

Frontiers in Polar Social Science

# **The Earth is Faster Now**

**Indigenous Observations of  
Arctic Environmental Change**



*Kunuk watches the ice. Photo © Bill Hess, Running Dog Publications.*

# The Earth is Faster Now

## Indigenous Observations of Arctic Environmental Change

Edited by  
**Igor Krupnik and Dyanna Jolly**

Published by  
Arctic Research Consortium of the United States  
in cooperation with the Arctic Studies Center, Smithsonian Institution  
2002



*Cover photo © 1980 James H. Barker: Nelson Island seal hunters from Toksook Bay study ice conditions during an April hunt.*

This book may be cited as:

Krupnik, Igor, and Jolly, Dyanna (eds.). 2002. *The Earth is Faster Now: Indigenous Observations of Arctic Environmental Change*. Fairbanks, Alaska: Arctic Research Consortium of the United States. 384 pp. ISBN 0-9720449-0-6.



This book is published by ARCUS with funding provided by the National Science Foundation (NSF) Arctic Social Sciences Program under cooperative agreement OPP-0101279. Any opinions, findings, and conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

Additional funds were provided by the Arctic Studies Center, Smithsonian Institution, to increase distribution and availability.



ARCUS, 3535 College Road, Suite 101, Fairbanks, Alaska, USA 99709  
907/474-1600 • fax 907/474-1604 • [arcus@arcus.org](mailto:arcus@arcus.org) • [www.arcus.org](http://www.arcus.org)

## Foreword:

### Where a Storm is a Symphony and Land and Ice are One

Jose A. Kusugak  
President, Inuit Tapiriit Kanatami



I have precious memories, childhood memories of our home life in dwellings and shelters going back to when I was a kid in Naujaat (Repulse Bay), Nunavut. During one of those times, it was during a severe March arctic blizzard. My brothers Arvaarluk, Qunngaataq, and I exhausted all indoor things to do like listening to legends and stories, finding and marking capital “H”s on all the magazines that we recycled as wallpaper for our *qarmak*, sod house. We had exhausted our string games and were now resorting to *Aaqsiiq*, the Silence Game.

This was not a clever ploy by our parents to keep us quiet. *Aaqsiiq* has a clear and important purpose and that is to test and increase one’s own sense of hearing.

We could hear the winds and blowing snow through our very basic air duct. It was crafted by fitting empty tin cans together end to end. (We were into recycling sand re-using long before blue boxes invention.)

Here was our own symphony of wind instruments. On the south side of our *qarmak* (sod house) you could hear rolling snow driving and building and shaping snowdrifts. On our roof, a different sound and a faster tempo with the swift movement of *natiruviaq* (flooring snow) and then the percussion, the wind itself beating its tempo through the air duct. If it were put on a music sheet, it would read, “The seals will be happy. They have snow in their own *natsiaqqitit*; those baby seal bearing holes have a fresh snow covering.” For us, the drifting snow will smooth out the sea ice for easier and faster travel. New snow will bury old prints and reveal only the new and the fresh animal tracks.

The gradual softening of the north wind, guaranteeing many days of clear weather, sunshine, and endless blue skies lie ahead. And best of all, we will be free from the smothering *qarmak* and back outside to be part of the symphony of elements. I think it is fair to say that until colonization dragged Inuit into houses, we generally lived our lives as nomads, outside in the open and in sync with both our eco and solar systems.

Inuit have “moons” in a year roughly coinciding with the same months as *qablunaat*, but each may be its own season. The moon is both a warning and a gauge of when it is good timing to go to the floe edge. About three days before and after the full moon is considered *piturniq* (extra high tide) and often is windy. In the winter when Inuit go to the floe edge to hunt they are taught to be aware of this since it might cause the main ice to *aukkaq* (break off and float away). It is quite useless to go *sinaasiuq* (seal hunting at the edge of ice) or literally to “look for the edge of ice” at high tide since there is no edge. It is necessary to know when to go sealing as not to waste your time or even worse, lose your life. For Inuit, perhaps in the past more than now, there are times of the year when there is no difference between land and sea ice. If there is a difference, it’s the fact that the sea ice is more important to our survival.

For Inuit, during most of the year, sea ice is really a large extension of land. In winter, it was rare to find igloos and camps built on land. The land was colder than building igloos on sea or lake ice. The radiant heat of the water made that much difference.

Climate change has real and serious implications for Inuit life because much of the traditional knowledge is based on the times of seasons and not traditionally on temperatures. In other words, one does “this” at “this time” of the year rather than when the temperature gets “like this.” For example, caching caribou is done in the fall after flies stop flying; not only to prevent maggots but because the meat shouldn’t be too fermented or for that matter, too fresh. It is called *pirujat* (cached) or fermented meat and fat is called *igunaq* (singular), *igunat* (plural). There are many grades of *igunat* from mild to green. Now with climate change and warmer temperatures, much meat is going to waste because of over fermentation and botulism is becoming a real hazard. *Iqalugjuat* and *kujjaitat* (fermented fish and “hung upside down” fish) are especially susceptible since fish rots easily.

I had better change the subject before I get too hungry.

