

The Northern Climate Exchange Gap Analysis Project

An Assessment

**of Documented Traditional and Local Knowledge and
Perspectives on the Impacts of Climate Change within
Nunavut Territory, the Northwest Territories, Northern
Alberta, Manitoba, Ontario, Quebec and Labrador**

Natasha Thorpe, Dyanna Riedlinger, Shari Fox
With GeoNorth Limited
Yellowknife
Northwest Territories
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1.0 Introduction

This report is one important part of a comprehensive project undertaken by the Northern Climate ExChange entitled, “An Assessment of the State of Knowledge of the Impacts of Climate Change on Canada’s North.” It assesses the current state of knowledge of the impacts of climate change, with a goal of helping to establish priorities for climate change research, monitoring, technological development and policy development in Canada’s North.

Until very recently, scientists have done almost all of the research on northern climate change and its potential impacts. However, people living in northern communities are already noticing the impacts of climate change (ICC 1996) as weather is the main factor controlling daily activity in their lives.

This close connection to the land gives local people a unique perspective from which to understand changes related to climate. Further, recent studies show that local observations and hypotheses parallel many of those made by scientists (e.g. McDonald *et al.* 1997; Fox 1998, 2000; Huntington 2000; Riedlinger 2000; Thorpe 2000).

For this report we analyzed the current state of knowledge of documented traditional and local knowledge on the impacts of climate change within the regions of Nunavut, the Northwest Territories, and northern Alberta, Manitoba, Ontario, Quebec and Labrador. In general, we examined the regional extent of this knowledge of climate change, and the topics covered by documented sources. We assessed how and by whom documentation is taking place, and we also looked at the kinds of traditional and local knowledge and observations that have been recorded, and

identified potential gaps. Our conclusions and recommendations on the state of documented traditional and local knowledge of climate change are somewhat limited by the fact that we located only 74 sources. However, this shortage shows that further research on local and traditional knowledge is needed.

1.1 Defining “traditional and local knowledge”: Semantics, Meanings and Terminology

This report addresses the knowledge and observations of climate change of local people, particularly indigenous people, living in the regions of Nunavut, the Northwest Territories, northern Alberta, Manitoba, Ontario, Quebec and Labrador. Debates both inside and outside academia have focused on finding an appropriate term and definition for the knowledge of indigenous people, or indigenous knowledge (IK). This knowledge has also been labeled traditional knowledge (TK), local knowledge (LK), traditional ecological knowledge (TEK), traditional environmental knowledge (TEK), folk ecology, ethno-ecology, customary law, and knowledge of the land (Johnson 1992). In addition, there has been a recent move to recognize specific groups. For example, the government of Nunavut is using the term Inuit Qaujimajatuqangit (IQ) in all of its government policies and practices to refer to Inuit knowledge. (Government of Nunavut, 1999).

However, despite these numerous terms, there is still no clear accepted definition of indigenous knowledge. One example is as follows:

Traditional environmental knowledge, or TEK, can generally be defined as a body of knowledge built up by a group of people through generations of living in close contact with nature. It includes a system of classification, a set of empirical observations about the local environment, and a system of self-management that governs resource use. The quantity and quality of traditional environmental knowledge varies among community members, depending upon gender, age, social status, intellectual capability, and profession (hunter, spiritual leader, healer, etc.). With its roots firmly in the past, traditional environmental knowledge is both cumulative and dynamic, building upon the experience of earlier generations and adapting to the new technological and socioeconomic changes of the present (Johnson 1992: 4).

In this report, we used the terms *traditional knowledge* and *local knowledge*. We used the word *traditional* with the utmost respect, recognizing that many of the sources we gathered are based on the knowledge of Elders. Such knowledge is the closest link to the past and incorporates the knowledge and skills of their ancestors with their rich life experiences through changing culture, language, and environmental and living conditions.

Local knowledge is often based on and includes *traditional knowledge*. We used *local knowledge* as a broader term that also recognizes knowledge developed over shorter time periods, such as that dealing with environmental monitoring (e.g. changes noticed in the last 5-10 years). *Local knowledge* also recognizes the knowledge of non-native long-time residents who have, in many cases, contributed to the studies we have included in the report.

