# CLIMATE CHANGE AND HEALTH IN NUNAVIK AND LABRADOR:

## Lessons from Inuit Knowledge *

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## INTRODUCTION

> *" ... just a comment about global warming, you hear it all the time on radio and TV, and I don't think it makes much difference in some places if the temperature rises two degrees, but if our temperature up here rises two degrees or something, the fact that we live on the ice and snow, I don't know what would happen to us. If we ever saw a real change, a real quick change, I don't know how we'd deal with the impacts of something like that, I don't know how we'd react to it, we'd have a hard hard time." (Nain, Labrador, man age 49)*

Our understanding of climate change processes and potential impacts on northern ecosystems and people has increased significantly in the last decade (Furgal *et al*., 2002; IISD, 1999a, 1999b, 2000; IPCC, 2001; Hughen, 1998; Cohen, 1997a; Environment Canada, 1997, 1998a,b; Bergeron *et al*., 1997; Bielawski and Masazumi, 1994). It is in this region of the world where changes and impacts to ecosystem and human health are potentially the greatest (IPCC, 2001). Changes across the North reported to date are variable with warming trends occurring in the western Canadian Arctic and Alaska, and some moderate cooling taking place in some locations of the eastern Canadian Arctic, while others locations in the east report warming as well (Environment Canada, 1997). This variability stresses the need to take a regional approach in gaining a better understanding of the changes and direct as well as indirect impacts generated by these changes in the North.

Temperature, precipitation regime and other changes projected for the Canadian Arctic are already being observed and reported by scientists and native residents alike (e.g. Furgal *et al*., 2002; Riedlinger and Berkes, 2001; IISD, 1999; Fox, 1998; 2000; McDonald *et al*., 1997; Hughen, 1998; Cohen, 1997; Environment Canada, 1997; LIA, 1997; LIHC, 1996; McMichael *et al*., 1996; Bielawski and Masazumi, 1994; Ernerk, 1994; Freeman, 1994; Meldgaard, 1987). Much of this information comes from the observations and traditional ecological knowledge held by local individuals living in the North and in close relationship with the land.

For nearly half a century many anthropologists and plant taxonomists (e.g. Mayr, 1953) recognized traditional knowledge systems in the form of extensively accurate and

comprehensive classification systems (Freeman, 1992; Anon., 1993). It is understood that these systems go far beyond simply describing -that they are ecological in nature as well (Freeman, 1992; Anon., 1993). However, with regards to climate change in the Canadian Arctic, it is only recently that a number of projects have begun to engage northern Aboriginal people and focus on Indigenous knowledge of climate processes, changes and impacts. It is argued that in order to better understand the complex nature of northern ecosystems all available knowledge must be considered and valued.

***Focus of the Chapter***

This chapter is a summary of much larger project in documentation of Inuit knowledge and perspectives about environmental change and health, "*Climate change and health in Nunavik and Labrador: What we know from Science and Inuit Knowledge*" (Furgal *et al.* 2002). The project was conducted in Kuujjuaq, Nunavik and Nain, Labrador in 2000-2001. It was initiated through discussions between a public health researcher (C. Furgal) and members of several Inuit agencies in charge of local health and social services: the Nunavik Regional Board of Health and Social Services/Nunavik Nutrition and Health Committee, and the Labrador Inuit Association. Previous and ongoing collaborative work with these regional organizations, coupled with an interest in another project documenting Inuit knowledge and climate change in the community of Sachs Harbour (see Jolly *et al.*, this volume) provided an impetus for undertaking a similar project in Nunavik and Labrador. Further, considering the amount of attention this issue had started to gain both within and outside the Canadian North, it was surprising to the research team that little attention had been given to the potential effects of climate on public health in northern communities. As a result of these interests and concerns, a project investigating climate change and potential health impacts was initiated in the two regions.

The project that we named "*Climate Change and Health in Nunavik and Labrador: What we know from science and Inuit Knowledge*" was aimed to develop a better understanding of climate change processes and its potential health impacts among the publics of Nunavik and Labrador. The project collected and synthesized available scientific data and documented Inuit knowledge of climate related changes and links to human health.

It was recognized that this project was something of a "scoping process" to begin documenting the various perspectives and potential areas of information requiring further detailed work in the future. In this sense, it provided a starting point for the regional agencies to review their current understanding about potential health impacts, in order to orient future resources and efforts on the issues related to climate change. Also, it utilized various sources of information (interviews, focus groups, existing literature) in order to begin to develop a common source of information (including both western science and Inuit knowledge) on the subject. For both regions, and both knowledge bases, it was recognized that other documentation existed, in part, discussing this issue. Therefore, whenever possible, these sources were sought out and included in the review conducted for this project. The information presented in this chapter focuses specifically on the Inuit knowledge documented through interviews and focus groups, and reviewed in existing documentation during this project.

***Organization of the Chapter***

The chapter is divided into three main sections. First, the methods employed in this project to document Inuit knowledge are described, and a brief introduction to the regions of Nunavik and Labrador is presented. Then, the Inuit observations of climate and weather changes and the impacts people feel that these changes are having on them and their communities are overviewed. All observations are organized within a particular local context, so as not to "generalize" or simplify observations as being representative of the entire Nunavik Labrador area. We also tried to capture the variability within and between regions reported by individuals in this study. Finally, a discussion of the implications of this information for adding to the general understanding and approach to addressing the issue of climate change in the North is provided.

## METHODS

The collection of Inuit observations and perspectives of environmental and climate change involved both a review of existing documentation, and the conduct of focus group

discussions and key-informant interviews among hunters, Elders (including both men and women) in the two regions. These methods are described briefly below

***Document Review***

All available documentation including Inuit knowledge reports, interview transcripts, and workshop reports related to the issues of environment and change in the two regions were collected. These materials were reviewed for their content related to environmental and climate related changes and individuals' reports of effects or impacts these changes have upon them. . The inclusion of existing Inuit knowledge literature on this subject allowed the development of a common source of information for this specific subject in the two regions. As some excellent projects / sources already exist on Inuit knowledge and environmental change in the two regions (Nunavik: *Voices From the Bay*; Labrador: *Our Footprints are Everywhere*; *From Sina to Sikujaluk: Our Footprint*) reviewing these sources for information pertaining to the subject at hand, allowed a more comprehensive picture to be drawn in this initial project on climate and health in Nunavik and Labrador.

***Focus Group Discussions***

Focus group discussions were held with a total of 16 hunters and Elders, in two selected northern communities, Nain (in Labrador) and Kuujjuaq (in Nunavik). Groups were comprised of hunters and Elders (both male and female). Individuals for interviews and group discussions were identified by the community research assistants and regional organizations involved in the study as people with extensive knowledge about the environment, primarily based on the time they spend on the land or their expertise related to a specific land-based activity (e.g. seal hunting). In this sense, these individuals were suggested as local "experts". They were contacted and asked to participate in a discussion group about their observations on the environment in the region. When required, an Inuktitut - English interpreter / translator assisted with the focus groups or interviews. In these cases, interpreters had been briefed beforehand to clarify the content of general discussion topics and process. Interviews were audio recorded only when permission was given by the participant(s). Notes and tapes were reviewed for clarification and participants were contacted again, if necessary, to clarify answers or

provide additional information. Group discussions lasted anywhere from 30 minutes to 2 hours.

***Key-Informant Interviews***

Semi-directed, key-informant interviews (Patton, 1980; Bordens and Abbott, 1991; Creswell, 1994) were conducted with experienced harvesters and Elders (men and women) when they were not comfortable or were unable to participate in a focus group discussion yet were still interested in talking to us. As with the focus groups, the outline, purpose and intent of the study was fully explained prior to the commencement of interviews, and a consent form was signed by the participants. The interview process was guided as a discussion format, posing open-ended questions followed by probes, or suggestions of specification (Creswell, 1994). We chose this format, as it encouraged a broader survey of individuals' knowledge of topics being reviewed, and allowed the discussion of other topics not anticipated by the interviewer. In this way, the interaction took the form of flowing discussions rather than question – answer sessions.

***Data Organization and Analysis***

In qualitative content analysis, as used here, the value of data groups are not reduced to simple frequencies of their occurrence. Rather, an attempt is made to consider the context, content and value of all responses given. In this study, a process of iteratively reviewing data and developing groups or categories of related information, as described by Tesch (1990), was used for the purposes of presenting the data in the project report. General groups were then discussed and reviewed with the northern partners and revised or adapted when necessary. The format of groupings presented here is recognized as one of potentially several ways of relating the information to the reader.

**Kuujjuaq, Nunavik**

Nunavik is the region north of the 55$^{th}$ parallel in the province of Québec, Canada. The region is home to approximately 9,000 Nunavimmiut (Inuit of Nunavik) living in 14 villages along the Ungava Bay, Hudson's Straight, and Hudson's Bay coasts in this northern region of Québec, Canada. The communities are between 1,000 and 1,900

kilometres north of Montreal and all but three of these communities have less than 1,000 inhabitants. Approximately 88 % of the regional population is Inuit and more than 50 % are under the age of 25 (Makivik, 1999). The level of language retention in Nunavik is over 95% among Inuit, and Inuktitut remains the dominant language spoken (Figure 1).

*[Insert Figure 1. Map of Nunavik]*

The regional centre, Kuujjuaq, located at the southern tip of Ungava Bay is comprised of 1,720 individuals of which 74 % are Inuit (Makivik, 1999; Statistics Canada 1996 in NRBHSS 2001: Figure 2). Kuujjuaq resident have access to country foods through harvesting, sharing, sale of foods at one country foods store and through some regional government subsidy programs designed to help supply country food to the community. A total of 7 individuals from Kuujjuaq participated in focus groups in Nunavik for this study. One focus group with 4 male hunters and Elders (men) and one focus group with 3 Elders (women) were held in Kuujjuaq, between May 22 and 31, 2001.

