunaaq, Arviat Interviews).

It was also noted that there are identifiable snowstorm types that are now missing – the *talimanguhiiniq*, the *padjarluk* and the *maujaq*. The *talimanguhiiniq* was a storm that used to occur in February and lasted five days. Three-day snowstorms were common during *ukiuq*, but after a layer of *Patuk* developed in January the *talimanguhiiniq* would occur. Due to the hardness of the *Patuk* it took longer to blow away the loose surface snow.

The 3-day snowstorms happen when there is a covering of lighter snow, but when there is a *Patuk* layer on top when there is a snowstorm it takes longer to get rid of it. So the snow lasts longer. Sometimes up to about 5 days. When you have that *Patuk* coverage you know that it is going to last longer (Eugene Niviatsiak, Baker Lake Interviews).



There is another storm that is called *padjarluk*. While the storm is happening the wind will shift. You can actually hear the storm while it is shifting. It doesn't occur anymore. Maybe it has gone to another season, we miss it...there were also blizzards causing very soft snow resulting in snow where your feet would go through it. It doesn't happen in a certain season anymore or it doesn't happen at all. Things aren't lining up with the seasons (Donald Uluadluak, Arviat Interviews).

Another significant change in the behaviour of the wind is the shift of the prevailing wind from its traditional orientation. In the past, the prevailing wind – *uangnaq* (or *uangniqtuq*)- has come out of *kangivut* (northwest), however recently it has rotated towards the Inuktitut direction of *kanangnavut* (northeast). In the western system of compass directions, the prevailing wind is still oriented northwest but it has shifted more towards north. See Figure 2 for a description of Inuktitut wind names and directions, compared against western compass directions. The shift of the prevailing wind is most noticeable in the changing orientation of *qimugjuut* or snowdrifts.

Wind changes that I have observed - the formations of the snowdrifts are created by the

*Uangnaq* (*uangniqtuq*) and yet they seem to have changed their orientation and are pointing in a different direction. Now the snowdrifts are pointing more to the northeast rather than their traditional orientation. Before when we were navigating we used to follow them when we were going to Gjoa Haven, but now we have to cut through them... Personally, I get more disoriented when I am depending on them. When I was a child we never used maps for navigation just snowdrifts (Barnabus Oosuaq, Baker Lake Interviews).

The patterns used to be oriented more towards the *kangivut* but they have rotated more towards *kanangnavut*. Other hunters are reporting the same thing. They know where they used to go and how the orientation has changed (Henry Isluanik, Arviat Interviews).

I have noticed that the prevailing winds have shifted more towards *kanangnaq* (northeast) because when we travelled we used to go almost directly with the drifts and now they have shifted and point more to the north (Donald Uluadluak, Arviat Interviews).

Traditionally we have used snowdrifts as a guide, especially when we are travelling in the dark. We would check the drifts occasionally to make sure

that we are heading in the right direction to return to our *iglu*. Now it is disorienting because they are not pointing in the direction that they were pointing in before (Philip Kigusiunaaq, Arviat Interviews).

This shift in the direction of the prevailing wind and the resultant change in the orientation of *qimugjuut* have put into doubt traditional navigation methods. A study participant from Arviat said that he noticed this change for about the last 3 years. One Baker Lake participant noticed the change “within the last five or six years”, while another estimated seven years.

A very common comment during the interviews and the workshops was that the skies are not clear as often as in the past in all seasons.

There are lots of things that we have noticed such as, there are hardly any clear skies now. There are clouds, or haze (*pujurattuq*). It is always white out (*qaqurnaqtuq*) when you can hardly see the ground. We don't get those clear skies anymore with very good visibility. The traditional word for it is *pujurattuq* - there is a lot of this now. It is not *ihiriaqtuq* (smoke from a fire) and there is a lot of that today. Even during clear skies. There is a lot of this [*pujurattuq*] now even during clear skies. Years ago there would be clear, clear skies and visibility would be very clear. But now there is a lot of this [*pujurattuq*] (Henry Isluanik, Arviat Interviews).

In the past, during the winter when the sun was at its lowest, it used to rise just above the horizon and would look red through the intervening atmosphere. This phenomenon has not been seen in last two years.

Starting about two years ago we noticed that the brightness of the days is so bright. That is when we started hearing about the climate change. The hunters had been asking each other “why are the days so bright that it hurts your eyes”. Also they are asking - in the past in *ukiuq* the sun would just peak up and it would be red, but now it is much brighter. Why is that? (David Uluadluak, Arviat Interviews)

The sun is brighter now than before. Also, during the shortest days the sun remains higher in the sky. Before it would just barely peek over the horizon causing a reddish light. Now it's always bright. This is another noticeable change in *ukiuq* (Louis Angalik, written submission).

### 3.3.5 SNOW

In recent years snowfall has been occurring later in the year and there has been less snowfall reported overall for the season of *ukiaq*. This has resulted in the slow accumulation of *Aput*.

The snowfall seems to be really late and it is coming at different seasons. Last fall was an example the snowfall was very late. When there should have been snow cover there was none... A year ago in the fall [1999] it was late in October it was probably alright to build snow iglus. This fall [2000], things are late. Snow coverage was late this year. Like last year (Moses Akilak, Baker Lake Interviews).

I have noticed that in *ukiaq* there was a lot of snow coverage and traditionally it was difficult to walk (*maujaq*). We haven't had that kind of snowfall recently...within the last 5 years is about right (Philip Kigusiunaaq, Arviat Interviews).

The last couple of years I have noticed that the snowfall has come in late (John Avaala, Baker Lake Interviews).

During October, November, December there was a lot of snow falling in the past because there is the right type of snow accumulation. But now I noticed that there is hardly any snowfall. We have noticed that there is very little snowfall (Henry Isluanik, Arviat Interviews).

The lack of snowfall in *ukiaq* has had implications for the structure of the snow cover. Traditionally the snow cover would be made up of a granular layer of old snow next to the ground called *Pukaq* that was laid down in *ukiaq*. With the reduced snow accumulation in *ukiaq*, *Pukaq* is very hard to find, making it difficult to find the proper snow to make a shelter.

Years ago snow accumulation - there was a good coverage everywhere. The lakes would have a good coverage. Enough to make snow blocks. I noticed just recently that the snow coverage has declined. When I travel out there - even between Baker Lake and Gjoa Haven - where you expect to see accumulation of snow, it is not there. There is hardly any snow accumulation. The south side of the hills always had snow accumulation but that is not the case anymore. Where you expect to see snowdrifts, it is not the case [now]...the texture of the snow also seems to have changed. It is packed and heavy and hard. There was a time when it was easy to find the right snow to build snow blocks, but these days it is very packed and hard. This is also the case recently.

*Question: When did you start noticing these changes?*

Not last year, but the year before we went up to Gjoa Haven. While travelling up there the weather was blowing and we were in a tent for a while. But I knew that we would be warmer in the *iglu*, so I was testing snow - snow after snow- and not finding the quality I was looking for. I noticed that it was harder to find that quality of snow I was looking for, and this was not the case in the past (Unnamed #1, Baker Lake Interviews).

One study participant estimated that it has been “hard to find good snow for the past 3 or 4 years”. The reduced snow coverage of recent winters and the increased strength and frequency of the winds have resulted in a very hard packed *Aput*.

Years ago the snow was nice and soft for making shelters. Just as recently as 3 years ago I can compare it to a rock (Barnabus Oosuaq, Baker Lake Interviews).

I can't comment much on the snow, but generally the snow has become much harder (Moses Akilak, Baker Lake Interviews).

The strong winds are also blamed for the lack of *Aput* as it is believed that the snow is being blown off the land by these extreme and frequent winds.