I think it is important to note that at least for now global warming is not all bad. Many northerners, who love to boat, actually are enjoying longer boating seasons. Many Inuit fish with fish nets under ice and are happy that the ice is not as thick as it once was. Fish are fat and plentiful at the moment. Berry picking in the fall has never been better. In biblical terms, it would be the seven years of plenty. But life as we knew it and know it now, is changing fast. *Sirmik* (permanent ice) in many areas is melting causing lakes to drain. *Aniuvvat* (permanent snow patches) are disappearing. *Aniuvvat* produces our favorite tea water, and caribou frequent *aniuvvat* patches to get away from mosquitoes and flies. What I fear is that lives will be lost, because of thinning of ice, and because after lake ice melts and snow on the land is gone in the late spring people are still travelling on sea ice to the beginning of July. Will the ice still be safe for them?

Finding examples of effects of climate change is easy and endless. I know Inuit, old and young, want to be informed of outside influences of global warming. Like acupuncture, they know that the pain is much in their homelands but the needles have to be inserted in the south, since that is where the disease really is. I also know that given the opportunity to partake in data keeping, Inuit are more than willing. We have been

careful caretakers of the Arctic from Siberia to Alaska to Canada to Greenland and back to Siberia for a long time. We have one language with varying dialects. Our customs and laws were designed to ensure our survival, and there are reasons behind everything we did. For example, we never stayed in one place or used one campsite for more than a few years, to avoid disease. We were told and taught *anijaaq*, which means “go outside to greet the day and elements first thing in the morning in order to live long.”

What it all came down to was respect for the Earth and doing your part in keeping the world as in its original state. Inuit see themselves as part of the ecosystem and want to be included: not as victims, but as a people who can help.

I believe Inuit can provide the rest of society with useful and timely information because we are at the forefront where the impacts and effects of climate change are felt first and may be the most severe. This book is a good example of “all of us earthlings” getting together to protect this bubble of atmosphere because it is a matter of life. Listen and look intently to the great outdoors as though it was a great symphony, where Land and Ice are One.

## Contributors<sup>1</sup>

**Fikret Berkes** is professor of natural resources at the University of Manitoba, Winnipeg, Canada. He is an applied ecologist by background and works at the interface of natural and social sciences. Berkes has devoted most of his professional life to investigating the interrelations between societies and their resources, and to examining the conditions under which the “tragedy of the commons” may be avoided. His main area of expertise is common-property resources and community-based resource management. He has conducted research throughout the Canadian North on indigenous resource use systems, small-scale fisheries, co-management, traditional ecological knowledge, subsistence economies, and environmental assessment. He has worked with the Cree people of Quebec and Ontario (James Bay area) and Manitoba, and also with the Nishnabe (Ojibwa), Dene, Nishga, and Inuit.

*Fikret Berkes, Natural Resources Institute, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2. berkes@cc.umanitoba.ca.*

**Claudette Bradley** is an associate professor of education at the University of Alaska Fairbanks. She is a member of the Schaghitcoke Tribe, whose reservation is located in Kent, Connecticut. Bradley has taught mathematics and education courses via distance delivery to rural students for the University of Alaska Fairbanks since 1989. Her research and publications address the development of culturally appropriate mathematics, science, and technology curriculum for Alaskan Natives and American Indian students. Since 1988, Claudette has been involved in teaching and coordinating precollege summer camps and science fairs for Alaska Native students. Her other projects include the development of an education module for grades five and six on Yup'ik Star Navigation Across the Tundra, which is part of National Science Foundation-funded Yupiaq Mathematics Project at the University of Alaska Fairbanks.

*C. Bradley, University of Alaska Fairbanks, Interior-Aleutians Campus, P.O. Box 756720, Fairbanks, Alaska 99775 USA. ffceb@uaf.edu.*

**Shari Fox** is currently a PhD student at the University of Colorado at Boulder and holds bachelor and master's degrees in environmental studies from the University of Waterloo. Fox is also the co-lead author, with Henry Huntington, of the Indigenous

---

1. This is a list of corresponding authors only. Affiliations of other contributors can be found in individual chapters.

Perspectives chapter of the Arctic Climate Impact Assessment, an international project organized under the auspices of the Arctic Council. Born and raised in the flat expanses of southern Ontario, these days Fox divides her time between studying and playing in the Rocky Mountains. Fox is committed to working on issues that concern indigenous people and hopes to continue visiting the North and working with Inuit. *S. Fox, Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado at Boulder, Boulder, CO 80309-0449 USA. sfox@kryos.colorado.edu.*

**Chris Furgal** is a researcher in the Public Health Research Unit, Centre Hospitalier Universitaire de Laval (CHUL) Research Centre, Université Laval, Québec. He conducts work in both the biological and social sciences on issues related to environmental contaminants, climate change, and other environmental health related issues and their management and impacts on people in the circumpolar North. Much of this work is conducted in cooperation with Aboriginal organizations in the Canadian North. He is a member of the Nunavik Nutrition and Health Committee and co-lead author of the Arctic Climate Impact Assessment (ACIA) chapter on health impacts in circumpolar arctic regions.