*[Insert Figure 2. Photo of Kuujjuaq]*

In spite of many economic, political and social changes in communities in this region in the last decades, Nunavimmiut have stayed very close to their traditions. The hunting of species such as caribou, small game birds, seals, walrus and beluga whales, fishing the many freshwater and marine species of the region, and the sharing of these items are still largely practiced. Traditional food is still culturally and socially very important in everyday life in the region.

**Nain, Labrador**

Approximately 4800 Inuit and *Kablunagajuit* live in Labrador, the far northeastern region of mainland Canada. Fifty percent of these individuals recognize themselves as Inuit while the others recognize themselves as *Kablunagajuit*[1] (Tanner *et al*., 1994; VBNC,

[1] *Kablunagajuit* refer to those individuals of mixed European and Inuit descent. Because of the long history of contact between Labrador Inuit and Europeans along the Labrador coast, and the close

1997). Approximately 55 % of the membership live in the communities along the north coast (Nain, Hopedale, Makkovik, Rigolet and Postville) while the majority of the remainder reside in the communities of the Upper Lake Melville area (Happy Valley-Goose Bay, Northwest River and Mud Lake) (Tanner *et al*., 1994; Williamson, 1994; VBNC, 1997). A significant proportion of the total economy of households and communities is still accounted for by the traditional economy as in other regions of the North (Wenzel, 1981; 1986 in Condon *et al*., 1995; Rees, 1988). Forty percent of households in Nain report getting 'most' of their food from the land, while 40 % reported getting 'some' (CRS, as in VBNC 1997). In a recent dietary survey conducted by the Centre for Indigenous Poeples, Nutrition and the Environment (CINE, 2001) Labrador Inuit consumed the least amount of country foods per capita, but were the most active in harvesting activities, and consumed the largest diversity of country food species as compared to all Canadian Inuit regions.

*[Insert Figure 3. Map of Labrador]*

Established as a Moravian Mission in 1771, Nain, is the furthest northern community along the Labrador coast and is the regional centre for the North Coast communities today. With a population of approximately 970, Nain is headquarters to the offices of the Labrador Inuit Association, Torngasôk Cultural Centre, Nain Town Council, and regional offices of the Labrador Inuit Health Commission and Labrador Inuit Development Commission. Williamson (1994) describes Nain as "the community in which Inuit lifestyle, language and values are most intact in Labrador". A total of 12 individuals from Nain participated to focus groups and interviews for this study. Three focus groups ( 5 Elders (men), 3 hunters (men), 3 Elders (women)) and one individual interview with an Elder (woman) were conducted in Nain from March 12 to March 22, 2001.

*[Insert Figure 4. Photo of Nain]*

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relationship and similarities in lifestyle that developed among these populations, the decendants of European and Inuit parents (*Kablunagajuit)* were recognized as full members of the Labrador Inuit Association since its incorporation in 1972 (Tanner et al., 1994; Williamson et al., 1994).

## INUIT OBSERVATIONS OF CHANGE IN NUNAVIK AND LABRADOR

From years spent travelling, hunting and living in close relationship with the land, residents of Kuujjuaq, Nunavik and Nain, Labrador have noticed many changes in their environment. Some of these changes are reported to be cyclical in nature (e.g. trends in numbers in the caribou population and some small mammals). Other changes, however, are being reported that have never being seen before, heard through stories passed down by Elders, or predicted by Elders and other experienced individuals. Further, many residents of Labrador and Nunavik are now eager to speak of the effects these changes have on various aspects of their lives, including their individual health and well-being. Local observations from Nain and Kuujjuaq and perspectives documented in this project were grouped into the general changes associated with:

- Weather
    - Temperature
    - Weather predictability and storms
- Intensity of the sun
- Ice and Snow
- Freshwater
- The Land
- The Sea
- Availability and Access to Country Foods

This grouping was done by the researcher to organize responses for their presentation in the project and represent one of many potential ways of grouping this information. The observations and perspectives presented below are organized on a local basis to emphasize the similarities and differences in changes observed both within and between regions. Further, the detailed and local nature of much of the information reported is critical to understanding the specificity of changes, and thus potential impacts in each of the studied regions. What is reported in this chapter merely "scratches the surface" of the knowledge held by many experienced individuals and shared within the two communities, Nain and Kuujjuaq, surveyed during the project. As individuals involved

in this study did not give direct permission during the consent process to identify them in the report, we present people's place of residence, sex and age to identify specific responses. We recognize that many of the individuals involved in this project have experience with large portions of their region through hunting and travelling on the land. Also, in some cases, individuals grew up in other communities and did not originate from Nain or Kuujjuaq. Thus they often speak of areas far from their community of residence. For these reasons, we indicate specific place names, when possible, where people have observed changes in the two regions.

**Changes in the Weather**

*Temperature*

*Nain*

The residents of Nain surveyed in this project report a general warming along the Labrador north coast over the past 2 –3 decades (Tables 1, 2). Individuals report that there are a greater number of very hot days in the summer now, than in the past. When speaking about the impacts of these very hot days, some individuals include shortness of breath and a limitation of physical activity (e.g. fishing). Alternatively, the heat is reported to be beneficial in some ways, through, for example, decreasing the number of flies during the summer. Fewer extremely cold days are also reported, allowing people to get out more in the winter.

> "This past summer while we were up at OKak (*location of old Labrador community along the north coast*) we had one full week, if not more, of hot hot weather. I don't ever remember it being that hot. Usually, before when it was hot like that it would only last a day and then it would rain….we were fishing and we had to go out on the boat to get away from the heat, it was shocking." (Nain, man age 71)

> "…I tended to my nets and my wife said she was not able to stay on land because she found it too hot…I decided to stay on land and take care of our char. I should have went because I almost suffocated because of the heat, I had to keep splashing myself with water and in the afternoon I

> couldn't stay on land because it was so hot. I had to stay in the water to stay cool….my breathing was even shallow." (Nain, man age 61).
>
> "…it was so hot, it was hard to breath around our camping area where we fish…" (Nain, woman age 70)

*Kuujjuaq*

In Kuujuaq , residents are also reporting a shifting in temperature regimes. The weather is becoming warmer sooner in the year and colder sooner in the fall and, on average, warmer in the summer. Some people mentioned that it now gets extremely cold when it is not expected to. The unpredictability of temperature changes and the degree of change are new to the climate in this region (Table 3). Impacts of such changes include some disruption of individual's plans to participate in harvest activities.

> "This year and last year, we have been stopped when we were going to go fishing because the weather changed at the last minute. We would have gone fishing more in the past" (Kuujjuaq, woman age 69).

It is interesting to note that some individuals attributed the impacts of these kinds of changes to their health and lifestyles to factors other than temperature change.

> "I don't think the weather has changed me, but getting older only changes me" (Kuujjuaq, man age 70)
>
> "Our bodies have changed too. We used to exercise like dogs, having to run with our dogs, we used to sweat a lot. Nowadays, you hop on a ski-doo and never get off and can go everywhere. That makes our traditions change too. We left our traditional way of living with having dog teams. We used to run with our dogs, in all areas, travelling with them. Ever since our dogs were killed, we have been just sitting on our vehicles. That's why we feel the sharp cold now." (Kuujjuaq, man age 62).

Further, some individuals feel that the changes are simply part of natural variation in the region.

> "The older people who were our parents used to talk about the weather and it looks like the weather to me is still the same. Even though some years are different, there is no special abnormal weather that I have come across." (Kuujjuaq, man age 70).

In *Voices From the Bay*, Elders in communities along the Hudson Coast (Kuujjuarapik / Whapmagootsui, Umiujaq, Inukjuak, Akulivik and Sanikiluaq) and Hudson Strait (Ivujuvik, Salluit and Kangiqsujuaq) (McDonald *et al*., 1997: 46) indicated a general cooling trend for the Eastern Hudson and James Bay coast and Hudson Strait regions. Colder winters with more very cold days are reported for these three areas (Table 4).

*Weather Predictability and Storms*

*Nain*

As well as changes in temperature, Nain residents report that the weather has become increasingly unpredictable compared to previous decades (Tables 1,2). There is inconsistency in observations of winter storms, as some report observing more, while others report experiencing fewer storms today than in the past. The number of thunderstorms is reported to have decreased and there is consensus that autumn storms have increased in frequency and intensity and that the weather changes much faster than people ever remember. This unpredictability is said to limit the ability of people going off on the land. An increasing number of people also report an increase in the likelihood of getting stranded out in storms. 'Quick' changes in weather and storm intensity are reported to have significant potential impacts on animal health. For example, Williamson (1997:32) documented north coast residents' reports of finding large numbers of eider ducks frozen in the sea ice following a sudden late autumn freeze-up (Williamson, 1997: 32).

> "…now the storms are more frequent and severe…..quickly changing from mild to cold and vice-versa…the autumns are especially windy and dangerous for speed boats" (Labrador, man; as in Williamson, 1997: 39)

> "…there are more fierce fall storms now. Before, it was nothing like the storms and strong winds we get now." (Nain, man age 49).

> "What I don't like much is these sudden real strong winds. We rarely used to get these much, but now we're getting them, suddenly, really strong winds." (Nain, woman age 61).

> "Yes, it changes so quick now you find. Much faster than it used to be.….Last winter when the teacher was caught out it was perfect in the morning, then it went down flat and they couldn't see anything. It was like you were travelling and floating in the air, you couldn't see the ground. Eighteen people were caught out then, and they almost froze, it was bitterly cold too." (Nain, man age 43).

*Kuujjuaq*

Similarly, Kuujjuaq residents report an increase in the unpredictability of the weather at certain times of the year. It was specifically stated that it was getting very cold unexpectedly, at varying times throughout the year which sometimes influenced people's ability to get out on the land (Table 3). In interviews conducted with Elders for *Voices From the Bay*, people also reported fewer thunderstorms throughout the region (Table 4).