Out there on the mainland I think that there is still snow coverage but it just becomes too hard. But I noticed that on the ice there is hardly any snow coverage. I think the snow is just being washed off the ice because of the high winds. It is not settling on the ice. So there are a lot of lakes with very little snow coverage. And the snow coverage on the land becomes very hard (Henry Isluanik, Arviat Interviews).

Another snow type that is absent in recent years is *qapiq*. *Qapiq* is when there is a thin layer of ice on top of the snow cover, which is hard enough to keep the snow together. It was useful in the past to cover fox traps. Snow with *qapiq* on it would be cut and it was scraped very thin from the bottom and the thin ice would keep the thin slice of snow together. This was placed on top of the trap to provide a wind resistant covering that wouldn't freeze to the trap.

Another thing we miss now is the *qapiq*, it is not happening anymore. Is it because we just don't notice it? It is a very thin ice layer on the surface of the snow. We used to use it for a trap. We would cut an oval of snow and scrap it. This cover was used to keep it together (Donald Uluadluak, Arviat Interviews).

A strange occurrence in recent years is the advent of significant amounts of snowfall in *ukiuq*. In the past, any significant snowfall was reserved for *ukiaq* and *upinnaqhaaq*.

In earlier years, the snowfall was expected during certain seasons and it was accurate. But now the snowfall has also changed. Snowfall is happening in odd seasons of the year. Even in the middle of winter there is snowfall (Jacob Ikinilik, Baker Lake Interviews).

Another weird weather change I have noticed is the snow falling. When there shouldn't be snowfall there is *qanniqtuq* [snowfall]. There are only certain seasons of the year when there should be snowfall and this is not occurring in the seasons that it should be (Moses Akilak, Baker Lake Interviews).

When *upinngaqhaaq* arrives the snow has started to melt earlier and more rapidly due to the warmer temperatures and lighter snow cover.

Once the snow started melting it would melt gradually. Now the spring melting is more sudden and much quicker (Barnabus Oosuaq, Baker Lake Interviews). [The snow melting] seems to be earlier because the snow cover is less than what is normal this results in earlier melting of the snow. We are not reaching the normal amount of snowfall (Jacob Ikinilik, Baker Lake Interviews).

### 3.3.6 RAIN

Ample amounts of rain were expected during *upinngaaq* in the past. This rain, supplemented the moisture provided by the melting snow to sustain vegetation growth. The amount of rain occurring during this time has changed.

In the *upinngaaq* it was common for rain showers and sunny periods in between. This resulted in good vegetation growth. Animals like caribou depended on that good plant growth for their health. This was an occasional thing in the *upinngaaq* to have rain showers and lots of sunshine. There is not as much as before now and there is less vegetation growth (Tony Otuk, Arviat Interviews).

These days there is less rain. Personally I think there is less rainfall than there was before. The winds from Kivativut [southwest] are what creates wet weather, it brings rainy weather. When that doesn't happen it is a dry weather (Luke Anowtalik, Arviat Interviews).

In the past, rain was often associated with thunderstorms. These thunderstorms could even occur early in the season before the ice had left the ocean. Rain and thunderstorms have been notably absent for some time.

No rain - not enough rain... Another change - in the past there was a lot of rain with thunderstorms - now there is occasional rain but hardly any thunderstorms. It was part of our expectations during *upinngaaq* that we would have lots of thunderstorms (Tony Otuk, Arviat Interviews).

**No more thunder storms during the summer. Before we used to have severe thunderstorms. The first thunderstorm occurred during the time of *tuvak*. This [early rain] happened rarely – not every spring (Louis Angalik, written submission).**

### 3.3.7 SEA ICE

Changes in climate have affected the formation of sea ice on Hudson Bay in the Arviat area. Ice has been forming later than was usual in the past.

Everything seems to be much later freezing. The same thing with the floe edge. Everything seems to be behind (Luké Anowtalik, Arviat Interviews).

The overall thickness of the sea ice has also been reduced causing there to be less confidence in the safety of the ice for winter travel.

**I am now more fearful of the sea ice because we don't know if what used to be safe to travel on may not be safe. There are more unsafe areas on the sea ice and this also goes for the lake ice (Johnny Karetak, Arviat Workshop).**

A change in the action of the wind at the flow edge has also been noticed.

Years ago when we had the *nigiqtuq* (southeast wind), very thick chunks of ice used to get on top of the sea ice. That was a normal occurrence in the past. We don't see that anymore (Philip Kigusiunaaq, Arviat Interviews).

The sea ice is also melting earlier than usual according to study participants. The melt occurred gradually in the past, and it was completed in the month of July. Recently the ice has been gone in the month of June.

I also want to comment on the *upinngaaq*. When melting the sea ice would break up first and drift out one chunk at a time and eventually disappear. But now it just disappears quickly by drifting out into the ocean (Tony Otuk, Arviat Interviews).

Another thing that is really noticeable is the going of the sea ice. It is going out earlier now because the thickness is not as it used to be....or is it the

creek over here that is causing more currents, but why is this happening (Donald Uluadluak, Arviat Workshop).

**It is even more noticeable when you go to other communities and compare the weather and see other weather patterns, [when you know] their weather patterns traditionally. For example I used to live in Rankin Inlet. There was a time when the sea ice used to go out in the middle of July. In the last three years there was a time when the sea ice went out on July 1. Now they are experiencing like Arviat that the sea ice is going out in June (Johnny Karetak, Arviat Workshop).**

### 3.3.8 FRESHWATER ICE

In general, observations on freshwater ice mainly indicate that the ice is forming later in the year.

**I have noticed that the thickness of the ice is often very much thinner in some areas. Another thing is that during the freeze up it remains dangerous for quite a while. Even last freeze up after it froze we waited a long time for it to be safe enough. We had to wait quite a while compared to when it would be traditionally safe (Tony Otuk, Arviat Interviews).**

Also in the last couple of years I observed that the ponds and smaller lakes may still freeze [on time] but the larger lakes like Baker Lake are late in the season (John Avaala, Baker Lake Interviews).

One participant estimated that late freeze-up and early break-up events have become common within 15 or 20 years. The ice is taking longer to reach a safe thickness, and it does not reach its previous maximum thickness. Traditionally, the thinnest ice on the lake could be found by locating areas with a thick layer of old snow. Today, even areas without snow coverage, the ice does not get as thick as previously experienced.

When we are looking for thin ice we usually test the snow to look for the thinner ice. You have

to look for good snow coverage to find the thin ice. Even in the month of March all throughout the lakes when the ice reaches its maximum depth the thickness of the ice has changed. It is not as thick as it used to be, even where there is very little snow coverage. Also the lateness of the freezing of the lakes...sometimes November appears like the month of September (Hugh Tulurialik, Baker Lake Interviews).

... the thickness of the ice has lessened compared to what was considered to be the maximum thickness in the past. It doesn't reach that thickness. I have experienced that (Jacob Ikinilik, Baker Lake Interviews).

**Years ago the ice used to get really thick where they had to have really long ice chisels. We would use up the whole length of the ice chisel. Now we have much shorter ice chisels and we still manage to reach the water. It seems that the overall ice thickness has lessened. Also the thickness of the ice is an indication of how cold the weather is. If it has been cold it will be thick. If it has good snow coverage it is likely to be thinner, but overall it follows the climate (Philip Kigusiunaaq, Arviat Interviews).**

The slow rate of thickening in *ukiaq* and the overall reduction in ice thickness have produced more dangerous ice conditions early in the season resulting in a delay of some land-use activities.

We also get very warm spells, like maybe 4 years ago or 3 years ago our winter was just too warm, and all the places that traditionally would have been safe to travel on - had to be postponed from three weeks or a month. For example the ice didn't freeze. It was very late. Something like almost a month before it finally froze. The hunters were told not to cross the lake because it was still too dangerous, because there were lots of caribou across the lake and everybody wanted to get out there. But the Elders and the experienced hunters were saying "it's not safe, wait for another week". A week would go by but still the ice was too thin. So it was something like 3 weeks later that they were finally able to get out there. This

was not only in this Lake [Baker Lake] but also in other areas where there is major lakes [White Hills]. Even little lakes behind the community were just too dangerous to travel on. You know it is scary because we can no longer depend on ... traditional knowledge; where it was safe to travel on these areas, now we don't know. I don't know if I am making any sense. Even to us it is hard to understand (Joan Scottie, Baker Lake Interviews).