*C. Furgal, Public Health Research Unit, CHUQ-Pavillon CHUL, 2400 rue d'Estimauville, Beauport, Québec G1S 1S7 Canada. christopher.furgal@crchul.ulaval.ca.*

**Henry P. Huntington** is an independent researcher in Eagle River, Alaska, where he lives with his wife and two young sons. He received his PhD from the Scott Polar Research Institute at the University of Cambridge (UK), having done his research on the interactions of wildlife management institutions and Native hunting practices in northern Alaska. His subsequent research has examined traditional ecological knowledge, environmental contaminants, climate change, conservation in the Arctic, and other topics concerning the Arctic, its environment, and the peoples who live there. He is currently president of the Arctic Research Consortium of the United States. *H. Huntington, 23834 The Clearing Drive, Eagle River, AK 99577, USA. hph@alaska.net.*

**Dyanna Jolly** is a Canadian researcher currently affiliated with the Centre for Maori and Indigenous Planning and Development at Lincoln University in New Zealand, and working on co-management issues. Before making the move to the southern hemisphere, Jolly did her graduate research at the University of Manitoba, exploring the contributions of traditional knowledge to understanding climate change in the Canadian Arctic. Her research was part of the project Inuit Observations on Climate Change, a joint effort between the International Institute for Sustainable Development (IISD) and the Western Arctic community of Sachs Harbour. She admits that she was born in (the dirty south of) Ontario, but brags about growing up in the Cree-Nakota-Saulteaux prairie community of Whitebear First Nations, in beautiful southern Saskatchewan.

*D. Jolly, Centre for Maori and Indigenous Planning and Development, P.O. Box 84, Lincoln University, Canterbury, New Zealand. dyjolly@ihug.co.nz.*

**Gary Kofinas** is a research assistant professor of public policy at the Institute of Social and Economic Research of the University of Alaska Anchorage and a senior fellow at the Institute of Arctic Studies of Dartmouth College. His research focuses on the evolution of co-management systems, the interface of local/traditional knowledge and science, and the sustainability of arctic communities. Gary received a PhD from the University of British Columbia in interdisciplinary studies/resource management

science. He serves as project leader for the Human Role in Reindeer/Caribou Systems initiative of the International Arctic Science Committee and advises on the design and implementation of the Arctic Borderlands Ecological Knowledge Co-op community monitoring program. Old Crow, Aklavik, Fort McPherson, and Arctic Village are partner communities in the Arctic Borderlands Knowledge Co-op program.

*G. Kofinas, Institute of Arctic Studies, Dartmouth College, 6214 Fairchild, Hanover, New Hampshire 03755 USA. gary.kofinas@dartmouth.edu.*

**Jose Kusugak** was born on May 2, 1950, in an iglu in Naujaat (Repulse Bay), located on the Arctic Circle. He is the second eldest of seven brothers and four sisters and attended school in Chesterfield Inlet and Churchill and high school in Saskatoon. Jose Kusugak first got involved with the Inuit Tapiriit Kanatami (then Inuit Tapirisat of Canada) in the early 1970s to work on the standardization of the Inuit writing system. Because project funding was delayed, Kusugak worked as an assistant to then-president Tagak Curley, introducing the concept of land claims to Inuit in the Arctic. In 1974, Kusugak went to Alaska to study the Alaska land claims and traveled the Inuvialuit region as part of the land use and occupancy study tour. From late 1974 to 1977, Kusugak chaired the standardization program of the Inuktitut language; from 1980 to 1990, he was the area manager of Canadian Broadcasting Corporation in the Kivalliq (Keewatin) region; and from 1994 to 2000 he was the president of Nunavut Tunngavik Incorporated, an affiliate of Inuit Tapirisat of Canada. He was elected president of Inuit Tapiriit Kanatami in June 2000. His wife Nellie works as a northern studies teacher at Arctic College in Rankin Inlet.

*J. Kusugak, Inuit Tapiriit Kanatami, Suite 510, 170 Laurier Ave. W., Ottawa, Ontario K1P 5V5 Canada. jkusugak@tapirisat.ca.*

**Igor Krupnik** is an ethnologist at the Arctic Studies Center of the National Museum of Natural History, Smithsonian Institution in Washington, D.C. Born and educated in Russia, he has done extensive fieldwork among the Siberian Native people in the Bering Strait area, in the Russian Far East, and recently on St. Lawrence Island in Alaska. He is currently coordinator of various international projects studying the impacts of global climate change and the preservation of the cultural heritage and ecological knowledge of Native peoples. He has published and co-authored several books and catalogs, and he writes extensively on arctic Native peoples, Native heritage resources, modernization and minority issues, and the history of anthropological research in the Arctic/North Pacific region.

*I. Krupnik, Arctic Studies Centre, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560-0112 USA. krupnik.igor@nmnh.si.edu.*

**Tero Mustonen** is manager of the project Snowchange: Indigenous Observations of Climate Change at the Tampere Polytechnic in Finland, where he works as a lecturer and researcher. He is currently finishing his masters thesis at the University of Tampere on indigenous self-governance in the Russian, European and Canadian Arctic. He has visited and lived in many indigenous communities in Canada, Alaska, Finland, and Russia, including those of the Inuvialuit, Haida Gwaii, Tahltan Nation, Cree Nation on James Bay, and Sto:lo Nation, as well as the Sami communities of Ochejohka in Finland and Luujavre in the Murmansk region of Russia. Mustonen recently coordinated a three-year climate change-related online educational project Northern Environment Student Forum between institutions in British Columbia,

Murmansk and Tampere. When he has free time, he plans a kayaking trip to New Zealand and enjoys playing bad rock music real loud.