**Changes in the Sun**

Both Labradorimiut and Nunavimmiut in Nain and Kuujjuaq respectively, speak of a change in the intensity of the sun's rays, observing that the sun burns their skin more now than they ever remember. This increase in intensity is said to be drying and burning the vegetation of berries and other small plants, and thus impacting their availability for consumption (Tables 1,2). However, there is some question as to whether or not this is a

matter of perception because of the increased awareness as a result of health messages on this issue today, as stated by one individual:

> "The sun burns more now too. You can even feel it on your skin. You can tell the difference…but I don't know, maybe you just think about it more because of all the warnings you hear, it could be that." (Nain, man age 64)

Similarly, people in Kuujjuaq report the need to wear sun glasses more often now, use protective creams and lotions, and sometimes stay indoors when it is too hot because of the change in intensity of the sun (Table 3, 4).

> "The sun burns us easily, it was not very hot in the past." (Kuujjuaq, man age 62)

> "The sun was not that hot in the past. Nowadays, it's really hot. My skin burns when I'm out for a while. Sometimes, we stay indoors in a shack." (Kuujjuaq, man age 70).

> "The sun is very hot, it's dangerous for me. It was never like that. We did not have to put cream on and these creams were never in the store in the coast, today we have to use these sun screens." (Kuujjuaq, man age 70)

**Changes in Ice and Snow**

There are changes in the snow and ice that are affecting wildlife and the established cycle of annual subsistence activities in both communities surveyed. In Nain, the timing of annual sea ice formation, consolidation, timing of spring melt, as well as the nature of the ice itself are reported to be changing. Ice in the bay around the town is reported to form these days approximately one month later (in January) than approximately 15-20 years ago.

> "We don't get any good ice before January now either, it's about a month later than long ago" (Nain, man age 49)

As well, people in Nain report that it takes longer for the ice to solidify, and that it appears to be *saltier* and thinner in nature, and that there is much less snow on top of the ice throughout the winter each year. It was reported that the ice goes out much earlier each spring and break up takes longer. As well, there is a decrease in the amount of pack ice coming south into the bay around the community of Nain each year.

These changes in ice are reported to have impacts on ringed seals (*Phoca hispida*) that use the ice for pupping and breeding habitat. The lack of snow on the ice is associated with the growing amount of scraped and wounded seals caught by hunters, and with a decrease in the number of breathing holes and dens in the area, the latter increasing the pups' exposure to predation on the ice. Changing ice conditions were also said to make travel very dangerous during spring. A lack of certainty regarding sea ice conditions in the spring, is keeping hunters and their families from heading out onto the ice. The inability to continue regular travel and harvesting routines causes mental stress at times of the year when people are used to being able to travel on the land (Tables 1,2).

> "…we have to wait for ice, like last fall there was no snow, the ice was bad, so you couldn't go far, just walk up on the hills…and go crazy." (Nain, man age 43)

Some participants felt that the early break up was a positive change, as it allows ships to come into Nain earlier in the spring, and community members to go out to their fishing camps earlier in the season (Table 1).

The amount and composition of snowfall and the composition of the snow has been changing over the last two to three decades as well. Many participants report that the first snow now arrives later in the year (often not until December); that there is less snow now than 15-20 years ago; and that the snow today is more 'granular' and lighter. They

also say that the snow in the mountains north of Nain, once visible year round, now melts each year leaving the hills bare in the summer months (Figure 5). During the winter months, "*glitter*" (frozen crust on top of snow) is observed as more common. The presence of glitter on top of the snow during the winter is described as impacting the health of both caribou and ptarmigan, as it blocks their access to valuable food resources during cold months (Table 1).

*[Insert Figure 5. Torngat Mountains]*

These snow-related changes restrict travel at certain times of the year (for example, not enough snow to get into the bush on snowmobiles) and thus the ability to access firewood from the forests in spring time. However, it was also seen to make walking easier, which is especially important for Elders, because the snow is not as deep. Due to the changes in snow, all respondents from Nain acknowledge doubt in the ability to build snow houses these days (Tables 1,2; Figure 6).

> "The snow is lighter [now]. As soon as it blows, the snow is gone. I don't think we can make snow houses anymore because the texture of the snow is not the same. There is a big change in the past 15-20 years." (Nain, man age 71)

> "…and all of a sudden we had a storm and everyone was lost, but with the snow now, years ago you'd get the good snow for snow houses but now, you wouldn't be able to make one (snow house) if you had to." (Nain, man age 49)

*[Insert Figure 6. Photo of snowhouse]*

Respondents from Nain also mentioned that the lack of snow on the hills in the North requires them to look for alternate sources for keeping their fish cool while fishing in this part of the region.

> "We used to always stick char in the snow when we were fishing up the coast. Go up the valley to get pockets of snow or ice in the shadows, but it's hard to find now for the fish when you're up there. There`s also a couple of places in Voisey's Bay where they used to get ice underground, the marsh I suppose used to freeze and there was ice all summer long and they used to chop it out, but that's not there anymore." (Nain, man age 61)

*Kuujjuaq*

In Ungava Bay, Hudson Strait, Hudson and James Bay, Nunavimmiut similarly report changes in the times of ice consolidation and break-up (McDonald *et al*., 1997; Table 3). As in Nain, the ice around Kuujjuaq is breaking up earlier and faster in the spring, and is thinner, on average, than when present-day Elders were young. As a result, ringed seals are reported to leave the region earlier with the receding ice. Consequently, hunters' travel times are increasing and there is a growing concern regarding travel safety on the ice at certain times of the year. (Table 3).

> "I felt that it was spring earlier and that the ice was thinner this winter….now the ice just tears open today as I see it" (Kuujjuaq, man age 36)

> "I know that today that seals, it might be because of early spring break-up or that they are out on the ice floes, that the seals are nowhere." (Kuujjuaq, man age 62)

> "This year and last year, we have been stopped when we were about to go fishing because the ice broke up. We would have gone fishing more in the past." (Kuujjuaq, woman age 68)

> "Sometimes we just go home now because we can't go off on the land anywhere. The ice melts right away. It's a fast melt down even in the lakes too." (Kuujjuaq, man age 62).

Detailed changes in sea ice are reported in other specific sub-regions within Nunavik (McDonald *et al*. 1997: 46,47). Fewer *polynyas* and poorer quality of ice were reported by Elders in the Hudson Strait communities (Ivujivik, Salluit and Kaniqsujuaq), and a greater extent of land fast-ice in Eastern Hudson Bay and Hudson Strait is being seen (McDonald *et al*., 1997: 46). Impacts of these changes include increased hunters' access to eider ducks, but at the same time a decrease in food sources available for these birds (Table 4).

Changes in snow conditions reported by Kuujjuaq residents included those related to both the nature of snow cover and composition, similar to observations from Nain (Table 3). As documented in McDonald *et al*. (1997: 47), Elders in Eastern Hudson Bay and Hudson Strait communities of Nunavik report snow melting later in the spring than in previous decades, and yet melting and thawing throughout the winter, when this did not happen in the past. This was described as resulting in more "ice-like" snow covering vegetation, making it difficult for animals such as caribou to forage throughout the winter. It also means that the snow is less suitable for making snow houses, as observed in Labrador.

**Changes in Freshwater**

*Nain*

The changes in temperature, snow and rain patterns observed along the coast of Labrador have resulted in changes in freshwater systems in the region. Many individuals have observed that summers are much drier today than during past decades, and that there is less snow. Further, because of the decrease in rain during the summer months, the lack of snow and the drier weather, individuals report that many brooks and small ponds are drying up or have dried up and are no longer there. These water bodies were used as sources of drinking water while people were out on the land hunting and fishing, and

depending on the location of a camp, it is now more challenging to locate good natural sources of drinking water.

> "…but even where people had summer camps there is no drinking water. There used to always be little brooks around when there was snow on the hills, there are no more little brooks, just a few ponds left." (Nain, man age 64)

> "Even some ponds have dried up…we spent some time…before the char went out to the salt water, and for the past two years we have had problems finding drinking water. The ponds and brooks are drying up. It was the worst this summer, we had to move to another camping area. We did that the summer before too…we found a mossy area and I had to dig to find water." (Nain, man age 62)

> "It's a lot drier in the summer. Up in the bays, some of the lakes and ponds, you can almost walk across where they were now. All the swamps and bogs…they're all drying up now. Some of the ponds, about half of them in some areas are drying up." (Nain, man age 46)

Further, these changes are said to have impacts on individual's travel routes out on the land making some routes less suitable, or not passable at different times during the year because of lack of water for boat access, or very soft conditions (where ponds have drained) not passable by all terrain vehicles (Table 2).

*Kuujjuaq*

Similar changes are observed in Kuujjuaq where many small lakes that were used as drinking water sources are now drying up. This is attributed to a lack of rain and damming in the area (Table 3). These changes are reported to have damaged equipment such as boats, and also limited supplies of fresh drinking water while out hunting and travelling.

> "…Even the small drinkable lakes have dried up, where there is no rain and because the other lake has a dam." (Kuujjuaq, man age 62)

As reported by McDonald *et al*. (1997: 46,47), the water levels in many brooks and rivers have decreased considerably throughout the Hudson Bay region, in such communities as Kujjuarapik, Inukjuaq, and Umiujak. Much of this is reported to be attributable to damming across the interior section of Nunavik for hydroelectric development, with decreased summer rainfall further exacerbating the situation in some years (Table 4). Where summer water flow is low, residents report that the quality of drinking water has decreased (e.g. in the communities of Salluit, Kangiqsujjuaq and Ivujivik; McDonald *et al*., 1997: 46).

**Changes in the Land**

Inuit are closely linked through their culture and way of life to the land and sea. As the foundation for human travel, support for vegetation and terrestrial wildlife upon which Inuit rely, the health and stability of the land occupies a central role in the relationship Inuit have with the environment. Individuals in both Nain and Kuujjuaq report that aspects of the land are changing as a result of climate, weather, and other forces. Changes in weather, precipitation, temperature, and the intensity of the sun as described above, are all impacting the local permafrost and tundra ecosystems. As a result of heat and less rainfall, the land is reported to be much drier than before. One location in Voisey's Bay (approximately 35km from Nain), where permafrost had been found no longer exists.