2.0 Methods

We searched numerous media to collect the information required for an annotated bibliography of all identified sources of traditional and local knowledge of climate change. Next, these media were collated and inserted into tables for purposes of a gap analysis.

2.1 Searching for Sources

Web searches: The World Wide Web was searched thoroughly for any pages containing references to traditional and local knowledge of climate and climate change. Appendix A includes all of the web pages that were searched, though not all of them contained relevant information.

Databases: We searched all existing databases containing information on Northern climate change, environmental change, indigenous knowledge, traditional and local knowledge, etc. Appendix A lists all the databases that were searched, though not all of them contained relevant information.

Contacting Northern Experts: The authors tried to contact 52 colleagues and experts in Northern areas regarding any possible sources of information on this topic. Most contacts were made by e-mail, and a total of 17 replies were received. The list of contacts is not included, as individuals were not informed that their names would be included.

Literature searches: The authors and GeoNorth team searched academic publications, conference papers and presentations, non-published material and obscure reports such as unpublished government or NGO reports for additional sources of information. All relevant sources

have been annotated and included in the bibliography.

Video library searches: The GeoNorth team searched the video archives of the CBC and National Film Board of Canada for productions related to traditional and local knowledge of climate and climate change. Shari Fox searched the archives at the Inuit Broadcasting Corporation in Iqaluit for similar material.

Media sources: An overwhelming amount of information appears in the popular media on climate change and its impacts on Northern areas, so we did not attempt to include such sources in our bibliography. However, we recognize that searches in newspapers, magazines, radio and television newscasts may reveal some relevant reports.

2.2 Creating Tables for Analysis of Sources

The above searches resulted in 74 sources documenting traditional and local knowledge of climate change. The following eight criteria were used to place the sources in tables:

- region
- format/medium
- keyword
- content
- continuity
- duration as of 2000
- regional extent
- type of information

These tables helped us to analyze the relative strengths and weaknesses of the sources as well as gaps and trends in the literature. Our broad conclusions and

recommendations on what further research may be needed are hindered by the fact that there are so few existing references to local and traditional knowledge of climate.

We did not include all possible sources. For example, we omitted literature that identifies the need to look to traditional and local knowledge in order to understand change in the North. Second or third party accounts of traditional and local knowledge of climate change (e.g. accounts of Arctic missionaries or adventurers) were not sought out, but were included when found. In order to stay with the objectives of this report, we included only sources focused strictly on traditional and local knowledge of climate change.

3.0 Results

A gap analysis was conducted according to the eight categories listed in the previous section. Results are shown below.

3.1 Region

Table 1a and 1b illustrate how well regions are covered in terms of documented local and traditional knowledge of climate change.

Table 1a. Regional Analysis

Region	Number
Not specific to one region	9
Western Arctic	13
Mackenzie Basin	8
Central Arctic	8
Eastern Arctic	5
Northwest Territories	6
Nunavut	25
Alaska	7
Hudson Bay	8
Northern Provinces	8
Northern Quebec / Labrador	2
Arctic Ocean	1

As illustrated in Table 1a, there were on average eight sources per region for the 11 identified regions when the category “not specific to a region” was excluded. Nunavut (25) and the Western Arctic (13) had more than the average number of sources.

In contrast, Alaska (7), Northwest Territories (6), Eastern Arctic (5), Northern Quebec/Labrador (2), and Arctic Ocean (1) fall below the average. The Central Arctic, Hudson Bay, Mackenzie Basin, and Northern Provinces equal the average (8).

Table 1b. Sub-Regional Analysis

Sub-Region	Number
Inuvialuit	14
Gwich'in	2
Sahtu	3
Deh Cho	4
North Slave	3
South Slave	4
Kitikmeot	9
Kivalliq	7
Qikiqtani	5

Table 1b shows that in the sub-regions of Nunavut and the Northwest Territories, most references are for the Inuvialuit (14), Kitikmeot (9) and Kivalliq (7) regions. The fewest sources pertained to the South Slave (4), Deh Cho (4), Sahtu (3), North Slave (3), and Gwich'in (2) areas. On average there were six references per sub-region.