*T. Mustonen, Tampere Polytechnic Teiskontie 33 FIN 33521, Tampere, Finland. tero.mustonen@tpu.fi.*

**Scot Nickels** has many years of experience working with both Inuit and First Nations on environmental issues, from documenting Inuit knowledge of bowhead whales and investigating the environmental, cultural, and socioeconomic impacts of tourism in the North to the development of an integrated resource management plan for the Algonquin community of Barriere Lake. Nickels obtained his PhD at McGill University in February of 2000. His doctoral thesis is entitled *Ecological Knowledge and Experience of the Forest Environment: the Algonquins of Barriere Lake, Quebec*, and provides an analysis of how human knowledge and action are shaped through on-going interactions of people with each other and their environment. In 1998, Scot became the director of the Environment Department for Inuit Tapiriit Kanatami (ITK) (formerly ITC), the national organization dedicated to supporting Inuit in Canada. He is currently involved in policy and research issues such as species at risk, marine conservation, environmental assessment, contaminants, and climate change as they relate to Inuit.

*S. Nickels, Environment Department, Inuit Tapiriit Kanatami, Suite 510, 170 Laurier Ave. W., Ottawa, Ontario K1P 5V5 Canada. snickels@tapirisat.ca.*

**Dave Norton** has conducted research from Alaska's Prince William Sound to the Arctic, in fields as diverse as ornithology, human ecology, vertebrate (dinosaur) palaeontology, history, and fishery ecology. He has been called an "arctophile" and a generalist bucking trends of specialization. He credits his nine-year residency and teaching in Barrow with enthusing him for transdisciplinary and transcultural environmental science. After a sabbatical assignment to the University of Calgary in 1996-97, he assembled a trinational team of investigators to work on arctic marine contaminants for National Oceanic and Atmospheric Administration. Dave now leads another interdisciplinary research group for National Science Foundation's Office of Polar Programs, which encourages linkages between traditional knowledge and remote-sensing applications to analyze the responses of coastal sea ice to environmental variables. *Fifty More Years Below Zero*, which Dave edited for the Arctic Institute of North America, appeared in 2001 and is distributed by the University of Alaska Press. The book chronicles the fifty-year history of the Naval Arctic Research Laboratory at Barrow.

*D. Norton, Arctic Rim Research, 1749 Red Fox Drive, Fairbanks Alaska 99709 USA arcrim@ptialaska.net or ffdwn@uaf.edu.*

**Natasha Thorpe** has been fortunate to share tea and stories with Inuit throughout the Kitikmeot region of the Canadian Arctic where she has worked, travelled and camped for the last seven years. Natasha holds a masters degree in resource management from Simon Fraser University in Vancouver. Her most recent project involvement was as principal researcher for the Tuktu and Nogak Project (TNP), a community-driven effort to document and communicate Inuit knowledge of caribou and calving grounds for the Bathurst caribou herd. *Thunder on the Tundra: Inuit Qaujimajatuqangit of the Bathurst Caribou*, a compilation of the results of the five-year study, was published in late 2001 and co-authored by Thorpe, Naikak Hakongak, Sandra Eyegetok, and Kitikmeot elders. She now lives in Victoria where she continues to be committed to Inuit Qaujimajatuqangit projects.

*N. Thorpe, Tuktu and Nogak Project, 231 Irving Road, Victoria, British Columbia V8S 4A1 Canada. nthorpe@telus.net.*



*Aklavik elders Anne B. and Danny A. Gordon watch the changing arctic sky. Photo by Deborah Robinson.*

# Table of Contents

<b>Preface</b> .....	xxi
<b>Introduction</b> .....	1
<b>1 These are Things That are Really Happening:</b> Inuit Perspectives on the Evidence and Impacts of Climate Change in Nunavut ... <i>Shari Fox</i>	12
<b>2 Community Contributions to Ecological Monitoring:</b> Knowledge Co-production in the U.S.-Canada Arctic Borderlands..... <i>Gary Kofinas with the communities of Aklavik, Arctic Village, Old Crow, and Fort McPherson</i>	54
<b>3 We Can't Predict the Weather Like We Used to:</b> Inuvialuit Observations of Climate Change, Sachs Harbour, Western Canadian Arctic .....	92
<i>Dyanna Jolly, Fikret Berkes, Jennifer Castleden, Theresa Nichols, and the community of Sachs Harbour</i>	
<b>4 Coastal Sea Ice Watch:</b> Private Confessions of a Convert to Indigenous Knowledge .....	126
<i>David Norton</i>	
<b>5 Watching Ice and Weather Our Way:</b> Some Lessons from Yupik Observations of Sea Ice and Weather on St. Lawrence Island, Alaska.....	156
<i>Igor Krupnik</i>	
<b>6 Nowadays it is Not the Same:</b> Inuit Qaujimagatuqangit, Climate and Caribou in the Kitikmeot Region of Nunavut, Canada .....	198
<i>Natasha Thorpe, Sandra Eyegetok, Naikak Hakongak, and the Kitikmeot Elders</i>	
<b>7 Travelling with Fred George:</b> The Changing Ways of Yup'ik Star Navigation in Akiachak, Western Alaska ...	240
<i>Claudette Bradley</i>	
<b>8 Climate Change and Health in Nunavik and Laborador:</b> Lessons from Inuit Knowledge .....	266
<i>Christopher Furgal, Daniel Martin, and Pierre Gosselin</i>	