> "There's a couple of places in Voisey's Bay (approximately 35km from Nain) where they used to get ice underground, the marsh I suppose used to freeze and there was ice all summer long and they used to chop it out, but that's not there anymore." (Nain, man age 54)

Further, this drying of the land is associated with some extreme events which were previously very rare in this region.

> "There was even a forest fire where we never thought there would be one, the land is so dry." (Nain, man age 61)

Nunavimmiut in Eastern James Bay interviewed for *Voices From the Bay,* report that the land is rising, and this is reported to be decreasing water levels in some estuaries and having impacts on the numbers and species of marine animals and fish seen in these areas (McDonald *et al*., 1997: 46).

**Changes in the Sea**

Tides in some areas along the Labrador shore are said to be stronger now, and the water in many bays shallower at low tide. No explanation or greater detail was provided on this issue in our discussions and interviews with the Nain residents during this study (Table 2). In contrast, some Nunavik-based projects have documented decreasing water levels and weaker currents in rivers and estuaries to be a result of a combination of both changing rainfall patterns and hydroelectric development (McDonald *et al*., 1997: 47).

**Changes in Availability and Access to Country Foods**

Another group of changes observed by residents in Nain and Kuujjuaq are those related to the wildlife and plants. The impacts of environmental change on plants and animals concern Inuit communities in terms of both availability of and access to country foods, and thus may have nutritional, social, cultural and economic effects as discussed by Fast and Berkes (1998). Several changes are observed in the animals and plants by residents of the two surveyed communities that are related to these environmental changes. This section presents a summary of some of these accounts.

*Nain*

In Nain, environmental changes are discussed as having negative impacts on the health and availability of certain important country food plants and animals. Changes in the health of caribou are reported by Nain residents in terms of more “sick” caribou, and caribou with bugs in their livers. The taste and texture of the meat is said to have changed in the last 20 years. A great number of red foxes (who are potential carriers of rabies),

beyond normal cycling numbers for coastal areas, are encountered today and more sick or diseased fox are seen as well. Similarly, more “sick and skinny” seals are observed by hunters, potentially attributed to a lack of prey resources.

> "It's true that animals, especially caribou, like to linger where there is snow, there weren't many places where they could cool off even this past summer, I think that might affect them." (Nain, man age 49)

> "There used to be a lot of snow and when it snowed a lot during the winter, the berries and bake apples were much better and when it's too hot during the summer they dry up from the sun." (Nain, women age 66)

> "I went to OKak Bay this year and there were no berries this year, it was just too hot. There weren't even any bake apples, they were all dried up by the heat." (Nain, man age 61)

Further, changes in vegetation is said to impact caribou migration and behaviour in the region (Table 1,2). Many of these changes are influencing the diet of Inuit through affecting the suitability of the food to eat or the access to these items.

> “Years ago we wouldn’t see any bugs in caribou, and we always ate the liver. But now, I don’t know if it’s because of the amount of caribou there are now or that we’re looking for them, but there are more bugs. Every once in a while you come across one with bugs, and now you don’t even look at the liver, we don’t touch it ever since we started to see the bugs in them.” (Nain, man age 43)

> “We see more sick seals now too. Some that you kill are just skin and bones and hair. There are more “crawlers” now too (seals crawling on top of the ice looking for a hole).” (Nain, man age 46)

Further, there is concern that the lack of rain and other precipitation may have negative impacts on Arctic char migrations up streams and into inland lakes during the fall.

> "Where it is getting drier, some of the lakes, there are less and less lakes, and some are smaller. Where the char are going in…those brooks are just about dried up and they can't get in, they have to wait for a heavy rainfall, so they just wait…I don't know if they go to find a larger river or what, so I don't know what will happen to the char if they just wait there, or if they can change their route." (Nain, man age 49)

Changes in the number of some species, and the sighting of new species in the region are discussed by hunters as well. Fewer and skinnier fish are found today and some changes in their behaviour are reported. For example, Arctic char are reported to be going directly out to sea from inland lakes in the spring, and thus hunters have to wait until later in the season than usual for them to return to the bays.

> "We see moose now, and never did before. We see them more and more each year. We've seen them up as far as the bay north of here (Nain)." (Nain, man age 43)

> "It was maybe twenty years ago that we saw the first beaver track ever up in the bay (Webb's Bay, north of Nain)…we didn't know what it was." (Nain, man age 46)

An increase in some species (seals, caribou, fox, black bears, wolves) and decrease in others (geese and other migratory birds, fish) are reported to have impacts to individual access to country food items. Some individuals have reported not going to their traditional hunting areas and camps anymore or traveling less frequently, because of a lack of wildlife that were once there (Table 2).

Changes in the extremity and unpredictability of the weather and changes in the land and sea ice stability have influenced the ability of Inuit in Nain to safely go fishing, hunting and collecting country food and access fire wood at certain times of the year. These changes are reported to have taken place during the last 2-3 decades (Table 1).

> "Just this past fall people were tired of waiting for the snow to arrive, people who needed fire wood were tired of waiting for the snow to come so they could go out wooding." (Nain, man age 54)

> "And because there's less snow and by May most of the snow is gone, it makes things drier on the land too. It's hard to get around on the land." (Nain, man age 49).

> "In the spring time, you're limited in distance you can go now. Fall too, you have to wait for ice to get out hunting." (Nain, man age 43)

> *[Insert Figure 7. Photo of people traveling across ice]*

Positive aspects of these changes are reported as well in that they allow access to summer fishing activities or store food supplies earlier in the season because of an early ice-free season.

> "I remember years ago, we used to have to wait for the pack ice to go before we could go fishing and now today we can leave in June to go to our fishing camps. I think the atmosphere is really heating up." (Nain, man age 49).

*Kuujjuaq*

Similarly, wildlife, plants, their health and Inuit access to them has changed in Kuujjuak (Table 3). Changes in temperature, the general increase in unpredictability in the weather

and changes in ice and snow distribution and stability have been reported to influence individual's ability to get out on the land.

> "This year and last year, we have been stopped when we were going to go fishing. The ice broke up so fast. We went fishing more in the past." (Kujjuaq, woman age 68).

Observations of changes in animal and plant health and distribution are described by many Kuujjuaq residents and other Nunavimmiut.as related to the climate, either directly or indirectly. Many of these changes have had an impact on residents' perspectives on the general health of wildlife and fauna and their suitability for consumption.

> "…I know today that seals, it might be because of early spring break up or that they are out on the ice floes, but the seals are nowhere." (Kuujjuaq, man age 36)

> "I have never heard of caribou being sick in the past. Caribou have toxic livers and their joints are bad. As for lake trout, before they (people) never said they caught a bad fish. But in the last twenty years, I have heard from time to time that they have caught such fish. I think that the weather is causing the animals to be like that." (Kuujjuaq, man age 70).

> "The berries don't grow sometimes now. The sun burns them." (Kuujjuaq, woman age 69)

> "Our plants burn before they go into full bloom now." (Kuujjuaq, man age 62)

Further, individuals reported seeing fewer whales and some bird species. This is attributed to a variety of possible causes, including climate change, regional

development, contaminants, and natural variability. Changes in sea ice distribution and cover are reported to decrease access to food for Eider ducks but increase human access to them for hunting in the Eastern Hudson Bay region (as reported in McDonald *et al*., 1997: 31; Table 4). Frozen and icier snow during the winter is said to have the same effect in Nunavik as in Labrador, where it is said to block access to vegetation by wildlife (caribou and ptarmigan) during the winter. Changes in fish and seal migrations due to lowering water levels in some estuaries are reported to directly influence people's diets in terms of suitability for consumption, availability, and accessibility to these country food items (Table 4). Further, some people in Kuujjuaq are observing an increase in the number of cases of rabid foxes, which they consider a potential link to climate change in the region (Table 3).

## ENVIRONMENTAL CHANGE AND INUIT HEALTH: PERSPECTIVES ON DIRECT AND INDIRECT IMPACTS FROM NAIN AND KUUJJUAQ

As seen from the many direct statements of residents of Nain, Labrador and Kuujjuaq, Nunavik, Inuit in these regions are observing various changes in the climate, weather, environment, flora and fauna, and the effects of such changes on their health, way of life, and relationship with the land. According to the World Health Organization (1967), health includes aspects of physical, mental and social well-being and is not simply the absence of disease. In the holistic Inuit vision of health, the well-being of individuals and communities is tied to the land and sea. Thus, changes in the land, weather, and sea reported here affect individual and community health and well-being in a variety of ways.

A number of *direct* impacts of climate related changes on health were reported by residents of the two communities surveyed in this project. In this sense we refer to "direct impacts" as *those health consequences resulting from direct interactions with aspects of the environment that have / are changing with changes in local climate* (i.e. resulting from direct interactions with physical characteristics of the environment: air, water, ice, land; e.g. exposure to thermal extremes). They included such things as: difficulties in dealing with heat and cold stress; alleviation of cold stress due to warmer winters; the dangers associated with travel and time on the land considering unpredictable

weather patterns and ice conditions; and, reports of increased incidences of sun burns and rashes as a result of increased sun intensity. Accounts of direct impacts varied within and between communities in the two regions involved in this study. The larger study we conducted utilized these reports, in concert with projected potential impacts gleaned from the scientific literature and discussion with environmental health experts, to develop a list of potential direct health impacts from climate change in the two regions (Table 5).

Similarly, a number of *indirect* climate-related health effects were identified by individuals in the two communities surveyed, as well as in the key pieces of literature for the two regions. We include under "indirect impacts", *those effects originating through indirect interactions with human health and behavior under the influence of local climate and aspects of the environment changing with local climate* (i.e. mediated through one of a variety of social or physical means). These indirect effects include such things as: effects on diet (decreased country food species abundance and / or availability) as a result of climate related impacts to wildlife species or environmental factors influencing Inuit access to these resources (e.g. ice distribution, land stability, weather predictability); effects on health as a result of changed access to good quality natural drinking water sources; effects on rates of disease as a result of heat and cold stress experienced by residents; various forms of social and mental stress related to changes in the environment, lifestyle, etc. related to changes in climatic regimes. Reports from Nunavik and Labrador were used in conjunction with projected potential impacts identified in the scientific literature and through discussion with environmental health experts, to develop a list of potential indirect health impacts from climate change in the two regions (Table 6).