Even when the general ice coverage on the lakes and rivers has become relatively safe there are areas that have thin ice or open water throughout the winter called piqtait or aukarniit. These dangerous areas have been changed by the altered ice conditions. There are now new aukarniit, and existing aukarniit have increased in area.

Especially the dangerous spots are taking much longer to be safe to travel on. The places that are dangerous remain open much longer while the rest of the area has frozen (Philip Kigusiunaaq, Arviat Interviews).

That is true the piqtait are taking much longer to freeze now, or to be safe enough to go to. Normally they are later than the rest of the lakes to freeze so they are much later now (Luke Anowtalik, Arviat Interviews).

In the 1940s when I lived out on the land there was a traditional fishing spot on Marjorie Lake that used to be frozen and we used to fish in April. Last May we went back there to go ice fishing when we reached it was all open water. We were surprised to see it open in May. Luckily Qaqimat came along. We thought it was the wrong place but he confirmed that this was the same location (Caller #20, Baker Lake Radio Show).

The process of the melting of the ice has been starting earlier and occurring more suddenly in recent years. During this process the ice first becomes *tuvak*, and can develop into illaujat (candle ice). This process is happening earlier.

...recently, the ice seems to go bad much earlier and much quicker. The ice seems to melt much quicker. And the ice seems to form illaujat earlier.

The ice doesn't last as long generally with regard to the whole spring... Illaujat are dangerous because you can't tell they are dangerous from a visual inspection. They should be feared. Piqtait are often at the narrows. They may be deep or shallow. They are hard to explain but these are often open water. They aren't rivers, but it must be created by currents (Jacob Ikinilik, Baker Lake Interviews).

A long time ago the weather wasn't too extremely warm, extremely hot. This is the case today. This could be contributing to the earlier melting of the ice (Barnabus Oosuaq, Baker Lake Interviews).

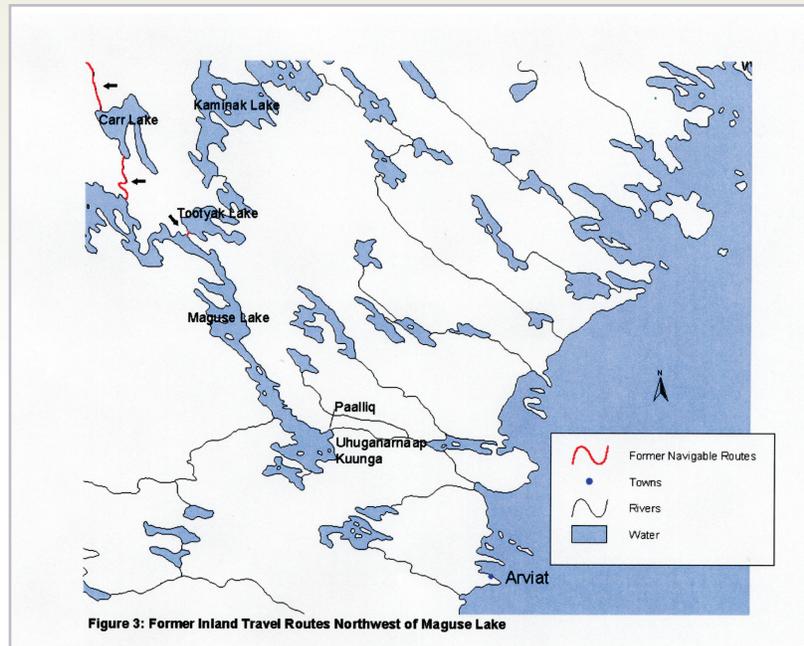
### 3.3.9 RIVERS AND LAKES

Several participants in both communities noted that water levels are lower in the lakes and rivers, and are now lower than historical high water levels. Smaller lakes and ponds have also dropped drastically, some even dried up completely.

When we first came here there were ponds and lakes north of the community and they were used as water sources and now they have dried up. I remember several of those small ponds or lakes have dried up. People who have lived most of their life on the ocean are reporting the drop of the ocean. These are changes they have noticed on the water levels (Henry Isluanik, Arviat Interviews).

In the fall before the freeze up the water level gets very low. Shortly after the spring runoff the water is expected to be higher than before freeze up. I have noticed that the high water level in Baker Lake is not being reached where it used to be. There is a sand bar in front of the community of Baker Lake, which is more visible now - it is always there (Barnabus Oosuaq, Baker Lake Interviews).

**The lakes, the ponds out there...it is normal for the water levels to go down in the past, but now the water levels are way down and for some they are completely dried up. I really noticed the difference. When I go out to the land and pass a lake that I passed on a previous year we now**



**travel right on the lakebed. This is something that we have really noticed (Luke Anowtalik, Arviat Interviews).**

Major rivers have also shown significant drops in water levels and they are becoming dangerous to navigate during low water periods. There was a drastic drop in the Thelon River noticed about four years ago. Other smaller traditional travel routes through creeks northwest of Arviat have become too shallow to navigate for at least the last six years (see Figure 3).

Some people have noticed the water levels have gone down. Especially about 4 years ago, 4 summers ago the area really dried up. Over a year ago I also noticed that up the Thelon there is rock that usually just the tip of it would appear when the water level goes down [in first rapids up the Thelon] That year the whole rock was just sitting there. Usually just the tip would appear. And in another area that is known as Okowt's Land, there is a little inlet that is no longer there. It is just a dried area now (Hugh Tulurialik, Baker Lake Interviews).

I have noticed how shallow it is now. There used to be deep areas where we used to travel through. You have to maneuver your boat through these deep areas. The water level has gone down and sometimes you are grounding your motor. In the summer time it is getting difficult to travel. Early in the spring when the water levels are high it is still okay....I can even say that years ago we used to go up the river in the dark, and we would not worry about hitting rocks or shallow water. It is so shallow now, and it has become a real problem when you have to go up the river - in the real *aujaq* (Unnamed #1, Baker Lake Interviews).

**When I was growing up my father used to tagjaq (go inland) and having to cross those rivers and creeks. Now these places have dried up. We went up there a few years ago to a place where my father used to frequent as a hunting area. We were able to put our canoe with a maximum load with all our dogs and everything, but now it has dried up (Tony Otuk, Arviat Interviews).**

One Baker Lake land user goes up the Thelon River yearly to prospect. He estimates that in the last 4 or 5 years the drop in water levels in the river has become noticeable to him.

Low water levels in the lakes and rivers were attributed to the lack of snowfall in *ukiaq*, lack of rainfall in *upinngaaq* and *aujaq*, and rapid ice break-up and run-off.

...there is more ice coming down from Shultz Lake or Aberdeen Lake... Faster and earlier” and this is eroding the riverbank (Andy Andy, Baker Lake Interviews).

I don't observe the whole river too closely, only last year I noticed that the river opened quite earlier. The ice cleared up pretty quickly. Usually when it opens the ice accumulates along the edges. But they didn't accumulate as they usually do; the ice was cleared up quite quickly. I used that area in the past and sometimes you would have to wait a certain length of time. That seemed to be earlier than usual. But again, I don't keep a record of what is happening. It wasn't last year, but the year before (1999) (Unnamed #1, Baker Lake Interviews).