<b>9</b>	<b>Putting the Human Face on Climate Change Through Community Workshops:</b>	
	Inuit Knowledge, Partnerships, and Research .....	300
	<i>Scott Nickels, Christopher Furgal, Jennifer Castleden, Pitseolalaq Moss-Davies, Mark Buell, Barbara Armstrong, Diane Dillon, and Robin Fonger</i>	
<b>10</b>	<b>Epilogue: Making Sense of Arctic Environmental Change?</b> .....	334
	<i>Fikret Berkes</i>	
	<b>Appendix: Snowchange 2002:</b>	
	Indigenous Views on Climate Change: A Circumpolar Perspective .....	350
	<i>Tero Mustonen</i>	

## List of Figures

- Aklavik elders Anne B. and Danny A. Gordon watch the changing arctic sky  
Inupiat whalers near Barrow, Alaska, waiting on the sea ice  
Northern Native communities discussed in this volume
- 1-1. Flying near Clyde River, August 2000
  - 1-2. Map of Nunavut showing Iqaluit, Igloolik, Baker Lake, and Clyde River
  - 1-3. View overlooking Iqaluit and Koojessee Inlet, July 2001
  - 1-4. Igloolik in February 1996
  - 1-5. An *inuksuk* overlooks the community of Clyde River, August 2001
  - 1-6. Baker Lake, July 2001
  - 1-7. Elders make caribou skin tents as part of a “traditional day” celebration in Baker Lake, August 2000
  - 1-8. An interview with Peter Kunulusie, Clyde River, in 2001
  - 1-9. Margaret Kaluraq and Shari Fox listen as Silas Aittauq discusses water level changes, 2001
  - 1-10. Interviewing Apak Qaqqsiq of Clyde River at his camp, 2001
  - 1-11. Camping near Igloolik, 1997
  - 1-12. Ice fishing at Mogg Bay, near Igloolik, 1997
  - 1-13. Scars left near Clyde River where an area of *aniuvvat* used to be, 2001
  - 1-14. Changing water levels in the Baker Lake Area
  - 1-15. Man building igloo, Kivalliq region, circa 1970
    - 2-1. Moses Sam, a Neets’aii Gwich’in elder, checks his fish net near Arctic Village
    - 2-2. The Arctic Borderlands Co-op area
    - 2-3. Allan Benjamin of Old Crow scans the landscape from above his cabin on the Crow River
    - 2-4. Sitting quietly for hours and observing is part of the Vuntut Gwitchin’s autumn hunt for caribou
    - 2-5. Local experts’ time on the land, 1998–2000
    - 2-6. Anne B. Gordon presents a report at the 2002 Arctic Borderlands gathering in Fort McPherson, Northwest Territories
    - 2-7. Perceptions of caribou herd declining
    - 2-8. Georgie Moses, an experienced Gwitchin hunter, inspects a caribou’s stomach on Crow Mountain
    - 2-9. Randall Tetlichy pre-tests the questionnaire by interviewing Edward Lennie of Inuvik

- 3-1. Banks Island has one of the largest populations of musk ox in the world
- 3-2. Sarah Kuptana and her daughter Rosemarie Kuptana in the home of Sarah Kuptana
- 3-3. Aerial view of Sachs Harbour, Northwest Territories, June 1999
- 3-4. Map of the community of Sachs Harbour, Banks Island, in the Inuvialuit Settlement Region
- 3-5. The community planning workshop at Sachs Harbour, 1999
- 3-6. Planning exercise was used to instruct the project team on community concerns and observations
- 3-7. Norm Snow and Theresa Nichols conducting an interview with Roger Kuptana, August 1999
- 3-8. The permafrost on Banks Island is melting at a faster rate than before (August 1999)
- 3-9. Filming a musk ox hunt in February 2000, Banks Island
- 3-10. Larry Carpenter and his son and daughter, ice-fishing at Middle Lake, May 2000
- 3-11. Lena Wolki, Geddes Wolki, and Terry Woolf on the shores of Banks Island
- 3-12. Roger Kuptana removes an arctic char from his net in Sachs River
- 3-13. Rosemarie Kuptana at a press conference to launch the Sachs Harbour video, November 2000
- 4-1. Pete Sovalik, Iñupiaq naturalist, on the ice at Barrow in May 1950
- 4-2. Whaling crew members at camp on floating ice
- 4-3. RADARSAT image of shorefast ice along the Chukchi Sea coast off Barrow, mid-May 1997
- 4-4. RADARSAT image of shorefast and pack ice along the Chukchi Sea coast off Barrow, May 19, 1997
- 4-5. Schematic view of ice zones off Barrow and Point Barrow, May 1993
- 4-6. RADARSAT image of ice off Barrow, May 15, 2001
- 4-7. Schematic representation of coastal ice, with key Iñupiaq names for structures
- 4-8. Hemispheric map showing ranges in pack ice surface melt dates, 1979–1998
- 4-9. Kenneth Toovak, Sr., reviews ice features after the helicopter overflight of sea ice, March 8, 2000
- 4-10. RADARSAT image of ice near Barrow, Alaska, March 6, 2000
- 4-11. Sea ice from helicopter over Barrow, looking at narrow waist of shorefast ice
- 4-12. Reconstructed surface map for barometric pressure, May 6, 1957
- 4-13. Billy Blair Patkotak of Wainwright, Alaska, discusses the sea ice dynamics, June 2001
- 4-14. RADARSAT image of sea ice, Barrow region, March 28, 2001
- 4-15. RADARSAT image of sea ice, Barrow region, March 31, 2001
- 4-16. Whalers to researchers: Make your graphic displays more understandable
- 4-17. Researchers to whalers: Here’s how deep the water is in relation to observed ice types
- 4-18. Diagrammatic representation of the *katak* theory as described by Warren Matumeak
- 5-1. A Yupik whaling crew cruises in a skin boat at Pugughileq, Southwest Cape