Understanding the importance of climate-related factors in contributing to Inuit health is critical, as many health issues potentially influenced by climate are prevalent in these two regions today. For example, unintentional traumas (including those resulting from accidents while on the land) account for a significant number of deaths each year in Nunavik (NRBHSS, 2001) and thus recognising the relationship between environmental change and accidents is important for public health professionals. Similarly, the social, cultural and physical importance of country foods in these two regions makes the

identification of potential threats to food security paramount. Country food intake accounts for greater than 35 % of the total energy in the diet of Nunavimmiut men over 50 years of age (Santé Québec, 1995). It also makes significant contributions to daily intakes of iron, protein, selenium, and vitamins A and D among some segments of the population (Santé Québec, 1995). Fish and marine mammals, especially beluga whale skin (a component of mattak, an Inuit delicacy), are significant sources of selenium to the Inuit diet (Blanchet *et al*., 2000). It is currently thought that selenium acts as an anti-oxidant in the prevention of artherosclerotic diseases and may reduce the risk of mercury toxicity amoung Inuit (Hansen *et al.*, 1994; Salonen, 1986)[2]. The consumption of other country food species (Arctic char and marine mammal fat) high in n-3 fatty acids, provides individuals in these populations with some protection against cardiovascular diseases (Dewailly *et al.*, 2001, Middaugh, 1990) and some benefits in relation to the occurrence of some cancers, diabetes, and hyperinsulemia (Dewailly *et al.,* 1998; Friedberg, 1998). Despite the known benefits associated with country food species, there is a growing shift in many Inuit regions, more prevalent among some segments of the population, towards a more "western diet" comprised of more store-bought foods and less country food items (Dewailly *et al*., 2000). Considering the known physical, social and cultural risks associated with such diet "shifts", any and all threats to country food security must be seriously considered. It is therefore important in terms of individual and community health to be able to properly identify and understand the impacts of any environmental factors, such as climate related changes, influencing the health, availability or accessibility of country food species.

**Understanding Climate Effects**

It is important to note that not all effects related to the current climate change in the North are negative. Several positive associations to warming or cooling were reported by people from both Nain and Kuujjuaq in this study. For example, warmer winters in some areas can lessen stress related to cold-exposure. Longer hunting seasons and an increased number of days available to get out on the land may improve productivity of subsistence

[2] For a detailed discussion on country foods, contaminants and human health benefits and risks in the Canadian Arctic, see Van Oostdam *et al*., 1999

activities and mental and social health among individuals. Climate change may also cause re-distributions of animal population ranges, bringing some species into new areas and thus making them more accessible for human consumption. Thus, in terms of human health effects, both positive and negative aspects must be considered.

Further, it is important to note that the changes observed and the impacts experienced to date in these regions were not reported by local residents as solely due to changes in climate. They are also related to changes in such non-climate-driven processes as economic development, pollution, change in individual lifestyle habits (such as the use of snowmobiles instead of dog sleds) and other social, cultural, economic, and natural factors (such as the change in food habits, shift from a more nomadic to more sedentary to increasingly sedentary community based life, etc.). The vulnerability of populations to any health risk varies considerably depending on a number of moderating factors such as population density, level of social, economic and technological development, local environmental conditions, pre-existing health status (including nutritional status and lifestyle habits), the quality and availability of health care services, and public health infrastructure. Further, in the context of this study, the knowledge of, and relationship to the surrounding environment is a significant mediating factor of great significance in northern communities. Much more work is therefore needed to better understand the extent to which climate related changes are influencing specific aspects of human health in the North.

**The Need for Local Perspectives**

It is critical to recognize and understand regional and local / community variability in order to support the enhancement of adaptive strategies and tools for remote indigenous communities. For example, a general cooling trend along the Labrador coast and in the Labrador Sea is reported by several studies of climate change (e.g. Mayer and Avis, 1997; IPCC, 1996), while people on the land – such as residents in Nain - report a general warming trend to date. For Nunavik, significant variability in temperature trends is also reported throughout the region. Nunavimmiut are experiencing warming in southern Nunavik (Kuujjuaq: this study) and a general cooling is observed in Eastern Hudson Bay

and Hudson Strait communities, as documented in other projects (McDonald *et al*., 1997; Read and Gould, 1992). These inter and intra regional variations and the difference between scientific models and locally-based knowledge, highlights the value of local, indigenous perspectives in climate change research and action. As members of the modelling community argue for more regionally specific climate models (e.g. Gough and Wolfe, 2001), we need to look to local observation based data as the scale required to accurately understand relationships and current impacts.

An understanding of environmental and climatic changes and their impacts on individuals is required if northern communities – such as Nain and Kuujuaq – are to be able to adapt and evolve with the changing nature of their surroundings. Stakeholders, such as those in Aboriginal communities in the MacKenzie Basin, have reported feeling as though they could adapt to climate changes if they occurred gradually, and were predictable (Cohen, 1997). Without the local understanding of changes and potential impacts, such as those discussed in this volume, it is difficult to know the rates of changes experienced in communities to date, and it limits the predictive ability of knowing what to expect for communities tomorrow.

## WORKING TOGETHER TO ADDRESS CLIMATE CHANGE AND HUMAN HEALTH

The cooperative planning, development and conduct of this project, involving southern-based scientists and northern environment and health professionals, researchers and local communities, was essential to its success. The project was a learning process through which knowledge was gathered and is continuing to be shared as a number of initiatives have developed as a result. Indigenous residents of the Arctic require a mechanism to voice their concerns, share and utilize their knowledge and address these issues as is being argued at the national and international levels (Fenge, 2001). This partnership is essential in order to address the broad impacts of global environmental change. Aboriginal people and their knowledge is critical in this process as they have a unique and valuable understanding of these issues developed through their relationship with their local environment.

This chapter illustrates that changes in the environment, such as those related to climate, are having an effect on Inuit health. Very little research to date has explicitly made these links between human health and climate change in northern communities. Yet, for people still maintaining a close relationship with the land and sea through their cultural, social, and economic practices and way of life, their health and well-being, and that of their communities is, and will continue to be inextricably linked to environmental change. A holistic concept of health must therefore remain central to future research and action on climate change in partnership with Indigenous peoples in the Arctic.

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**REFERENCES**

Anonymous. 1993. Traditional Ecological Knowledge: The variety of knowledge systems and their study. A Report submitted to the Great Whale Public Review Support Office. June, 1993. 41pp.

Bergeron, L., Vigeant, G., and J. Lacroix. 1997. Impacts and Adaptation to Climate Variability and Change in Québec. Synthesis Summary. Volume V of the Canada Country Study: Climate Impacts and Adaptation. Environment Canada, Ottawa, Ont.

Bielawski, E., and Masazumi, B. 1994. Dene knowledge on climate: cooperative research in Lutsel k'e, Northwest Territories. In, Riewe, R., and Oakes, J (eds.). 1994. Biological Implications of Global Change: Northern Perspectives. Canadian Circumpolar Institute, Royal Society of Canada, Canadian Global Change Program, and the Association of Canadian Universities for Northern Studies. Canadian Circumpolar Institute, Edmonton, Alberta.

Blanchet C, Dewailly E, Ayotte P, Bruneau S, Receveur O, Holub BJ. 2000. Contribution of selected traditional and market food to Nunavik Inuit women diet. *Can J Diet Pract Res* 61:50-59.

Bordens, K.S., and Abbott, B.B. 1991. Research Design and Methods : A process approach . Mountain View, Calif. : Mayfield Pub. Co., c1991

Brice-Bennett, C. (Ed). 1977. Our Footprints are Everywhere: Inuit Land Use and Occupancy in Labrador. Labrador Inuit Association, Nain, Labrador.

Centre for Indigenous Peoples, Nutrition and the Environment (CINE). 2001. Report of dietary surveys in 18 Inuit communities. CINE, McGill University, Montreal, Qc.

Cohen, S J. 1997a. Mackenzie Basin Impact Study. Final Report. Environment Canada, Ottawa, Ontario.

Cohen, S.J. 1997b. What if and so what in Northwest Canada: Could climate change make a difference to the future of the MacKenzie Basin ? Arctic, 50(4): 293-307.

Condon, R.G., Collings, P., and Wenzel, G. 1995. The best part of life: subsistence hunting, and economic adaptation among young adult Inuit males. Arctic. 48(1): 31-46.

Creswell, J.W. 1994. Research Design: Qualitative and Quantitative Approaches. Sage: Thousand Oaks, Ca. 227 pp.

Dewailly, E., Ayotte, P., Blanchet, C., Muckle, G., Bruneau, S., Proulx, J-F., and A. Gilman. 1998. Integration of 12 years of data in a risk and benefit assessment of

traditional food in Nunavik. Department of Indian and Northern Affairs, Ottawa, ON. 48pp.

Dewailly, É., Blanchet, C., Lawn, J., Nobmann, E.D., Pars, T., Bjerregaard, P. and J.-F. Proulx. 2000. Diet profile of Circumpolar Inuit. GETIC: Université Laval Québec. 16 pp.

Dewailly, E., Blanchet, C., Lemieux, S *et al*. 2001. N-3 fatty acids and cardio vascular disease risk factors among the Inuit of Nunavik. Amercian Journal of Clinical Nutrition. 74(4): 603-11.

Environment Canada. 1997. Canada Country Study: Climate Impacts and Adaptation. Canadian Arctic Summary. Environment Canada, Ottawa, Ontario.

Environment Canada. 1998a. Arctic Ozone - the Sensitivity of the Ozone Layer to Chemical Depletion and Climate Change. Environment Canada, Ottawa, Ontario.

Environment Canada. 1998b. Climate Change. National Environmental Indicator Series. State of the Environment Reporting Program. Bulletin No. 98-3.