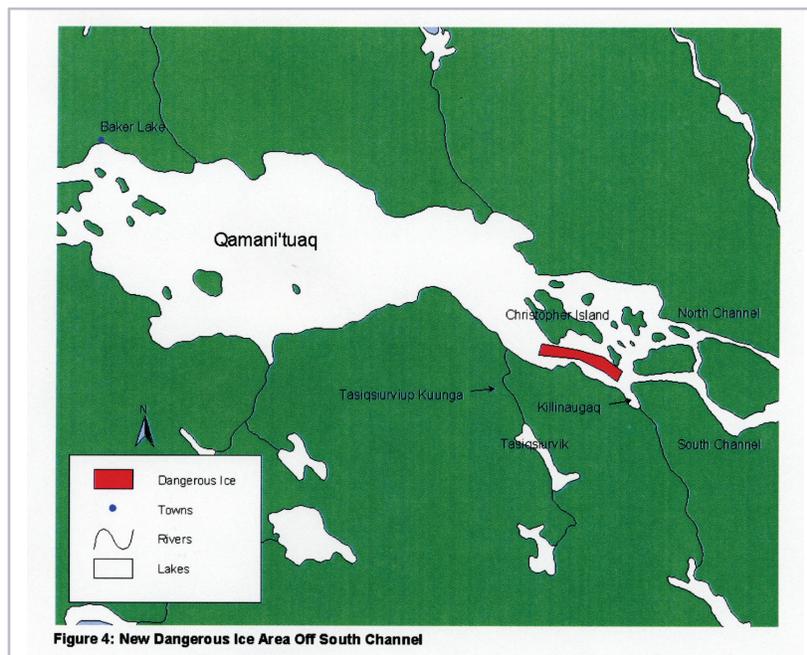
...when we have the three months with no rain during the summer and during the spring the water levels go down right away right after the spring run-off. Early in June or rather late in June when everything is melting and early in July after

the spring run-off, we have very deep areas on the rivers where it is safe to travel (by boat). But by late July everything dries up and it becomes dangerous. Even in areas where it was safe to travel, during these dry spells it is too dangerous. The water is too shallow or the rivers are too shallow (Joan Scottie, Baker Lake Interviews).

Low water levels in the “Channels” (where Baker Lake drains into Chesterfield inlet) were first noticed in 1975 and have caused the currents of the outlet to reach out further into Baker Lake. Strong currents have caused thinner ice conditions and earlier ice-free conditions in this area (Figure 4), and it has also allowed the salt water of Chesterfield Inlet to move further into Baker Lake.

Within the years I was piloting [1963-1980] I noticed that the water level was going down. The piloting was visual, and so I noticed rocks that weren't there. They had surfaced...In 1975 that was when I noticed while I was still piloting the ships. I noticed where water should have been there was no water. It had dried up (Eugene Niviatsiak, Baker Lake Interviews).

I was talking earlier about the level of the water that has gone down in the channels. The result



is that the currents in this area have become stronger and it is causing the ice to go out earlier. By late June it was still travelable years ago... I grew up in the Tasiqsiurvik area and after freeze up we used to fish in this area. Back then when we put our line down it was straight. Recently he noticed that now when you put your line down it is carried by the current [towards the ocean] (Eugene Niviatsiak, Baker Lake Interviews).

I am not an expert on exactly where you taste the salt water. But recently it used to be the Bowell Islands area where you could taste salt. But now when there are big waves on Baker Lake, one can even taste salt here at the settlement of Baker Lake. I noticed just recently how salty it is on the windy days. I have been in this area before and it was not as bad. It has worsened... I think is that because the water level has gone down so much in the Chesterfield Inlet area, when it is a high tide the currents are so strong that it just enters into the lake and mixes with the fresh water. At the time when the water level was higher the high tide did not affect the water in the lake so much. (Eugene Niviatsiak, Baker Lake Interviews).

When I piloted the route [through Chesterfield Inlet] had to be a minimum of 25 feet deep during high tide. Today these areas are may be only 19 or 20 feet, so I figure that the water level has gone down at least 2 feet in some areas (Eugene Niviatsiak, Baker Lake Interviews).

The low water levels in the rivers and streams are having an effect on the seasonal migration of the char according to some participants. The char populations in the Prince River, and the Maguse River have been identified as having less fish due to low water levels.

There used to be paalliq and in Maguse River because the fish were able to go up there was lots of fish [char]. Now there is no fish. I think they are having a hard time getting up. Also the fish that are there. The meat has changed. They used to be nice and red but now the color has changed (Tony Otuk, Arviat Interviews).

I know that the decline is resulting from the low water level. There are places where arctic char were caught where they were not able to migrate.

I know other places in the world where they dig it out to make it deeper, they are lucky (Donald Uluadluak, Arviat Interviews).

Usual spawning areas may have changed because of changes in water levels. This could be one of the reasons there seems to be no fish at spots they were traditionally found (Eugene Niviatsiak, Baker Lake Workshop).

### 3.3.10 VEGETATION AND LAND

The higher temperatures in *upinngaaq* and *aujaq* together with a reduction of snow and rain are creating dry conditions on the tundra. Birch, willows and grasses are growing more rapidly and reaching larger than normal sizes in response to the changes. This over growth has been noticed at old campsites where artifacts have been swallowed up by the growth.

Our old sailing boat that we beached on the land - now the whole inside is full of vegetation and it is just the rim sticking out. I was sorry that I didn't bring a camera [in 1998] when I was a child we beached it and look how part of it has disappeared, I wanted to put it in the paper because I was so amazed (Eugene Niviatsiak, Baker Lake Interviews).

Just that the vegetation, plant growth is growing a lot more. When I used to live inland – coming up here there was less plant growth. Now there are more willows and grasses in the area. This is probably resulting from the warmer temperatures... Also with the rocks, old graves and other rocks that were used for weights, they are disappearing. Sometimes I feel when we are doing caribou caching that we may have done it on an old grave. Because of the way the growth is the rocks are being covered over (Philip Kigusiunaaq, Arviat Interviews).

This increased rate of growth of the willows has resulted in an increase in the height of willows in traditionally known areas, and a rapid advance of the tree line.

**Tree line seems to be getting closer and the trees are growing much taller. At Padlei there was no willows at all, but now it is like a forest (Philip Kigusiunaaq, Arviat Interviews).**

The fruit bearing plants, however, do not appear to be faring well under the hotter and drier conditions. All species of berries are being reported as having stunted growth resulting in no berries, or a reduced number. Berries are ripening earlier than in the past.

They [the berry plants] seem to be growing not as big as they used to be. They seem to be ripening when they should still be growing. Also the cloudberry, they open up even before they reach their full growth ... There is not as much moisture on the ground, and when it is a good day the temperature is way too hot killing the proper growth of the berries and other plants. Although the plant growth of other plants seem to be growing more, but the edible things are seemed to be bothered by the heat (Philip Kigusiunaaq, Arviat Interviews).

In the springtime when the vegetation is growing, at first they grow as they should, but when they are just about dried and withered away, some of them come back to life from the moisture. This is resulting in berries and other things not growing as they should. The only moisture they are getting earlier in *upinngaaq* is from the melting of the snow. ... The ones I am talking about is referring to the inland plant life. There is less berries and plant life close to the coast. But I am referring to my spring campsite inland and I have observed that there aren't cloudberry (Donald Uluadluak, Arviat Interviews).

With the lack of rain the berries don't grow, as they should. Even last summer the growth of the berries and the ripening seemed to be late. They were later due to the dry spell (Barnabus Oosuaq, Baker Lake Interviews).

There are hardly any paungrat [black berries] now. About 2 or 3 years ago there used to be more berries up where we go prospecting [north of Half-Way Hills]... I don't see blueberries or cloud berries (Andy Andy, Baker Lake Interviews).

I have observed that the cloudberry are not growing as they should be and the same thing with the paungrat. This may be due to very little or not rain during *upinngaaq* (John Avaala, Baker Lake Interviews).