3.2 Format/Medium

Table 2 shows the formats or types of media that document local and traditional knowledge.

Most references were found in books (14), book sections (12), reports (11), journal articles (10), and conference presentations (10). Theses, websites, videos, conference proceedings, CD ROM, summary or periodic reports and projects produced four or less sources. There were no documented sources for dissertations, maps, periodic reports, bibliographies, computer models, brochures, and fact sheets.

Table 2. Format / Medium Analysis

Format / Medium	Number
Book	14
Book section	12
Report	11
Journal article	10
Conference presentation	10
Thesis	4
Web Site	3
Project	3
Conference proceedings	3
Other	2
Video	1
CD ROM	1
Summary or periodic report	1
Dissertations, maps, bibliographies, posters, summary or periodic reports, computer models, brochures, fact sheets (digital and printed formats)	0

3.3 Keyword

Table 3 summarizes the number of sources associated with 23 keywords provided by NCE. Most sources were associated with more than one keyword.

More than 20 sources contained the following keywords: climate, indicators, temperature, land, wildlife, human activity, land use, water/ice, and traditional knowledge. There were 10-19 sources related to marine, snow, vegetation, lakes, sea ice, coast, precipitation, mammals, birds, adaptation, and economy. Fewer than 10 sources were associated with air, palaeoclimate, erosion, permafrost, glaciers, run-off, streams, forests, fish, invertebrates, transportation, sea level, peat, ground ice, ice-cores, storms and flooding. There were

no sources for four keywords: landslides, chronology, pollen, and tree rings.

Table 3. Keyword Analysis

Keyword	Number
Traditional knowledge	64
Climate	62
Wildlife	31
Temperature	31
Land use	30
Human activity	30
Indicators	24
Water/Ice	21
Land	20
Mammals	19
Sea Ice	18
Vegetation	17
Marine	16
Snow	16
Economy	15
Coast	14
Precipitation	14
Lakes	11
Birds	10
Adaptation	10
Permafrost	9
Fish	8
Storms	8
Air	7
Sea level	7
Erosion	6
Transportation	5
Run-off	4
Flooding	3
Palaeoclimate	2
Invertebrates	2
Streams	2
Forests	2
Glaciers	2
Ground ice	1
Ice-cores	1
Peat	1
Landslides, chronology, pollen, tree-rings	0

3.4 Content

Table 4 shows the eight categories that were used to summarize the state of knowledge in key areas of local knowledge.

Table 4. Local Knowledge Content Analysis

Category	Number
Weather and seasonal change	56
Wildlife	36
Human adaptations and impacts	48
Sea ice and oceans	40
Environmental change	32
Water (lakes and rivers)	23
Vegetation	16
Land processes and permafrost	14
Historical	9

The keywords with the most references were weather and seasonal change (56) and human adaptation and impacts (48). Other keywords with numerous sources were wildlife (36), sea ice and oceans (40), water (23), vegetation (16) land processes and permafrost (14).

3.5 Continuity

Table 5 shows that continuity did not apply to the majority (53) of sources. Only nine sources were continuous and eight sources were discontinuous. A small number (4) were not recorded or unknown.

Table 5. Continuity Analysis

Category	Number
Continuous	9
Discontinuous	8
Not applicable	53
Not recorded / unknown	4

3.6 Duration

As of the year 2000, most sources reflected more than one year of research (7) or two years (6), as illustrated in Table 6. Few studies or projects (<3) lasted more than three years. This category did not apply to 42 sources.

Table 6. Duration Analysis

Length of time as of 2000	Number
Less than one year	4
One year	7
Two years	6
Three years	3
Four years	1
Five years	3
More than five years	3
Not applicable	42
Not recorded / unknown	5

3.7 Regional Extent

Table 7 shows the number of communities contributing to each source. Population levels within each community were not considered.