- 5-2. Members of the Savoonga Association of Whaling Captains discuss the proposal, December 2000
- 5-3. Gambell, St. Lawrence Island, May 1999
- 5-4. Savoonga, St. Lawrence Island, May 1999
- 5-5. The aerial view of Gambell, February 2001
- 5-6. The shore at Savoonga, with the darker patches of open water, February 2001
- 5-7. Fragment of the sea ice satellite chart, western Bering Sea, February 23, 2001
- 5-8. Fragment of the same chart, February 22, 2000
- 5-9. *Qenghuk*, refrozen crashed ice. Pencil drawing by Vadim Yenana, October 2001
- 5-10. Chester Noongwook and Vadim Yenana working on drawings of the Yupik sea-ice terms, October 2001
- 6-1. Looking westwards across Bathurst Inlet at Ikalulialuk Island from the community of Umingmaktuuk
- 6-2. The study area for the Tuktu and Nogak Project (1996–2001)
- 6-3. Organizational framework for the Tuktu and Nogak Project (TNP)
- 6-4. Elder Mary Kaniak of Umingmaktuuk joins two youth to help them set up a caribou skin tent
- 6-5. Elder Nellie Hikok of Kugluktuk shows some of the places she used to camp while hunting for caribou
- 6-6. A generated map showing spatial references to Inuit travel routes and caribou migrations
- 6-7. Using the database to identify climate change impacts on caribou as an emerging theme
- 6-8. Kitikmeot Inuit observations of causal relationships resulting from warmer temperatures
- 6-9. Mona Keyok of Umingmaktuuk prepares arctic char at a traditional fishing and hunting camp
- 6-10. Bathurst caribou near the Hood River on the west side of Bathurst Inlet
- 6-11. Kitikmeot elders with Naikak Hakongak, Natasha Thorpe, and Sandra Eyegetok
- 7-1. In their trips across the tundra, hunters use many traditional navigation practices
- 7-2. Average yearly temperature increases over the past fifty years (1949–2001) in Bethel, Alaska
- 7-3. Average yearly snowfall over past fifty years (1949–2001) in Bethel, Alaska
- 7-4. The hand measurement used to measure the distance between the Big Dipper and true north
- 7-5. The grass is frozen in the same direction as the snow waves
- 7-6. Marcus Alexie works with a sky map as Robyn Kasayulie looks on
- 7-7. Fred George explains how he navigates in Yup'ik to a class at Akiachak Elementary School
- 8-1. The snowhouse, an icon of the North, may be a thing of the past because of changes in snow composition
- 8-2. Regional map of Nunavik, showing the study community of Kuujjuaq
- 8-3. Kuujjuaq, the regional centre of Nunavik

- 8-4. Map of Labrador showing local Inuit communities
- 8-5. Nain, the center of the north coast Inuit communities in Labrador
- 8-6. Nain residents report that snowfields in the Torngat Mountains are now melting during the summer
- 8-7. A lack of snow and abundance of water on top of the ice make travelling difficult during the spring
- 9-1. Storm clouds developing near Aklavik, Northwest Territories
- 9-2. Map of Inuit regions in Canada supported by Inuit Tapiriit Kanatami
- 9-3. Map of communities (Inuvialuit and English names) in the Inuvialuit Settlement Region
- 9-4. Small group discussion, Tuktoyaktuk, January 2002
- 9-5. Plenary discussion group, Inuvik, Northwest Territories, February 2002
- 9-6. Chronological arrangement of observations of local climate-related changes. Inuvik, February 2002
- 9-7. Summary presentation of community observations to the workshop group in Tuktoyaktuk, 2002
- 9-8. Funnel cloud observed outside of Aklavik captured on film
- 9-9. Group photo of workshop participants, Inuvik, February 2002
- 10-1. Spring goose hunting camp at Middle Lake, Banks Island, May 2000
- 10-2. A partnership model for research that can combine indigenous knowledge and Western science
- 11-1. A view of Finnmark region in Norway, coast of the Barents Sea