Ernerk, P. 1994. Insights of a hunter on recent climatic variations in Nunavut. In, Riewe, R., and Oakes, J (eds.). 1994. Biological Implications of Global Change: Northern Perspectives. Canadian Circumpolar Institute, Royal Society of Canada, Canadian Global Change Program, and the Association of Canadian Universities for Northern Studies. Canadian Circumpolar Institute, Edmonton, Alberta.

Fast, and F. Berkes. 1998. Climate change, northern subsistence and land-based economies, *In* Canada Country Study (1998). National Cross Cutting Issues, Environment Canada, Ottawa, ON.

Fenge, T. 2001. The Inuit and Climate Change. Isuma: Canadian Journal of Policy Research 2(4): 79-85.

Fox, S. 1998. Inuit Knowledge of Climate and Climate Change. Unpublished Thesis, Master of Environmental Studies, University of Waterloo, Canada.

Fox, S. 2000. Project Documents Inuit Knowledge of Climate Change. Witness the Arctic 8(1): 8.

Freeman, M.A. 1994. Angry spirits in the landscape. In, Riewe, R., and Oakes, J (eds.). 1994. Biological Implications of Global Change: Northern Perspectives. Canadian Circumpolar Institute, Royal Society of Canada, Canadian Global

Change Program, and the Association of Canadian Universities for Northern Studies. Canadian Circumpolar Institute, Edmonton, Alberta.

Freeman, M.M.R. 1992. The nature and utility of traditional ecological knowledge. Northern Perspectives. 20(1): 9-12.

Friedberg, C.E., Janssen, M.J.F.M., Heine, R.J., Grobbee, D." 1998. Fish oil and glycemic control in diabetes. A meta-analysis. Diabetes Care. 21: 494-500.

Furgal, C., Martin, D., Gosselin, P., Viau, A., Labrador Inuit Association (LIA), and Nunavik Regional Board of Health and Social Services (NRBHSS). 2002. Climate Change in Nunavik and Labrador: What We Know from Science and Inuit Ecological Knowledge. Final Project Report prepared for Climate Change Action Fund. CHUQ-Pavillon CHUL, Beauport, Québec. G1E 7G9

Gough, W.A., and E. Wolfe. 2001. Climate change scenarios for Hudson Bay, Canada, from general circulation models. Arctic, 54(2): 142-148.

Hansen J, Pedersen H, Mulvad G. 1994. Fatty acids and antioxidants in the Inuit diet. Their role in ischemic heart disease (IHD) and possible interactions with other dietary factors. A review. *Arctic Med Res* 53:4-17.

Hughen, C. 1998. Past Environmental Change in the Arctic: A PALE contribution of Arctic system science. Witness the Arctic: Chronicles of the Arctic System Science Research Program. Spring 1998, Vol. 6(1): 1-3.

Interational Institute for Sustianable Development. 1999. Inuit Observations on Climate Change: Trip Reports 1,2 and 3 from Sachs Harbour, Northwest Territories. IISD.

Intergovernmental Panel on Climate Change (IPCC). 1996, *Climate change 1996 : the IPCC scientific assessment.* Houghton JT *et al*. (Eds). Cambridge : Cambridge University Press (cited in : IRVING, W., 2001, *Changing habits, changing climate. A foundation analysis,* Canadian Institute of Child Health, 116 pp.)

Intergovernmental Panel on Climate Change (IPCC). 2001. Climate Change 2001: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) James J. McCarthy, Osvaldo F. Canziani, Neil A. Leary, David J. Dokken and Kasey S. White (Eds.)Cambridge University Press, UK. pp 1000

Labrador Inuit Association (LIA). 1997. Environmental Health Study. Final Report. Labrador Inuit Association, Nain, Labrador. A0P 1L0

Labrador Inuit Health Commission (LIHC). 1996. Workshop on Social Health and Environmental Change. Labrador Inuit Health Commission, Nain, Labrador, A0P 1L0.

Makivik Corporation. 1999. *Nunavik at a glance*, Kuujjuaq, Québec: Makivik Corporation, 17 p. Kuujjuaq, Nunavik.

Mayer, N., and Avis, W. (Eds) , 1997, *Canada Country Study : climate impacts and adaptations, National Cross Cutting Issues,* Volume VIII, Cat. No En56-119/7-1997E.

McDonald, M., Arraqutainaq, L., and Novalinga, Z. 1997. Voices From the Bay: traditional ecological knowledge of Inuit and Cree in the Hudson Bay bioregion. Canadian Arctic Resources Committee and the Environmental Committee of the Municipality of Sanikiluaq: CARC, Ottawa, ON.

McMichael, A.J., Haines, A., Slooff, R., and S. Kovats (Eds.). 1996. Climate Change and Human Health: An assessment prepared by a Task Group on behalf of the World Health Organization, the World Meteorological Organization and the United Nations Environment Programme. WHO, World Health Organization, Geneva.

Meldgaard, M. 1987. Human implications of Arctic animal population fluctuations: Caribou in Greenland. In (Nelson, J.G., Needham, R., and L. Norton, Eds.) 1987. Arctic Heritage, Proceedings of a Symposium. Association of Canadian Universities for Northern Studies, Ottawa, Canada.

Middaugh, J.P. 1990. Cardiovascular disease deaths among Alaskan Natives. American Journal of Public Health. 80: 282-285.

Nunavik Regional Board of Health and Social Services (NRBHSS). 2001. Health statistics prepared by P. Lejeune. Unpublished. NRBHSS, Kuujjuaq, Nunavik.

Patton, M.Q. 1980. Qualitative Research Methods. Beverly Hills, CA: Sage Publications.

Read, J.F. and Gould, W.J., 1992, Cooling and freshening of the subpolar North Atlantic Ocean since the 1960s, *Nature,* 360, pp. 55-57

Rees, W.E. 1988. Stable Community Development in the North: Properties and Requirements. In, G. Dacks and K Coates (Eds.) *Northern Communities: The Prospects for Empowerment.* Occasional Publication Number 25. Boreal Institute for Northern Studies. University of Alberta: Edmonton. 100 pp.

Riedlinger, D. and Berkes, F. 2001. Contributions of traditional knowledge to understanding climate change in the Canadian Arctic. Polar Record, 37 (203): 315-328.

Salonen, J.T. 1986. Selenium and Cancer. *Ann. Clin. Res.* 18: 18-21.

Santé Québec. 1995. Report of the Santé Québec Health Survey Among the Inuit of Nunavik (1992). Diet: A health determining factor. Montréal, Ministère de la Santé et des Services Sociaux du Québec, Gouvernement du Québec. Pp : 47-124.

Tanner, A., J. C. Kennedy, G. Inglis and S. McCorquodale. 1994. "Aboriginal Peoples and Governance in Newfoundland and Labrador". Report to the Royal Commission on Aboriginal Peoples, For Seven Generations: An Information Legacy of the Royal Commission on Aboriginal Peoples. Ottawa, Libraxus Inc.

Tesch, R. 1990. Qualitative research: Analysis types and software tools. Falmer: New York, NY.

Van Oostdam, J., A. Gilman, E. Dewailly, P. Usher, B. Wheatly, H. Kuhnlein, S. Neve, J. Walker, B. Tracy, M. Feeley, V. Jerome and B. Kwavnick. 1999. Human health implications of environmental contaminants in Arctic Canada: a review. The Science of the Total Environment. 230: 1-82.

Voisey's Bay Nickel Company. 1997. Environmental Impact Statement of the proposed mine and mill project at Voisey's Bay, Labrador.

Wenzel, G.W. 1981. Clyde Inuit adaptation and ecology: The organization of subsistence. National Museum of Man, Mercury Series, Canadian Ethnology Service Paper no. 77.: Ottawa.

Wenzel, G.W. 1986. Canadian Inuit in a mixed economy: Thoughts on seals, snowmobiles, and animal rights. Native Studies Review. 2(1): 69-82.

WHO (World Health Organization). 1967. The constitution of the World Health Organization, WHO Chronicle 1967; 1: 29

Williamson, T. 1994. Labrador Inuit politics from household to community to nation. A Report for the Royal Commission on Aboriginal Peoples: The North. St. John's Newfoundland.

Williamson, T. 1996. Seeing the Land is Seeing Ourselves. Final Report. Issues Scoping Project. Report prepared for the Labrador Inuit Association by T. Williamson. Labrador Inuit Association, Nain, Labrador.

Williamson, T. 1997. From Sina to Sikujaluk: Our Footprint. Mapping Inuit Environmental Knowledge in The Nain District of Northern Labrador. Report prepared by T. Williamson for the Labrador Inuit Association. Labrador Inuit Association, Nain, Labrador.

Table 1. Environmental changes and impacts reported during Labrador focus group discussions, Nain, March 2001.

| | Focus Group – Elders (men) | | Focus Group – Elders (women) + 1 individual woman | | Focus Group – Hunters (men) | |
|---|---|---|---|---|---|---|
| | Reported Changes | Reported Impacts | Reported Changes | Reported Impacts | Reported Changes | Reported Impacts |
| Weather | • warmer now<br>• hotter summers<br>• more freezing rain than snow<br>• much drier than before | • gets uncomfortable when fishing<br>• no flies some summers<br>• had a forest fire where we never thought possible | • much hotter now<br>• more rain now and rain in winter sometimes<br>• winter temperature more variable<br>• get mild spells in winter now<br>• more fierce fall storms now<br>• stronger winds now<br>• weather more unpredictable<br>• get sudden strong winds (north)<br>• get unpredicted mild weather more often | • burns berries and bake apples some years<br>• fewer berries some years<br>• hard to breath sometimes out on the land in summer<br>• warm spells in winter brings sickness, flu, bad colds<br>• limits going off on land sometimes<br>• many people will not go off if there is a north wind | • stronger winds<br>• stays warmer longer in the fall<br>• fewer very cold winds<br>• fewer very cold days<br>• much more spring wind<br>• fewer offshore storms<br>• weather changes faster (and more in winter)<br>• fluctuations in April, gets warm, then cold again<br>• summers are much drier<br>• not as much fog now<br>• fewer thunderstorms<br>• weather more unpredictable | • able to travel in wind more now<br>• delays break up<br>• can't get out early<br>• dangerous to go on ice at this time<br>• can travel through light storms now<br>• people are getting caught out on the land<br>• young people are getting caught out more now |
| Snow | • snow on hills always melts in Torngat mountains now<br>• snow is lighter, texture has changed<br>• all blows away b/c it is lighter<br>• snow comes later<br>• less snow | • no snow to cool char in summer when fishing<br>• caribou don't have place to cool off<br>• can't make snow houses anymore<br>• people have to wait for snow to go wooding<br>• don't have to walk through deep snow anymore (easier travel on foot) | • snow up North that stays year round is melting<br>• much less snow now<br>• snow comes later now (not until December)<br>• first snow comes and melts (used to come and stay)<br>• less spring snow<br>• snow melts earlier<br>• snow is much thinner | • hard on blueberries, less blue berries now because no snow to keep bushes warm in winter<br>• don't think you could make snow houses now | • not as much snow<br>• fall snow comes and melts (used to stay)<br>• snow is sugary, thinner, not wet snow anymore<br>• no heavy snow falls in the fall<br>• crust on top of snow is more common now<br>• get more "glitter" now (mild spell and rain on snow, then freezes) | • harder to get around when you're used to<br>• no snow to cool char when you're fishing in the summer<br>• can't make snow house if you need to<br>• hard on caribou for getting food<br>• impacts caribou and partridge and makes walking on snow hard |