Table 7. Regional Extent Analysis

Regional Extent of Research	Number
One community	19
Two to five communities	12
Six to ten communities	6
Eleven to twenty communities	2
Entire regions as grouped in table 1a & 1b (e.g. Nunavut, Mackenzie Basin)	10
Not specific to a region	14
Not applicable	3
Not recorded / unknown	8

Most sources applied to one community (19) while twelve applied to between two and five communities. Six sources pertained to between six and ten communities while two sources covered between eleven and twenty communities. Many sources (14) were not specific to a region or, alternatively, covered an entire region (10).

digitized map information (5), video footage (4) and archaeological records (4). Eight types of information informed three or fewer sources: history (3), participatory action research (3), participant observation (3), other (3), presentation (1), anecdotal (1), graduate thesis (1), and narrative data (1).

3.8 Information Type

Table 8 illustrates the various types of information that informed each source.

Table 8. Type of Information Analysis

Type of Information	Number
Observational	38
Interviews	32
Archival records	17
Oral histories	11
Testimonies	10
Community workshops	7
Study reports / surveys	5
Digitized map information	5
Video footage	4
Archeological records	4
Language history	3
Participatory action research	3
Participant observation	3
Other	3
Presentations	1
Anecdotal	1
Grad theses	1
Narrative data	1
Not applicable	2
Not recorded / unknown	8

Observational information (38) and interviews (32) informed most sources. Archival records (17), oral history (17) and testimony (10) applied to numerous records while fewer sources came from community workshops (7), study reports/surveys (5),

4.0 Discussion

This analysis of eight criteria is a starting point for identifying areas where documented sources of local and traditional knowledge are strong, weak, or have gaps in them. However, each “absolute” number must be taken with caution as it does not account for varying spatial and temporal scales, regional coverage and depth of information. In other words, we are comparing apples and oranges. As a result, the following conclusions should be used as one of many tools in identifying information gaps regarding local and traditional knowledge of climate change.

A search for documented local and traditional knowledge of climate change using the methods described in Section 2 yielded 74 sources. This low number indicates that very little local and traditional knowledge of climate change has been recorded, and does not necessarily reflect the actual state of knowledge of climate change. As outlined in the terms of reference for this report, we included only documented sources of traditional and local knowledge of climate change and this number does not adequately show the total state of knowledge in communities nor the levels or extent of local expertise.

Following are four of the reasons why local and traditional knowledge of climate change have not been more fully documented:

- i) Interest in climate change is relatively recent. The number of references on traditional and local knowledge of climate change has increased since the late 1980s.
- ii) The validity and usefulness of traditional and local knowledge has not

always been recognized. More recently the implementation of land claims, self-government and legal precedents (e.g. Delgamuukw) have both empowered community members to conduct their own research and increased recognition for their ways of knowing. Communities are now pursuing their own efforts to document their knowledge of climate change.

- iii) In the last few years there has been more demand for local and traditional knowledge research and a concurrent rise in available funding for such initiatives. Both of these conditions have facilitated the recent documentation of local and traditional knowledge by researchers.

- iv) The current number of references on traditional and local knowledge of climate change essentially reflects the level of collaboration between researchers and community members. Now most communities are starting to document this knowledge on their own, with less input from outside researchers. As both the funding and the demand for such projects continues to increase, community members will be better able to document their own knowledge in the future.

4.1 Region

These results suggest that Nunavut and the Western Arctic have a relatively high number of sources while the number is low for the Northern Provinces, Quebec, Labrador and the Arctic Ocean. This finding should be considered with caution as each region greatly differs in geography, size and population.

The relatively high numbers for the Western Arctic and Mackenzie Basin may reflect

recognition of this region as a climatic “hot spot” or an area where impacts from climate change may be seen first. As a result, more research has taken place in these regions. As well, several key projects have contributed multiple sources to our database (e.g. the Mackenzie Basin Impact Study (MBIS) and Inuit Observations of Climate Change). Essentially, a few large projects can make regions stand out because of the limited number of sources in our database. MBIS, Northern River Basins Study, Inuit Observations of Climate Change Study and the Tuktu and Nogak Project are four examples of such studies.

With respect to sub-regions, the fact that most sources pertained to the Inuvialuit, Kitikmeot and Kivalliq regions may partially reflect the researchers’ areas of familiarity.