## List of Tables

- 1-1. Fieldwork phases and methods in the Climate Change Documentation Project in four Canadian Arctic communities
- 1-2. Examples of environmental changes observed by Inuit in Iqaluit, Igloolik, and Clyde River
- 1-3. Evidence of climate change as discussed by Inuit in Baker Lake
- 2-1. Examples of “observations,” “theories,” and “values” documented from interviews with Old Crow, Aklavik, and Fort McPherson hunters
- 2-2. Weather conditions that created problems for people on the land
- 2-3. Reports on quality of salmonberries, 1996 to 2000
- 2-4. Porcupine caribou hunters’ indicators of good quality caribou: body condition and overall health
- 2-5. Fall 2001: Caribou availability and meeting needs
- 3-1. Summary of topics covered during the Inuit Observations on Climate Change (IOCC) project at each trip, 1999–2000
- 3-2. Key features of the IOCC project design
- 3-3. Primary activities during the planning workshop in Sachs Harbour, June 1999
- 3-4. Examples of recent environmental changes related to climate, Sachs Harbour
- 3-5. Convergence areas that may facilitate the use of traditional knowledge and Western science
- 4-1. Synopsis of case studies, as addressed by the Barrow Symposium on Sea Ice, November 2000
- 6-1. The goals, objectives and research priorities of the Tuktu and Nogak Project as defined by its board
- 7-1. Yup’ik navigation practices and techniques
- 8-1. Summary of possible direct climate related health impacts in Nunavik and Labrador
- 8-2. Summary of possible indirect climate-related health impacts in Nunavik and Labrador
- 9-1. Primary activities of climate change community workshops, January–February 2002
- 9-2. Examples of recent local environmental changes reported in three Inuvialuit communities
- 9-3. Examples of observations and reported associated effects, Tuktoyaktuk, 2002
- 9-4. Examples of changes, effects, and strategies used by community residents
- 9-5. Examples of potential indicators of environmental change from community observations, 2002



*Inūpiat whalers in spring near Barrow, Alaska, waiting on the sea ice by their umiaq as they scan the open lead for bowhead whales. Photo by Henry P. Huntington.*

# Preface:

## Human Understanding and Understanding Humans in the Arctic System

Henry P. Huntington  
*President, Arctic Research Consortium of the United States*  
*Director, Science Management Office,*  
*Human Dimensions of the Arctic System Science Program, National Science Foundation*

Social sciences in the Arctic enjoy many exciting and important opportunities. The series *Frontiers in Polar Social Science*, of which this is the first volume, explores and articulates those opportunities, the new frontiers of arctic research. It offers new insights for both social scientists and others to learn about developments in research concerning humans and their societies in northern regions. Although such a series cannot hope to encompass every branch of the social sciences, it can and should provide an introduction to several aspects of social science research in the North, stimulating further interest among specialists and non-specialists alike.

This volume, *The Earth is Faster Now*, addresses indigenous observations of arctic environmental change and the implications of such change for arctic peoples. Despite all the attention currently being given to climate change globally and in the Arctic, indigenous perspectives are all too frequently overlooked. As this volume shows, arctic residents have a great deal to say. Understanding and addressing climate change simply cannot be done without incorporating their specific and detailed views. The processes by which this can be done, however, take considerable time and effort of the part of both researchers and arctic residents. Applying this approach not just in a few isolated projects but as an integral part of arctic environmental research is an ambitious and important goal.

In making these points, the chapters in this volume also examine the ways in which social science methods and results contribute to our collective understanding of the arctic system—the combination and interactions within and among physical, biological, and social conditions—and its relationship with the rest of the world. In academic terms, an understanding of the way the system works must rest squarely on a solid foundation of research in and across the various disciplines that address the many

aspects of a complex system such as the Arctic. But that overarching understanding requires thinking in broad terms, finding ways to encompass disparate disciplines. This obstacle does not appear in indigenous perspectives, which draw naturally on changes observed in the physical, biological, and social realms to develop a coherent view of the world.

Although this volume addresses primarily the process of adapting scientific perspectives to incorporate indigenous ones, it is important to keep in mind that information flows the other way as well. Indigenous communities wrestle with the ways in which they can use scientific research and information for their purposes. Such information can be understood and also misunderstood, sometimes with significant consequences. Effectively communicating the results of scientific research is no less important than helping scientists appreciate what they can learn from arctic residents.

### **Understanding the Connections Between Humans and Their Environment**

Crossing cultures as well as disciplines is a vital challenge for arctic social science, and environmental change is an excellent way to explore that challenge. These changes have been observed by arctic residents and by scientists. They include thinning sea ice and changes in its characteristics, poor body condition in many animals, earlier growing seasons, a greater frequency of extreme weather events, rising temperatures in permafrost, and many others from the general and to the highly specific. Humans are connected to this changing environment in ways that are both similar and distinct from the ecological relationships that tie plants and animals to their ecosystems. Understanding the nature of those connections is essential to understanding the implications of environmental changes.

In the premodern era, arctic peoples were dependent largely on local resources but used a variety of means to influence their relationship with the living things on which they depended. Today, the use of living resources by arctic residents retains many ecological characteristics but is shaped also by regional, national, and international politics governing the allocation of harvests, the management of environmental impacts, and the influence of ideas such as animal rights. As human societies change, willingly or otherwise, their relationship to the environment is inevitably affected. If the environment is changing as well, we face an additional layer of complexity in trying to understand how arctic communities will respond to and cope with this challenge and how they will function in the future.

The connections of people with their environment must also be understood broadly. Typically, researchers focus on physical connections such as hunting, fishing, travel, and construction. There is also, however, the perceptual realm in which people understand their position relative to their surroundings in ethical and spiritual terms. Indigenous people often talk about this aspect of their relationship with their surroundings, but their listeners rarely take it in. When speaking of indigenous perspectives, however, it is essential to include the full range of the indigenous worldview and not just the subset that fits most neatly into the current scientific paradigm. Although

the spiritual dimensions of the environment may be inaccessible to science, they nonetheless play a vital role in shaping perceptions and actions and thus must be taken into account when discussing appropriate responses to environmental change.