Table 1. Environmental changes and impacts reported during Labrador focus group discussions in Nain, March 2001 (cont'd).

| | Focus Group – Elders (men) | | Focus Group – Elders (women) + 1 individual woman | | Focus Group – Hunters (men) | |
|---|---|---|---|---|---|---|
| | Reported Changes | Reported Impacts | Reported Changes | Reported Impacts | Reported Changes | Reported Impacts |
| Ice | • little snow on the ice now<br>• pack ice doesn't seem to come here from North anymore | • hard for seals (nowhere to build breathing holes and dens, hard on pups) | • goes out of the Bay much earlier<br>• less snow on the ice, sometimes bare<br>• freeze up later (late Dec.)<br>• break up takes longer now | • ships come in earlier, don't have to wait as long for supplies<br>• can go out to fishing camps earlier<br>• very hard to travel on ice<br>• hard on seals when there's no snow on the ice<br>• makes thin ice and dangerous in spring for travel<br>• have to be more careful going off on the land | • no good ice till January (about a month later now)<br>• not as solid / thick<br>• takes long time to solidify when its there<br>• breaks up earlier<br>• cracks form early<br>• ice seems to be saltier<br>• don`t get the fog or vapour over the water before freeze up anymore<br>• takes longer to break up, because of temperature fluctuations in April<br>• rough ice has changed, not coming in the Bay after break up, no multi-year pieces coming in<br>• rough ice at the ice edge seems to break up fast (quickly)<br>• much less snow on the ice<br>• some ice on rivers is thinner | • dangerous traveling in spring, have to be more careful<br>• can't get out on it during this time, too dangerous<br>• get stuck in community longer time now during break up, go crazy<br>• pups get attacked by crows etc.<br>• dangerous crossing is you don't know |
| Glaciers | • glaciers in North are melting, much smaller<br>• cracks in glaciers larger, and more plentiful | | | | | |
| Brooks | • many have dried up | • no drinking water at some camps in summer | | | • some of brooks up North have dried up<br>• some rivers dried up or are very low | • char have to wait for large rain to get up river |

Table 1. Environmental changes and impacts reported during Labrador focus group discussions in Nain, March 2001 (cont'd).

| | Focus Group – Elders (men) | | Focus Group – Elders (women) + 1 individual woman | | Focus Group – Hunters (men) | |
|---|---|---|---|---|---|---|
| | Reported Changes | Reported Impacts | Reported Changes | Reported Impacts | Reported Changes | Reported Impacts |
| Ponds | • some have dried up | • hard to find drinking water sometimes<br>• move camping areas<br>• bake apples grow well in areas of old ponds | | | • some in north have dried up | |
| Land | • torn up more from caribou | | • caribou paths everywhere now | | • land is much drier now<br>• no more "underground ice" | • has impact on berries, much fewer some years and burnt |
| Caribou | • changed migration route | • harder to get, have to go further | • changed migration (even out on islands now)<br>• meat has changed too<br>• sometimes scarce | • not as much fresh meat in the freezer this year | • some bugs in caribou now<br>• stronger taste to caribou now<br>• marrow used to be thick and greasy, now just stringy<br>• coming out along coast recently<br>• moving back inland now I think<br>• moving farther south<br>• main herd comes out to the coast now (never used to) | • don't eat the liver anymore because of bugs<br>• easier access, but this is changing |
| Seals | • habitat has changed | • hard on pups, lack of snow on ice, bellies get scratched up | | | • more square flippers now (bearded seals)<br>• harp seals come through earlier (August now - used to be Sept-Oct)<br>• more sick, skinny seals and more crawlers | |
| Fox | | | | | • gets strong smelling earlier now (February)<br>• fox are fatter now | |
| Marten | | | | | • coming back (disappeared for 15-20 years) | |
| Rabbits | | | | | • disappeared for a few years and are back now | |

Table 1. Environmental changes and impacts reported during Labrador focus group discussions in Nain, March 2001 (cont'd).

| | Focus Group – Elders (men) | | Focus Group – Elders (women) + 1 individual woman | | Focus Group – Hunters (men) | |
|---|---|---|---|---|---|---|
| | Reported Changes | Reported Impacts | Reported Changes | Reported Impacts | Reported Changes | Reported Impacts |
| Moose | | | | | • now seen here within last 10 years | |
| Beaver | | | | | • last 20 years started to see beaver again up this far | |
| Birds | | | | | • fewer young geese<br>• fewer ducks<br>• cormorants now seen here within last 10-15 years<br>• partridge come out to coast more | |
| All animals | | | • getting smarter, know where nets and tents are of people and stay away<br>• coming closer to people and town | • harder to catch<br>• don't have to go as far to go hunting now | • getting more used to noise | • can get closer to them when hunting |
| Fish | | | • no cod anymore (Rock cod, Tom cod) | | • no more fish left<br>• char have changed their diet<br>• char come out of the rivers and go straight out to sea<br>• fish are skinny now too | • hard to get them close to the community now<br>• taste is different<br>• harder to get, must wait for them to come back into the Bay |
| Berries and other plants | | | • changes with years, some years none b/c it is too hot<br>• more burnt berries and leaves | • really miss berries if there aren't many | • berry leaves are burning more<br>• berries dry up earlier in year<br>• some years, no berries | |
| Other | | | • water in harbour is polluted now | • fewer people fishing there<br>• less fish there | • sun burns your skin more<br>• more trees with brown needles<br>• contaminants and worms in wildlife | |

Table 2. Some environmental changes and impacts reported in Labrador (from literature sources)*.

| | Literature | |
|---|---|---|
| | Reported Changes | Reported Impacts |
| Weather | • Elders say weather patterns have changed<br>• storms more unpredictable now<br>• drier summers over last 10 years<br>• less thunderstorms<br>• more autumn storms with fierce winds<br>• more storms and more severe storms<br>• more unpredictable weather, faster changes<br>• winds stronger<br>• milder winters<br>• some rain in the winter | • implications for animals, frozen eiders found during one fast freeze up in autumn<br>• impacts on berries<br>• dangerous for travel |
| Snow | • much less snow in last 20 years<br>• less snow on ice<br>• snow more granular | • can't make snow houses anymore |
| Ice | • Bare ice more frequently seen now<br>• freeze up later (early January now) used to be mid-Dec<br>• takes longer to freeze up<br>• ice edge is closer than usual | • dangerous for travel<br>• limits travel |
| Brooks | • many have dried up<br>• many rivers have lower levels | • changed hunting routes |
| Ponds | • Many are drying up | |
| Caribou | • migration has changed<br>• started to come to coast more in 1970s, huge increase in numbers<br>• numbers decreasing and animals moving inland<br>• some caribou stay on coast year round and even on islands, but this changing<br>• caribou going further south each year<br>• easier to approach, tame<br>• caribou are smaller now (or just small ones come to coast)<br>• diet has changed, eating black moss on rocks<br>• change in health (decline), worms, strange behaviour, barren does, starving | • made hunting easier access<br>• trampling berry patches<br>• hunting caribou will get more difficult again |
| Seals and Whales | • seals (all species) numbers very high now<br>• larger number of crawlers<br>• seals thinner and taste different b/c decrease in food species<br>• ringed seals are smaller<br>• hooded seals seen inside islands now for first time<br>• minke and beluga whales seen more often now | • increase in seals, decrease in cod, sculpins and capelin impacted remaining food sources and health, size and fat content of seals (skinnier now) |
| Fox | • increased beyond cycle amount | • changes in trapping patterns<br>• impacts on birds eggs on islands |
| Marten | • gone from 1926-1980 now returning | |
| Moose | • started to appear in Nain region in last 20 years for first time ever | |
| Beaver | • becoming common occurrence for first time in long while | |
| Birds | • migratory species (birds and ducks ) decreasing over last 20 years except for Canada Geese<br>• mergansers are increasing | |
| All animals | • fewer animals in general<br>• more sick and diseased animals | • changed hunting routes<br>• people don't go to their old campsites anymore because no wildlife there in some cases |
| Fish | • fish are gone (cod)<br>• size and number of char decreased by 1980s<br>• salmon became scarce by late 80s early 90s<br>• decrease in cod<br>• char more afraid of nets | • changed lifestyle regarding fishing<br>• some systems closed and some had quotas placed on them<br>• loss of licenses for salmon<br>• impacts to marine food chain (seals etc.)<br>• harder to catch |

Table 2. Some environmental changes and impacts reported in Labrador (from literature sources)*.

| | Literature | |
|---|---|---|
| | Reported Changes | Reported Impacts |
| Other | • contaminants and polluted wildlife<br>• increase in number of black bears<br>• increased numbers of wolves<br>• Arctic hare decreasing<br>• porcupine making comeback after absence in Nain district<br>• lynx scarce (but subject to cycling)<br>• in some places tide is much stronger and water shallower | |