We could more easily find sources for the regions in which we work and it was also easier to consult with other experts for obscure sources. The least number of sources pertained to the South Slave (4), Deh Cho (4), Sahtu (3), North Slave (3), and Gwich’in (2) areas.

4.2 Format/Medium

Analysis of the different sources revealed that there is little non-written material and a relative abundance of written material. This is a critical point as community members usually prefer communication through non-written materials such as videos or oral recordings. These approaches ensure that elders who cannot read English are included.

This finding highlights the need to determine which formats are best for providing information on documented traditional and local knowledge to community members. These preferred

formats should then be used in future projects.

For example, most documentation is contained in books and reports, which are useful formats for preserving traditional and local knowledge. However, they may be more accessible to academics and outside researchers than they are to community members. One approach might be to require that researchers provide written summaries of their works to communities in the local language.

It appears that videos, web-based materials and oral testimonies are becoming popular, and these formats may be well suited for documenting traditional and local knowledge related to climate change.

4.3 Keyword

As stated earlier, traditional and local knowledge provide an important local/regional understanding of the environment. Accordingly, the keywords “wildlife,” “temperature,” “land use,” and “human activity” all have numerous sources.

Other keywords that we expected to produce a similar number of sources did not do so. However, this finding was less surprising when we considered that most of the references were from the Nunavut region, which is primarily above treeline.

Also, contrary to popular belief, our analysis showed that many Arctic communities are not familiar with glaciers. This keyword produced few sources, as did ice-cores, pollen, tree-rings, and palaeoclimate. These terms refer to tools used by Western scientists to evaluate climate and are not as relevant to local and traditional knowledge.

Two important points need to be raised here: First, a distinction needs to be made between

how indigenous and local people in the North make, interpret, and talk about their observations, as compared to the more reductionist approach taken by scientists. Many Northerners do not think of their environment and changes occurring to it as an accumulation of parts. Rather, environmental characteristics, features, creatures and processes are tied together in complex interrelationships that are only beginning to be understood and documented in terms of climate change. Therefore, everything on this list is probably incorporated in some form at some scale in all traditional and local knowledge.

Second, quantification of these key words does not clearly indicate the sum total of northern traditional and local knowledge on climate change; rather this exercise reflects what questions are being asked by the people who are documenting the knowledge.

As has been noted several times already, the documentation of traditional and local knowledge of climate change in the North is a new endeavor, and very few sources of this type of work have been found. Research to date has only laid the foundation and is just beginning to ask questions about local observations. These questions have often been broad in scope and that is reflected in the keyword analysis. However, the stage is now set for more specific research.

Anyone familiar with northern communities will not be surprised that many of the keywords with the most sources are tied to community life and use of the land. People in the North often discuss their environment in a “big picture” way. For example, changes are often discussed in terms of the “sea ice environment” or “weather and seasonal change.” In addition, like any other population, local people in the North have been noticing and talking about the “big

impacts” first, such as those that are tied to community living.

4.4 Content

We found that content analysis may be a more appropriate tool for identifying what has been done on traditional and local knowledge, as well as the gaps in this area. These categories reflect how we see traditional knowledge of climate change being documented, based on our own experience and knowledge with this issue. For example, most people in the community are talking about “weather and seasonal change.” This topic can be divided into more specific keywords such as climate, temperature, indicators, snow, precipitation, storms, and air.

This analysis showed a high number of sources for human adaptation and impacts. As noted earlier, the keyword analysis showed that most sources deal with impacts rather than adaptations. This finding speaks to the assertion that northerners are the first peoples to experience climate change, and they have already begun to discuss its impacts.

There are only nine references for the keyword “historical” which reflects the difficulties in accessing older local and traditional knowledge that is nested or embedded in materials found in archives, community libraries, hunting and trapping organizations, and heritage societies.