There was only one report of erosion from the interviews, and that was located along the banks of the lower Thelon River, close to Baker Lake. According to Andy Andy of Baker Lake, the large amounts of ice being cleared by the river all at once, is causing the land to be eroded along the riverbank.

Along the Thelon River Banks the ice crashes along the edge. Traditionally when the river bursts open the ice is pushed up the banks and this piles up gravel and rocks (*apurtiniq*). I have seen mudslides... They are sliding down to the river. I guess from the heat. You know there is permafrost below the [ground surface]... and they just slide down (Andy Andy, Baker Lake Interviews).

Vegetation changes have also been observed in the aquatic ecosystems.

**The ocean has more qitquat [sea weed] than before. This is vegetation on the bottom of the ocean. There is more "hair-like" sticky qitquat. The ocean beaches are now littered with these plants. Our ocean has definitely changed over the last 100 years and is still changing (Louis Angalik, written submission).**

### 3.3.11 WILDLIFE

#### Caribou

Study participants in both Baker Lake and Arviat expressed their concerns over a decline in the health of the caribou. This was attributed to warmer temperatures and low levels of rain and snowfall resulting in dry and unhealthy vegetation. The heat and the insects also disturb the caribou and cause them to eat less and move constantly.

Traditionally the hunters knew that during June and July- during the hot months - the further up inland you go the temperature is much hotter, and the animals are not very healthy. They are running around bothered by the bugs and they are not eating right. They are too hot and sometimes

they are just skin and bones. The experienced hunters used to go down into the channels where traditionally the caribou there have big fat on them just like *ukialiit* [fall caribou]. Now you go down there to hunt looking for healthy caribou and they are not as healthy as they used to be. They are being bothered by the heat. I know this from my own experience that this has been happening (Hugh Tularialik, Baker Lake Interviews).

The caribou are thinner even in the middle of July from dry grass. Not enough fat to be called perfectly fit. (Andy Andy, Baker Lake Interviews).

The caribou I see and hunt - I have noticed they are less fat and more undernourished. Not all of them. When they should be fat they are more often undernourished.... Traditionally we know when the caribou should be fat but when there are extreme hot/warm temperatures they are always on the run and this makes them more undernourished and unhealthy. During August and September they should be fat but they are often not today. If they have fat then it is less and a small percentage of them have fat (Jacob Ikinilik, Baker Lake Interviews).

Caribou are thought to be undernourished due to the heat and dryness in the summer. In the winter, the hard packed *Aput* may also play a role by making it difficult for caribou to reach their feed.

When you have this packed snow it is very hard and I think that the caribou are not eating right as they used to as they must dig to get their food. It would result in caribou not eating well enough (John Avaala, Baker Lake Interviews).

The poor condition of the caribou is not only observed in the quality of the meat, but is also seen in the skins. The skins are weak and tear easily during field dressing.

It is hard to find an explanation for all the health of the caribou. It is not just the meat but also the condition of their skins. They will just rip while you are skinning them. They can easily tear... I

noticed that the caribou with the easily tearing skins are usually very skinny caribou, in very poor health with no fat (John Avaala, Baker Lake Interviews).

Years ago when we were getting skins for clothing you knew which animals to kill. The hair side and the inner side. Now today the skins may look good but after they skin them the inside is in very poor condition. It is very thin and has a poor texture (Jacob Ikinilik, Baker Lake Interviews).

There are a lot of things that we have noticed that have changed. In the winter we collect the caribou legs for clothing, because they are the toughest part of the skin but they are in a more fragile condition now. They are easier to rip. This is strange (Tony Otuk, Arviat Workshop).

Other affects to caribou reported include a change in antler development.

Another thing that I have noticed and that I have discussed with other hunters - in the fall the caribou antlers used to become very hard and thick but I haven't seen that type of antlers in the past for a while. What is causing that? They used to be common and now you don't see them.

*Question: How long has it been since you saw them?*

Ten (10) years. We used to live up inland and it used to be very common over 10 years ago. The antlers don't get that thick anymore (Donald Uluadluak, Arviat Workshop).

The decline in the fitness of the caribou is associated with an observed increase in the number of diseased animals being killed by hunters.

I have experienced [diseased caribou] at least 3 times. I have noticed strange condition of the caribou. During the fall, even when it has started to snow, that is the time when big bulls have a lot of fat on them. But they were unfit for human consumption. One was just skin and bone with all kinds of sores on the mouth and the tongue. I

find this strange... The recurrence of these types of strange sicknesses on the caribou has begun to occur on a more regular basis. This was not the case in the past and I find this unusual. (Unnamed #1, Baker Lake Interviews).

From the time that I was growing up to now I have been eating caribou. I know what to expect in meat and the health of caribou. Compared to years ago the percentage of caribou caught is more often unhealthy. In many ways, sores on their limbs, usually identifiable sicknesses –pus on the limbs or sores on the joints. [This] Seems to occur more now than in the past (Jacob Ikinilik, Baker Lake Interviews).

One respondent considered the presence of disease in caribou as normal.

In the past we used to find sores on the caribou. They may have had swollen limbs. We would take that part off and eat the good part. With regard to the meat we also saw the white spots on the caribou, and if it was deemed unfit we would just feed it to the dogs. To me this is continuing and the health of the caribou seems to remain the same (Philip Kigsiunaaq, Arviat Interviews).

### Other Animals

Other than caribou, observations of changes in the behaviour and range of polar bears and grizzly bears were common among Arviat participants. Polar bears and grizzly bears have become common in areas and during times when they were not normally there in the past. As well, there have been unusual sightings of black bears in the area. The bears have also been showing unusual behaviour, such as depicting no fear of humans. This situation has raised safety concerns among the study participants.

First of all I want to mention about the migration of the polar bears. Before people were used to put up tents in July and August, but now you don't feel safe because the polar bears are still around. There are also lots of polar bears ...they [polar bears] weren't there at all during the summer months. Now they just happen to be there. Safety-wise, people are concerned that they are still around (Donald Uluadluak, Arviat Interviews).

In the middle of winter during the *ukiuq* they [polar bears] are usually all gone by then. You might see an odd one, but by mid-winter they have all migrated. I am talking about *ukiaq*, there are lots in the area, when they should all be gone by December (Philip Kigsiunaaq, Arviat Interviews).

I grew up in this area and I spent a lot of time in this coastal area. There were places where there were no polar bears expected. Now they are there when they shouldn't be there. Now they are unpredictable. They wouldn't attack you but now they will (Johnny Karetak, Arviat Workshop).

Talking about camping in the tents. There was a time in the spring when we really enjoyed being in the tents. Now it is not comfortable due to fear of polar bears and grizzly bears in *upinnaaq*. Now there is fear of high winds. It is not as enjoyable as it used to be. Even grizzly bears are coming out as far as the coast (Donald Uluadluak, Arviat Workshop).

Grizzlies may be more numerous in the Baker Lake area, or perhaps they are simply coming into contact with humans more often.

Grizzlies seem to be more numerous. Cashed caribou would normally not be disturbed. But some people cached at Aberdeen and they had 20 caches and every single one was emptied (David Toolooktook, Baker Lake Workshop).

Grizzlies seem to be more in the tree-line. They seemed to be less abundant in the past, but are now being sighted more frequently. I think they must be wandering out from the tree-line (Thomas Qaqimat, Baker Lake Workshop).

Observations were recorded in the study area concerning the failure of birds to arrive in the spring.

...birds, and even ptarmigan, that used to be plentiful in the springtime they didn't arrive. There used to be a lot being very noticeable. It has been ongoing (Luke Anowtalik, Arviat Interviews).

There used to be lots of smaller birds and lemmings in the spring and they have disappeared (Caller #24, Baker Lake Radio Show).