* Sources: Brice-Bennett, 1977; LIHC, 1996; Williamson, 1996; Williamson, 1997

Table 3. Environmental changes and impacts reported during Kuujjuaq focus group discussions, May, 2001.

| | Focus Group – Hunters and Elders (men) | | Focus-Group - Elders (women) | |
|---|---|---|---|---|
| | Reported Changes | Reported Impacts | Reported Changes | Reported Impacts |
| Weather | • gets warmer sooner and gets colder sooner<br>• spring comes earlier<br>• warming and cooling are more gradual (take longer)<br>• no real large changes, some years are just different<br>• not as hot for as long as it used to be | • more impact has come from getting older and losing our traditional ways<br>• we don't exercise as much anymore | • gets extremely cold when it is not expected to<br>• fast changes in temperature<br>• less rain<br>• warmer in summer | • <br>• have been stopped when we were going fishing, would have gone fishing more in the past |
| Ice | • break up is earlier<br>• seems thinner now during the winter | • seals gone earlier in spring | • ice breaks up faster now | • changes travel times and ice safety |
| Seals | • -fewer because of ice leaving earlier<br>• more harp seals here, especially in the fall | • | • | • |
| Caribou | • more sick caribou seen<br>• more caribou with bad joints and livers seen<br>• thinner now<br>• more sport hunting | • don't eat some parts now and don't eat parts that look bad<br>• limits caribou for Inuit and disturbs them, sometimes diverts them away from Inuit when we are hunting<br>• sometimes hard to get caribou because of this | • liver has white spots now<br>• caribou have returned, more now<br>• marrow is all bloody | • <br>• don't need to go as far to go hunting for caribou<br>• not as good tasting |
| Fish (Lake Trout) | • some Lake trout caught are very skinny | • don't eat them all now | | |
| Water | • river by Kuujjuaq is getting shallower every year<br>• some small lakes have dried up | • damage to boats and equipment from low water (related to damming)<br>• limited drinking water on the land sometimes | | |

Table 3. Environmental changes and impacts reported during Kuujjuaq focus group discussions, May, 2001 (cont'd).

| | Focus Group – Hunters and Elders (men) | | Focus-Group - Elders (women) | |
|---|---|---|---|---|
| | Reported Changes | Reported Impacts | Reported Changes | Reported Impacts |
| Foxes | • fewer now<br>• more rabid foxes now<br>• foxes further from community now | • <br>• harder to get in traps | | |
| Muskox | • increasing | • chasing caribou away from some areas | | |
| Beluga whales | • fewer<br>• whales don't go to some locations anymore | • get fewer beluga whales now | | |
| Sun | • the sun is very hot now, dangerous<br>• get sun burns now for first time | • dangerous, it burns your skin now<br>• have to wear cream on your skin now | • sun burns easily now<br>• it is hotter nowadays | • have to be careful with the sun<br>• skin burns now sometimes<br>• stay inside sometimes because of sun<br>• too hot in tents sometimes<br>• plants are dried up<br>• no berries sometimes, sun burns them<br>• cloud berries bloom and get dry quickly |

Table 4. Recent environmental changes and impacts reported in Nunavik (from McDonald *et al.,* 1997)

| | Literature | |
|---|---|---|
| | Reported Changes | Reported Impacts |
| Weather | *E James Bay*<br>• shorter spring and fall<br>• increased variability, less predictability in weather<br>• colder winters on average<br>*E Hudson Bay*<br>• cold weather lasts longer into spring<br>• spring and summer are cooling<br>• less, rain, fewer thunderstorms<br>*Hudson Strait*<br>• greater variability, less predictable in weather<br>• cooling on average<br>• longer winter<br>• less rain on annual basis | • decrease in insects |
| Snow | *E James Bay*<br>• increased snowfall<br>*E Hudson Bay*<br>• snow melts later in the year<br>• melts and thaws during the winter<br>*Hudson Strait*<br>• snow melts later in spring<br>• snow is "icier" | • covers vegetation with ice for animals, harder for them to get food<br>• no good snow for snow houses |
| Ice | *E James Bay*<br>• salinity changing<br>• more freshwater ice forming in the Bay<br>• less solid ice in LaGrande area and freezes later<br>*E Hudson Bay*<br>• freezes later<br>• solid ice cover larger and thicker<br>• fewer polynyas<br>• floe edge melts before breaking up<br>*Hudson Strait*<br>• freezes faster<br>• poorer quality ice<br>• landfast ice extends further<br>• polynyas freeze<br>• floe edge melts before break-up | • some impacts due to activity with damming and mining<br>• increased access to Eiders<br>• decreased food for Eiders |
| Brooks, Rivers | *E James Bay*<br>• seasonal reversal in levels and flow<br>• ice unstable on some rivers, breaks earlier<br>• water quality poorer<br>*E Hudson Bay and Hudson Strait*<br>• decrease flow and levels | • leaves hanging ice along shores, dangerous<br>• too low for boat travel in some areas |
| Ponds, Lakes | *E. James Bay*<br>• fluctuating water levels<br>• Ivujivik, Salluit and Kangiqsujjuaq where summer flow is low<br>• quality of drinking water has decreased all over | • decreased beaver and muskrat in area<br>• hard traveling for caribou, moose, and humans<br>• increased accidents when traveling<br>• fish migration must wait for rainfall in some rivers to have enough flow in river<br>• fish fewer and smaller |
| Land | *J Bay*<br>• rising land in rivers and along shores<br>• rising land all over<br>• shoreline and habitat changes | • some estuaries too shallow for whales to moult<br>• impedes fish migration and seals too<br>• decreased numbers of walrus seen |
| Beluga Whale | *All regions*<br>• decrease in numbers<br>• further off shore | |
| Walrus | *E James Bay*<br>• no longer present in some areas<br>*E Hudson Bay*<br>• moving away from Belcher Islands and move offshore now<br>*Hudson Strait*<br>• more in off shore areas | |

Table 4. Recent environmental changes and impacts reported in Nunavik (from McDonald et al., 1997).

| | Literature | |
|---|---|---|
| | Reported Changes | Reported Human Impacts |
| Caribou | *All regions*<br>• change in body condition and behaviour<br>• moved closer to coasts, larger herds<br>• changed diet, change in their taste to Inuit | |
| Polar Bears | *E Hudson Bay*<br>• more since 1960s<br>*Hudson Strait*<br>• fewer in Ivujivik area | |
| Rabbits | *All regions*<br>• fewer | |
| Moose | *E James Bay*<br>• habitat decreasing in size resulting in fewer moose<br>• changes in body condition and taste<br>*E Hudson Bay*<br>• in-migration from SE James Bay | |
| Canada and snow geese | *E James Bay*<br>• migration moved inland and eastern<br>• increase in non-nesting moulting geese<br>*E Hudson Bay*<br>• smaller flocks of Canada geese<br>• increase in non-nesting moulting geese<br>*Hudson Strait*<br>• increase moulting snow geese | |
| All animals | *All regions*<br>• decreases in small game<br>• change in taste of animals<br>*James Bay*<br>• fewer sick and dead animals | |
| Fish | *E James Bay*<br>• Hg contamination is here now<br>• loss of habitat for many species<br>*E Hudson Bay*<br>• fewer Arctic cod and char in Inukjuak area | |
| Other | *All regions*<br>• weaker currents in all regions<br>• change in sky colour in all regions<br>*E. Hudson Bay*<br>• sky is light blue and pale yellow and sun is more intense<br>*Hudson Strait*<br>• sun burns your skin more now | • all changes have had influence on Inuit diets<br>• effects the vegetation and Inuit |

Table 5. Summary of possible direct climate related health impacts in Nunavik and Labrador (from Furgal *et al*., 2002)

| ***Mediating process*** | ***Possible Direct Health Impacts*** |
|---|---|
| ***Exposure to thermal extremes*** | Heat and cold related stress (especially among Elders) resulting in illness etc. |
| ***Changes in frequency or intensity of other extreme weather events (storms, etc.)*** | Accidents resulting in death, injuries, stress related disorders, psychosocial disruption (e.g. being stranded in a storm) |
| ***Changes in ice distribution and stability, and snow composition and amount*** | Accidents while traveling or hunting resulting in death or injuries (e.g. accident while traveling on poor ice) |
| ***Increased UV exposure*** | Increased risks of skin cancers, burns, infectious diseases, eye damages (cataracts)-immunosuppression |

Table 6. Summary of possible indirect climate related health impacts in Nunavik and Labrador (from Furgal *et al*., 2002).

| Mediating process | ***Possible Indirect Health Impacts*** |
|---|---|
| ***Exposure to thermal extremes*** | Infectious diseases, stress related disorders, other health related disorders (such as psychosocial disruption) |
| ***Change in ice distribution and stability, snow composition and amount*** | Dietary problems associated with availability of food sources and affect on ability to fish and hunt |
| ***Effects on range and activity of vectors and infective parasites*** | Changes in geographical range and incidence of vector-borne diseases and their transmission to humans |
| ***Changes in local ecology of water-borne and food-borne infective agents*** | Changed incidence of diarrheal and other infectious diseases – emergence of new diseases |
| ***Changes in food and drinking water availability and productivity (Food and drinking water security)*** | Dietary problems: nutritional deficiencies and/or hunger, and consequent impairment of child growth and development, cultural and social implications due to diet 'shift', diabetes, changed contaminant exposure, etc. |
| ***Changes in distribution and composition of permafrost*** | Psychosocial disruption related to damages to infrastructures and population displacement – dietary problems associated with impacts via access to country food species |
| ***Sea level rise*** | Increased risks of infectious diseases – psychosocial disruption associated with infrastructures damages and population displacement |
| ***Changes in air pollution (contaminants, pollens and spores)*** | Increased incidence of respiratory and cardiovascular diseases – cancers etc. |

**List of Figures and Tables for Furgal *et al.***

**FIGURES**



**TABLES**