4.5 Continuity

This analysis showed that the number of sources for continuous and discontinuous sources was roughly equal, but this criterion was not applicable to most sources. While continuity and duration are concepts easily assigned to scientific studies, they are not so easily applied to local and traditional

knowledge works. Many of the sources were not actual studies so duration was not applicable or was difficult to pinpoint. For example, when Inuit Elders give presentations on changes they are experiencing, this source cannot be analyzed in terms of continuity or duration. Community-based projects that are documenting this knowledge can be assigned duration, but continuity does not apply in the same way that it would for a scientific study since communities may not have a rigid timetable for documentation.

sources, though they would likely contribute useful information if used more often. Relatively few sources are informed by presentations, graduate theses, or anecdotal and narrative data.

4.6 Duration

Since climate change has only been noticed in the last decade or so, most sources of documented traditional and local knowledge are relatively new. Therefore, it is not surprising that most research projects and studies are less than five years in duration. In fact, most are less than one year in duration, although they may develop into longer works.

4.7 Regional Extent

This analysis showed that most sources involved only one community, but such sources can be just as important as ones involving multiple communities. For example, there may be more local experts in one community than in five communities combined. Also, local experts may know much more about the surrounding region than do average community members.

4.8 Information Type

Analysis of the sources showed that most of them come from observations, interviews, and archives. Oral histories and testimonies, which are commonly used for local and traditional knowledge research, are also important. Surveys, digitized map information, video footage, and archaeological records provide fewer

5.0 Conclusions

Climate change is now one of the leading areas for research in the Canadian North. Evidence from both the scientific community and from within northern communities suggests that the impacts of climate change are already noticeable in high latitude regions. While western science-based research provides an extensive body of literature on climate change trends and impacts, contributions from traditional and local knowledge have received less attention.

Based on our analysis of 74 sources, we can draw the following conclusions:

- Our gap analysis uncovered so few sources that it is difficult to state whether specific areas of research on traditional and local knowledge of climate change are covered poorly or adequately.
- Much of the existing documentation comes from larger sources or general reports on climate change, and is incidental or descriptive. There are fewer examples of specific projects or substantial explorations of traditional and local knowledge of climate change.
- Some regions have better documentation than others on traditional and local knowledge of climate change. However this variation most likely reflects the existence of regional “hot spots” for climate change and the fact that key projects in certain areas have looked specifically at community perceptions of climate change.
- Documented traditional and local knowledge of climate change mainly reflects broad categories of impacts and change, rather than details and specifics. This may reflect the ‘newness’ of this area of research. However, the kinds of changes being documented reflect what is most noticeable in communities and what communities are saying about the changes. The documented sources of traditional and local knowledge of climate change mainly reflect community concerns about community livelihood and community life.
- Much of the work being done to document traditional and local knowledge appears to focus on current observations of change rather than the historical context for these changes.
- Most traditional and local knowledge of climate change is found in books, journals and reports.
- Many sources documented general observations of climate change in the North and were not specific to a region or community. However, specific studies and research projects were usually based on between one and five communities.
- Most studies of documented traditional and local knowledge are very short in duration, lasting less than five years.
- The 74 sources that we uncovered do not reflect the total knowledge base that can be found in the North. Rather this relatively low number reflects the fact that mainstream researchers are just starting to pay more attention to this new area of research. In addition, the small number of sources must be viewed in the

context of the questions that were asked by the researchers.

In conclusion, while our analysis was not as useful in identifying specific regional or topical gaps, it did help identify that:

1. There is an overall need for more projects that specifically explore and document traditional and local knowledge of climate change in the North. Most of the information that we found was incidental or only briefly described changes. Substantial explorations of the issues were not found.

2. *What* is being documented and *where* it is being documented are both very important questions. However, the critical overriding issue is *how* to encourage or support documentation *with* and *in* Northern communities. A standard gap analysis identifying sources on traditional and local knowledge by region and topic is not particularly effective in focusing future research needs. Traditional and local knowledge of climate change is being documented largely because northerners are concerned and talking about it. Our analysis clearly identified a need for more projects at the community level, and for linking western science-based climate change research with this knowledge to move towards a more comprehensive understanding of the impacts of climate change on the North.

Also, community-based projects on documenting local and traditional knowledge should only be the first step. Relationships must be built between scientists and communities so that traditional and local knowledge of climate change is included in mainstream research. This process continues to be hindered by questions of how to integrate or bridge the

gap between western science and local and traditional knowledge.