**Snow conditions may also be affecting birds like ptarmigan.**

While everyone is talking about the disappearance of the ptarmigan, earlier it was discussed about the growing of the willows. I have noticed that there are lots of willows and where the willows are there are lots of ptarmigans. I think they have just taken over a new habitat. This gradually happened over about 20 years (Donald Uluadluak, Arviat Workshop).

The discussion of the ptarmigans and their disappearance. I believe what Uluadluak was saying about moving to where the willows are. All these things we are talking about have to do with the snow. The snow has become very hard and they have been unable to dig through the snow and they go where the willows are where the snow is very soft. All these other birds must also have been affected by the hardness of the snow. Years ago we were able to cut snow anywhere to make a shelter or a windbreak the snow is very hard now. What other animals are being bothered by the packed snow? Another thing I wanted to comment on is my wife really loved ptarmigan and she really craved for ptarmigan. Her son went to get one and he got one and they checked the gizzard and it was empty. It didn't have a proper diet. We thought it would have a different taste and sure enough it did because of its diet. The snow is too hard for them and they don't have enough feed (Johnny Karetak, Arviat Workshop).

**While some species of birds are rarely sighted, other birds have become more numerous.**

There are so many of the ravens now where they never used to be (Tommy Miseralaak, Arviat Workshop).

Another strange thing is there are too many ravens. In the past we rarely saw them in the winter. In the spring they leave (Thomas Qaqimat, Baker Lake Workshop).

**Sandhill cranes have changed with many being observed eating carrion.**

How the sandhill cranes feed traditionally, now they have turned into carrion eaters. They eat dead meat or meat that they have stored. I wish my parents talked about this so we would know if this happened in the past, but I find this strange (Donald Uluadluak, Arviat Workshop).

Even where you have skinned a caribou the sandhill cranes will be there to eat the guts and skin. There may be a shortage of their traditional feed now (Louis Angalik, Arviat Workshop).

**As discussed under the "Rivers and Lakes" section, there have been some changes observed in the fish populations. Low water levels are being blamed for smaller populations of fish. There were also observations made about fish being undernourished.**

There is a river called Kuu'naaq. We went fishing there 2 years ago and we noticed that this river, which is bigger than Anigup Kuunga, has frozen right to the bottom. This is where we used to fish in the past... There used to be lots of fish and it is a traditional fishing place for her. The fish have become very skinny and long - undernourished. All this is probably due to the climate change (Caller #16, Baker Lake Radio Show).

The only difference is there seem to be more skinny fish. Six or seven years back during the spring breakup the fish used to be more fat, especially char and trout (David Toolooktook, Baker Lake Workshop).

### **New Species**

Several non-indigenous species of birds, insects and mammals have been sighted. Names for these species are being introduced into the Inuktitut language.

There are insects that we call tuktuujaq that are like big mosquitoes. We have seen these, but there are different insects that look like tuktuujaq and we just name them tuktuujaqtuq – they appear to be this type of insects. Strange insects we are just naming them as look-alike mosquitoes or bumblebees. They are all flying insects not crawling (Joan Scottie, Baker Lake Interviews).

Warmer temperatures may be responsible for the arrival of flying insects from the south and for insects generally being active longer in the year.

There are also different birds. Larger types of black flies. And also the houseflies - when they should be long gone - they are flying longer (Donald Uluadluak, Arviat Interviews).

...I have noticed different types of insects that are probably due to the temperature getting warmer. Before we had the same type of insects every year and now there are foreign insects (Philip Kigusiunaaq, Arviat Interviews).

There are unusual bugs that I am seeing which I consider to be from the tree-line and they give me the creeps (Barnabus Oosuaq, Baker Lake Interviews).

In trying to understand the arrival of these new species, normally found within the tree-line, many participants postulated that forest fires to the south have caused their relocation.

I guess sometime in the 80s we started getting weird very foreign looking bumblebees and they were blaming one teacher that was trying to raise some honey or something one summer. They were saying that it was all her fault that we have these weird looking bumblebees. But she has been gone for 15 years and these bumblebees are still around. I don't know if they are able to breed after they are up here, or I don't know. There are other strange looking insects that we have seen and people are trying to explain it by saying that there are too many forest fires in the Yellowknife, Fort Smith area and these insects are moving to this area (Joan Scottie, Baker Lake Interviews).

There are foreign species, especially the tingmiat (bigger birds). Also there are reports of tiriirjuat (weasel / marten) that were very rare in the area. We think that because there seem to be so many forest fires in the south that they are deserting

their traditional range and looking for new territory to live in (Tony Otuk, Arviat Interviews).

Also, different species are being sighted more frequently very close to Baker Lake and Arviat.

In the past you knew which types of birds would come back year after year. You knew their colors and what they were. Now you see different birds that are different in color or size. They weren't seen before (Eugene Niviatsiak, Baker Lake Interviews).

And we also see quite a bit of moose now. Quite close to the community. We know that there are some moose up in Beverly Lake, even near Shultz Lake area, but now they come right near the community. And for the birds, we also see all kinds of birds we haven't seen before. Sometimes they don't migrate and they stick around the community and sometimes we don't know if they're lost up here. That has been happening quite a bit. Not the little birds but there are all kinds of strange birds flying around (Joan Scottie, Baker Lake Interviews).

We already have the piqtu & iraq, the native lynx to this land. But there are different kinds of lynx that they are reporting but I haven't seen them and I don't know what they look like. (Joan Scottie, Baker Lake Interviews).

### 3.3.12 HEALTH

The only observations that were made associating changes to the weather and human health are the advent of sunburns. In the past sunburns were not experienced, but recently they have started to rely on sunscreen and clothing for protection.

Years ago you didn't put any lotion on of any kind. Even mosquito lotion and it didn't bother you. But now if you spend a few hours out there without any sun protection you come in with

either a sunburn or skin rash. It wasn't like that... Another thing is that when you plan to go out on the land for a long distance travel you have to plan to bring along sunscreen. This wasn't done before. (Hugh Tularialik, Baker Lake Interviews).

I noticed that years ago without any kind of *qablunaaq* made sun lotions we weren't getting any kind of skin irritations. But now we must have some sort of sunscreen on. And also the snow blindness, we have to wear sunglasses (Philip Kigusiunaaq, Arviat Interviews).

# 4.0 CONCLUSIONS

Conclusions from the literature review include:

- Inuit knowledge of climate change has not been widely documented at the community level.
- The state of documented traditional knowledge of climate change does not reflect the level of Inuit knowledge of climate change.
- Science-based research is providing an extensive body of work on climate change trends and impacts. In contrast, climate change as observed and experienced by individuals and communities has received less attention.
- Most work to date has been incidental and a component of larger studies.

The first and second objectives of this study were to collect information on whether or not climate change is occurring and first-hand observations and experiences. The consensus among the participants of this study is that the climate has been changing over the past 5 to 10 years and is based on the following observations and experiences:

Season and weather

- Changes in the length and timing of the traditional Inuktitut seasons;
- Warmer temperatures year-round;
- Unpredictable weather and winds;
- Stronger winds;
- A change in the direction of the prevailing wind;

Ice, Snow and Water

- Later and slower freezing of the lakes, rivers and the ocean;

- Earlier and more rapid melting of ice and snow inland and on the ocean;
- Reduced and more compacted *Aput* on the land;
- Reduced rainfall and fewer occurrences of rain/thunder storms;
- Reduced water levels in the lakes and rivers;

Land and Vegetation

- Impaired growth of edible/fruit-bearing plants;
- Increased growth of willows and birch;
- Movement of the tree-line northward;

Wildlife

- Unhealthy caribou;
- Polar bears encountered in new areas later in the season;
- New species being sighted;
- Some existing species becoming more abundant while others are becoming less common.

The third objective of this study was to collect information on the impacts of climate change to Nunavummiut and their adaptation. Observed changes resulting from climate change present many challenges to the land users. The residents of Baker Lake and Arviat are having to adapt their traditional activities and knowledge to the observed changes.