There are both conceptual and logistical challenges to linking these ways of knowing. Research that seeks to include a traditional and local knowledge component is often faced with barriers such as project-funding structures and timelines that can be inadequate for community-based or long-term research. These issues are particularly important when addressing traditional and local knowledge of climate change, as this research must cover a wide range of topics, not just one variable, over the long term. Both the conceptual and logistic aspects of increasing collaboration between scientists and communities are included in the recommendations we provide below.

6.0 Recommendations

Based on the above conclusions on the state of traditional and local knowledge of climate change in Nunavut, the Northwest Territories and Northern Alberta, Manitoba, Ontario, Quebec, and Labrador, we have developed a series of recommendations. They are intended to help further efforts to document traditional and local knowledge of climate change and increase collaboration between scientific and traditional and local experts. Together, this should create the capacity for sharing information and for feedback. These recommendations reflect the analysis we have conducted for the purposes of this report, as well as of our shared experiences as researchers actively working in this area:

- 1) **More research is needed that is specifically focused on documenting traditional and local knowledge and interpreting this knowledge with local people.** This approach is different from research where such knowledge is a sub-component of a larger study.
- 2) **Although we are reluctant to say that a specific region is under-represented, very few sources for Northern Provinces and Northern Quebec/Labrador were found.** Local and traditional knowledge research is scarce in all regions and needs support and encouragement. Documenting traditional and local knowledge of climate change requires substantial commitments of both time and money for research. One way to address regional gaps may be to focus on climatic “hot spots” since there is already an emerging body of research in these areas. Another approach may be to encourage research in regions and sub-regions that are poorly represented, for example, the Northern Provinces and Labrador.
- 3) **Individual communities, in consultation with researchers, should identify priorities for future research topics on traditional and local knowledge of climate change.** The topics identified in our gap analysis may be more appropriate for describing the *kind* of research that is being done than for identifying where future studies should focus. For example, while invertebrates are an underrepresented keyword in our analysis, this does not mean that they should not be a research priority for all northern communities.
- 4) **Future research should focus on exploring traditional and local knowledge in more depth and detail.** This work could highlight the strength of local knowledge regarding regional climatic variables. Multi-year projects would help add depth to the research.
- 5) **More research is needed on *how* to bridge the gap between western science and local knowledge, both conceptually and practically.** This requires moving beyond simply recognizing that the gap exists, and will most likely require more creative approaches as well as efforts to build capacity within communities. Currently, there are good examples of this kind of research taking place.
- 6) **Documenting traditional and local knowledge of climate change requires creative methodologies.** As with other community-based research, methodologies and approaches are needed that retain the context of the knowledge. These methodologies may include time on the land, mapping, film and video.

7) Project structures, funding requirements and timelines must reflect the needs of community-based research.

Promoting collaboration between science and traditional and local knowledge requires flexible approaches to research. Working with communities to understand climate change requires significant time, logistical and organizational contributions. More time can be needed to ensure that traditional and local knowledge is documented in a manner appropriate to the community. Funding structures should be adaptable and reflect the unique needs of this kind of research.

8) Future research in this area possibly could be promoted by developing a forum for tracking current research on climate change in the North.

A web-based database could help increase collaboration between researchers and communities. For example, if communities could access this database, they could invite researchers to engage in collaborative projects based on research priorities that they have already identified. This is one area in which the NCE is making progress.

9) Scientists should be actively encouraged to communicate and collaborate with communities, and include traditional and local knowledge in their research.

This would include providing information and feedback to communities from these projects, and it would most likely require more funding and project support mechanisms. Encouraging scientific communication and collaboration could also help improve the links between traditional and local knowledge and the scientific community. (see recommendation 5)

10) Continued support for projects that are initiated by communities is critical.

More opportunities should be created for

communities to document and monitor climate-related changes in ways that are appropriate for and reflect their needs. This initiative could require more funding and better connections with researchers and research projects.

11) A series of conferences, bioregion meetings, or “on the land summits” should be created.