## **Seasonal Change**

Six Inuit seasons were identified based on environmental conditions and the traditional activities that would occur. Observed changes in season timing, duration and environmental conditions have resulted in a change in the activities

that would occur and bring into doubt the use of traditional Inuktitut terms for the seasons.

### **Weather Patterns**

Observations indicate that weather patterns are unstable with respect to temperature fluctuations, wind speed and direction and storm behaviour. These conditions have resulted in a lack of confidence in the knowledge related to weather forecasting. The unpredictability of weather conditions has implications for safety during hunting, fishing and other activities.

### **Temperature Change**

Warmer temperatures year-round have resulted in a change in environmental conditions in the seasons particularly noticed during *ukiuq* and *aujaq*. Many of these changes have affected traditional activities for example skin collection and use for clothes and meat drying / caching.

### **Wind, Storms and Skies**

The general consensus is that in the past there were longer, and more, periods of calm weather. Observations to date include stronger winds and a change in the prevailing wind direction.

Strong winds and their unpredictability has resulted in safety concerns regarding staying in tents / cabins and going on the water while participating in traditional activities. A change in the wind has also resulted in a different behaviour in the snow particularly during storms, contributing to the unpredictability of the weather, and drifting. The change in snowdrift orientation has resulted in the loss of traditional navigation methods.

### **Snow and Ice**

Changes to snow quality and accumulation has resulted in a reduced availability of suitable snow for shelter construction. Sea and freshwater ice has been coming in later and leaving earlier and is generally thinner. Also, areas known to be open and dangerous

are growing in size and new areas are being found. This has meant that traditional activities have been affected and that traditional travel routes cannot be used due to safety concerns.

### **Rivers and Lakes**

In addition to the formation and extent of ice, commented on previously, the general consensus is that water levels are dropping, and in some cases gone, particularly during *aujaq*. This has resulted in more dangerous boat travelling conditions and a loss of traditional travel routes.

### **Vegetation and Land**

The warmer temperatures and lack of rain/snow has resulted in drier conditions. Some vegetation (birches, willows and grasses) are growing faster, bigger and in areas never seen before while other vegetation (fruit bearing plants) are experiencing stunted growth and reduced number of berries. The latter means a reduction or loss of traditional gathering areas and more importantly reduction or loss of feeding areas for wildlife.

### **Wildlife**

Of note was the decline in health of the caribou attributed to warmer temperatures, less available food year round and increased number of bugs. Additional safety concerns now exist due to the increased occurrence of polar and grizzly bears in known, and new, areas in addition to a change in behaviour by being less afraid of humans. Migration and nesting habits of birds have changed in addition to the loss of some species, abundance of others and arrival of new birds. Also reported were new insect, bird and mammal species. Lower water levels have also impacted fish health, fishing areas and spawning runs.

### **Health**

Sunburns are more common and people depend on sunscreen and clothing for protection.

Residents of Baker Lake and Arviat provide many examples of adaptation, or changes in their activities due to experiences associated with climate change impacts. However, many of these adaptations are simply being more vigilant when engaged in subsistence activities. For example, being prepared for a change in the weather, wearing sunscreen, observing water levels and ice conditions, using other navigation methods and caching meat later in the year.

Of note, is that the impacts and adaptations documented during this study may be the precursors to more significant changes that may occur too rapid, or over a broader area, for this type of simple adaptation to occur. Changes of this nature would require a more planned approach in order that adaptation can occur and the negative impacts to individual and community activities be minimized.

In the introduction of this report, it was discussed that this study was being completed as part of the development of the Nunavut Climate Change Strategy. Since this study has concluded that climate change and its associated impacts are occurring and that adaptation is, and will be, necessary, it was important that the Government of Nunavut address adaptation within its Strategy.

Recommendations from this study for input to the Nunavut Climate Change Strategy included:

- Enhance awareness and understanding of climate change in order that
- Nunavummiut know what climate change is, how it may affect them and what they can do;
- Encourage action on an individual, community and regional basis to prepare for climate change impacts and adaptation;
- Collect and use *Inuit Qaujimajangit* to identify indicators of climate change

and its impacts and establish a monitoring system of these indicators; and

- Continue to collect and use *Inuit Qaujimajangit* to identify impact / adaptation research needs.

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# APPENDIX A: LITERATURE REVIEW

## INTRODUCTION:

English-language social science literature was surveyed back to 1993 to identify studies of Traditional Ecological Knowledge (TEK) and environmental change, internationally. This survey supplements and does not duplicate references included in the report prepared for the Northern Climate ExChange study in October 2000 (Thorpe et al. 2000).

Studies included here provide critical perspective on the relationship between TEK and ‘western’, ‘modern’ or ‘traditional’ science, usually emphasizing their distinction through differences in scale and worldview (Berkes et al. 1998) but also underscoring commonalities and convergences (Berkes et al. 1998; Snively and Corsiglia 2001; Murdoch and Clark 1994). They provide insight into the reliability of TEK (Costa-Neto 2000), the cultural and economic conditions under which TEK is sustained (Benz et al. 2000) and a criticism of the modern use (Nadasdy 1999) and non-use (Clark et al. 1997) of TEK.

The articles include two focused on Canadian Inuit communities in the eastern Arctic (Pellerin et al. 1998; O’Neill et al. 1997). Both of these studies concern Inuit perception of ecosystem health.

## ANNOTATED BIBLIOGRAPHY:

**Snively, G and Corsiglia, J**  
 Discovering indigenous science: Implications for science education  
 SCIENCE EDUCATION 85:6-34 (January 2001)  
 This article concerns science-teaching (pedagogy) and the role of TEK versus “western modern science” in the classroom. It highlights examples of TEK and indigenous people’s contributions to science and an understanding of sustainability — particularly in Canada. They include controlled burns formerly on Vancouver Island to promote edible plants; the

aboriginal recognition of desirable genetic variability within plant taxa; sensitivity to change in natural patterns (e.g., by the Nisga’a) with implications for recognition of environmental pollution in its early stages; and the use of aboriginal technology in scientific fish sampling programmes. The article outlines how students should negotiate both forms of science.

**Benz, BF, Cevallos, J, Santana, F, Rosales, J and Graf, S**  
 Losing knowledge about plant use in the Sierra de Manantlan biosphere reserve, Mexico  
 ECONOMIC BOTANY: 183-191 (April-June 2000)  
 This article documents a negative correlation between TEK — in this case, indigenous plant use — and indicators of modernization, including aboriginal language loss, literacy and modernization of housing and community services, in Mexico. The authors show that TEK is both more diverse and more evenly distributed within communities speaking an indigenous language - the Huastec - than in mestizo and Spanish-speaking communities.

**Costa-Neto, EM**  
 Sustainable development and traditional knowledge: A case study in a Brazilian artisanal fishermen’s community  
 SUSTAINABLE DEVELOPMENT 8(2):89-95 (May 2000)  
 This article demonstrates the consistence of TEK concerning folk taxonomy, behaviour, distribution and diminishing abundance of fish among artisanal fishermen in Siribinha, a community in north-eastern Brazil. Consistence of traditional knowledge was observed through comparative cognitive tables. Fieldwork included open and semi-structured interviews, tours guided by the fishermen, direct observations and collection of fish specimens.

**Nadasdy, P**  
 The politics of TEK: Power and the “integration” of knowledge

ARCTIC ANTHROPOLOGY 36:1-18 (1999)

This article criticizes the idea of integrating TEK with western-based science. The author argues that TEK studies, as they are usually performed, require that TEK become subsidiary to science by contributing 'scientific data' to established western institutions and bureaucracies. As a result, aboriginal people are forced to express themselves through these institutions and non-aboriginal power bases rather than in ways that reflect their own values and practices, including TEK.

**Pellerin, J and Grondin, J**

Assessing the state of arctic ecosystem health: Bridging Inuit viewpoints and biological endpoints on fish health

ECOSYSTEM HEALTH 4(4):236-247 (December 1998)

This study was designed by Quebec's public health service and the oceanography department at the University of Quebec to examine fish health in Ungava Bay through a programme of scientific sampling and analysis and also through the documentation of Inuit perceptions of fish health and to provide a comparison of the results of the two methods. The health of Arctic char was measured directly by the scientists by assessing deformities, pollutant levels and parasites. Inuit knowledge of contaminants and perceived effects on fish and human health was documented. Observations by scientists and Inuit are contradictory and suggest that a complex relationship exists between TEK and scientific studies. It also suggests that local knowledge should guide or refine the focus of scientific research programmes and highlights differences between perceived risks and measured danger.

**Berkes, F Kislalioglu, M Folke, C Gadgil, M**

Exploring the basic ecological unit: Ecosystem-like concepts in traditional societies

ECOSYSTEMS 1:409-415 (Sept-Oct. 1998)

This article emphasizes the convergence of TEK in

Asia, the Americas, Africa, the Pacific and ancient Europe with modern science in two insights into and perspectives of the natural world: nature is often defined in terms of a geographic boundary, such as a watershed; and components of nature (earth, biota, climate) are linked in highly complex ways which make prediction exceedingly difficult. TEK complements science in providing a more locally-informed perspective of these relationships but does so in unfamiliar language that includes metaphorical imagery to convey information about context and concepts.

**O'Neil, JD Elias, B and Yassi, A**

Poisoned food: Cultural resistance to the contaminants discourse in Nunavik

ARCTIC ANTHROPOLOGY 34:29-40 (1997)

This article reports on a public health study forming one part of a larger-scale food/environmental contaminant study in the eastern Canadian arctic. Public response to the announcement of country food contamination was monitored in three Inuit communities in Nunavik (Quebec). Response in the community was to downplay the danger of poisoned food and environmental risk and to resist the implications of scientific studies where TEK was excluded from the discourse on this public health issue.

**Clark, J and Murdoch, J**

Local knowledge and the precarious extension of scientific networks: A reflection on three case studies

SOCIOLOGIA RURALIS 37(1) (April 1997)

This study examines local knowledge of three environmental issues in England (scallop fishing; Chernobyl fallout on pastures; wetland conservation). In contrast to scientific knowledge, which claims to be universally valid, local 'traditional' knowledge is contextualized. The authors find that scientists tend to ignore local understandings of situations and that scientific understanding would benefit from a partnership with local actors.

**Newton, J**

An assessment of coping with environmental hazards in northern Aboriginal communities

CANADIAN GEOGRAPHER-GEOGRAPHE  
 CANADIEN 39(2):112-120 (1995)

This study distinguishes between three levels of perception and action in people's attempt to deal with flood hazards in three northern communities: individual, community and government. The authors contend that vulnerability and preparedness are influenced by the extent of integration of TEK, community and technological knowledge at these operational levels.

**Murdoch, J and Clark, J**

Sustainable knowledge

GEOFORUM 25:115-132 (May 1994)

Traditional or local knowledge is compared to scientific knowledge in the agricultural realm. The authors argue that the former is often 'scientific' but relates to local environments. As such, it does not necessarily embrace more sustainable solutions to problems. 'Scientific' knowledge derives its power from its potential application and validity over large distances. Like science, TEK should be investigated 'in action'. Investigation of the universal should be integrated with the local.

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# APPENDIX B: GLOSSARY OF CLIMATE CHANGE TERMINOLOGY

## CLIMATE CHANGE GLOSSARY

**Aput (Aputit):** Snow cover on the land accumulated by qanniqtuq and blowing, drifting snow.

**Aqilluqaq:** The hard packed top layer of aputit (snow cover) which is formed later in the season on top of the *Pukaq*. It is deposited by blizzards and becomes very hard and wind-packed.

**Hi'tujuq:** Descriptive term for earth sliding away. Falling away is *Kataajuq* and where there has been extensive damage is *A'siruqtuq*.

**Hiku:** The ice cover on lakes, rivers and the ocean.

**Hiuraq:** Sand or area of sand.

**Huvirnaqtuq** - when it is so cold that the cold air penetrates your clothing

**Iglurjualik:** Place name meaning "place of a big *iglu*".

**Ihriaqtuq:** Smoke from a fire in the atmosphere.

**Ilitqisituqaq Qaujimanig:** Traditional Knowledge. Knowledge passed on from the previous generations and knowledge gained through a lifetime of personal experience.

**Illaujat:** Candle Ice. A stage in the deterioration of ice when it is melting.

**Imaiqtittuq:** Evaporates. Applies to any liquid that evaporates.

**Imaqsuk:** Swamp or marsh.

**Imaup kiglingit:** Water levels. Low water is *Imaiqtisimajuq* and high water is *Ima'qutusisimajuq* or

**Imaqtujuq** (also means deep).

**Kalluqtuq:** Thunderstorm.

**Kanangnavut:** Northeast directional term.

**Kanangniqtug/Kanangnaq:** Name of the wind coming from the northeast direction (*kanangnavut*)

**Kangivut:** Northwest directional term. Towards the inland (as opposed to the ocean).

**Kihik:** Clothing made of sea mammal skins.

**Kitivut:** Southeast directional term.

**Kivativut:** Southwest directional term.

**Kiviangniqtuq/Pinangniqtuq:** Name of the wind coming from the southwest direction (*kivativut*)

**Kuulirniit:** Resulting in running water.

**Ma'raq:** Mud or muddy area.

**Maujaq/Majaaqtut:** When the snow gets soft so that one sinks with every step.

**Minguliqtuq:** When the wind picks up the snow and it swirls around close to you.

**Minijuq:** Drizzle. Light rain.

**Nigiqtuq:** Name of the wind coming from the southeast direction (*kitivut*)

**Nilak/Nilalik/Nilalirjuaq/Nilallaq:** Glacier or ice that does not normally melt throughout the year.

**Nipalutuq/Maqqu'tuq:** "It rains".

**Niviuvak:** A standard "housefly" type of fly.

**Nuvujat:** Clouds.

**Padjarluk:** Storm during which wind will shift

**Paniqtituq:** A dried object.

**Panirnarjuaq:** Extreme dryness.

**Patuk:** Atmospheric water vapour condensing in the form of dew in temperatures above freezing and frost in colder temperatures.

**Piqhiqtuq/Piqhiq:** Severe winter weather condition characterized by low temperatures, strong winds and low visibility due to blowing snow. Expected to last from 3 to 5 days.

**Piqtait/Aukarniit:** An area on a lake, river or the ocean which has either thin ice, snow cover alone, or open water throughout the winter. Often located at narrows.

**Pujuq:** Water vapour.

**Pujurat/Pujurattuq:** There is a light mist in the air, covering the ground; fog.

**Pukaq:** Granular snow.

**Puvipqurnaqtuq:** Conditions under which you become frostbitten. The frostbite could be a result of the wind chill, severe ambient temperatures, or touching metal or ice that would cause a frostbite.

**Qablunaaq (Qallunaaq):** A Person of European descent.

**Qaniutaput:** Fresh fallen snow

**Qanniqtuq:** It snows. Snowfall.

**Qapiq:** A thin layer of ice on top of the snow cover which is hard enough to keep the snow together. It was useful in the past to cover fox traps.

**Qaqurnaqtuq:** (1) Conditions are right to turn skins white. (2) white-out weather conditions.

**Qimugjuit:** snowdrifts

**Talimanguhijjuq:** 5 day long snow storm.

**Tuvak:** After the snow melts on top of the ice and the water is gone the ice has a very rough surface.

**Uangniqtuq/Uangnaq:** Name of the wind coming from the northwest direction (*kangivut*).