These gatherings would bring together local experts and scientists to discuss climate change. Meetings could be organized around climate trends and impacts in a particular bioregion (i.e. Beaufort Sea), and could take place either as an organized conference or as an “on the land summit” – a meeting out on the land/ice/water. Summits organized for local participants only should be seen as having the same importance as meetings involving only scientists.

12) More focus should be placed on adaptation strategies for climate change as northern Canada has little control over the impacts.

It may be important to focus research on practical adaptation strategies and processes. The emerging body of traditional and local knowledge can be used to help develop these mechanisms.

13) Opportunities should be supported and created for northern communities to share their experiences and concerns related to environmental and climate change with local, national and international decision-makers.

These forums could help influence these decision makers by showing how climate change is affecting human livelihoods in the North. For example, such forums could support efforts to change international legislation on greenhouse gas emissions and provide funding for developing local adaptation strategies.

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Appendix A: Database / Web Search

Name	Location
Arctic Research Consortium of the U.S (ARCUS)	www.arcus.org/a.html arcus.polarnet.com
Arctic Borderlands Ecological Knowledge Co-op	www.taiga.net/coop/about.html www.taiga.net/sustain/lib/index.html
Aurora Research Institute	www.auresint.nt.ca/
Taiga News (of the Taiga Rescue Network)	www.snf.se/TRN/TaigaNews
Arctic Institute of North America (AINA)	www.ucalgary.ca/UofC/Others/AINA
Arctic Science and Technology Information System (ASTIS)	www.aina.ucalgary.ca/ASTIS
Canadian Wildlife Service	www.cws.ca/
Dene Cultural Institute	www.deneculture.org/tradknow.htm
Department of Fisheries and Oceans	www.dfo-mpo.gc.ca/home-accueil_e.htm
Indian and Northern Affairs Canada (Northern Scientific Training Program)	www.inac.gc.ca/index_e.html
Association of Canadian Universities for Northern Studies (ACUNS)	www.uottawa.ca/associations/aucen-acuns/en/about.html
West Kitikmeot Slave Study Society (WKSS)	www.wkss.nt.ca
First Nations Periodical Index	moon.lights.com/index2.html
World Wide Web Virtual Library – environment	earthsystems.org/Environment.shtml
Nunavut Environmental Database	http://136.159.147.171/ned/
Arctic Roadmap	www.dartmouth.edu/acad-inst/arctic/roadmap.html
Inuit Circumpolar Conference, Canada	www.inusiaat.com
Arctic Council	arctic-council.usgs.gov/
Polar Web	www.urova.fi/home/arktinen/polarweb/polarweb.htm
Nunavut Research Institute (NRI)	www.nunanet.com/~research/
Inventory of Circumpolar Arctic Sustainable Development Initiatives	www.grida.no/parl.isdi
International Institute for Sustainable Development (IISD) Information Centre	iisd1.iisd.ca/ic/default.htm
Canadian Arctic Resources Committee (CARC)	www.carc.org
Canadian Polar Commission	www.polarcom.gc.ca/homepage.htm
Canadian Circumpolar Institute (CCI)	www.ualberta.ca/~ccinst/polar.html
Arctic Circle	arcticcircle.uconn.edu/ArcticCircle/
Northern Information Network (NIN)	nin.inac.gc.ca

	esd.inac.gc.ca/NIN
	www.nunavut.com/nunavut99/english/inuit-land.html
	www.greenpeace.org/~comms/97/arctic/library/region/people.html
Environment Canada Library	http://199.212.19.41/cgi-bin/bestn?id=8
	www.inac.gc.ca/pr/pub/indigen/ipsdca_e.html
Environment Canada (Green Lane)	www.ec.gc.ca/
Environment Canada (Ecosystem Initiatives)	www.ec.gc.ca/ecosyst/backgrounder.html
	www.atl.ec.gc.ca/nei/
	www.atl.ec.gc.ca/nei/pdf/bibliography.pdf
The international arctic environment data directory (ADD)	www.grida.no/add/
Akwesasne task force on the environment (ATFE)	www.slic.com/atfe/atfe.htm
AMP International	www.ampinternational.gl/
Climate change knowledge network	http://iisd.ca/climate/southnorthkn.htm