The nine papers collected in this volume focus primarily on documenting and understanding the nature of changes that are being seen by northern indigenous residents in their environment. The special emphasis of the papers is not simply on change but also on the ways arctic peoples perceive, influence, and are influenced by their surroundings. As we move towards broad, multidisciplinary attempts to characterize the arctic system, it becomes increasingly important to understand the nature of the human components of that system and how they are connected to the physical and the biological realms. The nature of those connections is especially important in the development of responses to environmental change.

### **Understanding the Arctic Environment and the Knowledge of Arctic Peoples**

Scientific understanding of arctic environmental and climate change is based on records that are often short-term, fragmentary, or both. Weather records and sea ice data are available for some places, but rarely extending back before the twentieth century. Satellite monitoring of snow, ice, greenness, and other parameters covers most or all of the Arctic, but obviously only for recent decades, if not years. Process studies have been carried out in several locations around the Arctic, giving insight into the dynamics of ecological processes but leaving open the question of how to extrapolate those findings across the vast areas where no such studies have taken place. Examination of paleoenvironmental and archeological records reveals a great deal about certain indicators of climatic, environmental, and social conditions but requires careful and cautious interpretation. Into this mix is thrown the fact that the arctic environment is highly variable. Change, large and small, frequent or infrequent, is simply a basic characteristic of the region, compounding the difficulty of identifying trends and causal relationships.

Arctic residents have long known about, and had to cope with, this variability. Alternative strategies for finding food, a cultural acceptance of recurring hardship and privation, and migration were among the means—not always successful—of surviving and thriving. The intimate knowledge that arctic peoples have acquired about their surroundings is well known. The applicability of this knowledge to scientific studies of topics such as environmental change or the resilience of arctic social and ecological systems, however, is another matter. One key theme running through the papers in this volume is how to develop methods for documenting the knowledge of arctic peoples and how to present it in a form that is accessible both to the environmental sciences and to arctic indigenous communities themselves.

The documentation of knowledge is, on the surface, relatively straightforward. Through interviews, for example, the researcher can record what an experienced elder has to say about a given topic. There are, to be sure, many potential pitfalls to this process, but the basic methods are already established in the social sciences, and much

has been written about the way such research can and should be conducted. Presenting the collected information is a separate step, but again, one that has been examined and improved over time. The difficulty comes in interpretation.

One hazard in the attempt to document indigenous knowledge about arctic environmental change is that what is collected often turns out to be little more than a body of accumulated facts, revealing what has been observed but not how it has been understood. This is particularly true when indigenous knowledge is collected separately from an appreciation of the system or framework in which it was originally generated, gathered, and held. Facts and observations, carefully collected and reviewed with those who provided them, can be immensely useful. Nonetheless, the difference between facts and a system of knowledge is akin to the difference between anatomy and physiology—knowing the parts does not tell you how they function and interact with one another in a living organism.

As scholars and researchers become more familiar with the environmental knowledge of arctic residents, the need to understand their system of knowing becomes ever more apparent. There is considerable overlap between the processes of observation employed by scientists and by arctic indigenous peoples. There is considerable interest in both groups about what the other has found. But there are also differences. Attempting a translation from one system to the other requires a certain level of understanding of how each system is constructed and how it works. Simply put, it requires understanding what people look for, how and why they look for it, and to what use they put the resulting information. The growing appreciation of the cultural basis of science is one manifestation of this line of inquiry. A similar appreciation of the cultural context of the knowledge of arctic indigenous peoples is necessary to move beyond acknowledging and using that knowledge solely as a source of raw data.

Researchers need, in other words, to understand why people see and interpret things as they do. Information is always collected and organized to suit a particular purpose or set of purposes, and certain biases are thus inherent in the body of knowledge that is created by human societies. Knowledge changes over time, and it is important to understand how it changes, how new information is incorporated, what are regarded as significant and reliable sources of information, and so on. In short, researchers need to understand the implicit method that lies beneath the knowledge of arctic peoples, just as they work diligently to follow the scientific method in other research. Only in this way can researchers appreciate not only the information that is generated by the environmental knowledge of the arctic residents, but also their perspective on the environment, their relationship with it, and what if any actions are needed to protect that relationship.

### **Addressing the Implications of Climate Change**

This last point raises a related question. We have looked briefly at the ways in which researchers can better understand arctic peoples' knowledge and thus improve their common understanding of topics such as environmental change. If indeed the envi-

ronment is changing, human actions may have to change, too, either as a passive consequence of environmental shift or in an active attempt to prevent, manage, or adapt to it. The former is simply a response to changes in environmental stimuli, something that can be watched but not controlled. The latter consists of the responses humans make to the prospect of environmental change, a conscious effort to manipulate society or the environment or both.

As is clear from the ongoing international debates concerning climate change and what, if anything, can and should be done about it, reaching consensus is probably an impossible task. Nonetheless, a broadly shared understanding of the nature, magnitude, and scope of expected environmental changes is an important starting point to determining what actions can be taken. When, as is the case in the arctic, those who must be included in that shared understanding are from various cultures and backgrounds, it is vitally important not only that they agree on the basic facts but that they understand how each group has acquired those facts and how they interpret them. This is a highly practical outcome of a thorough appreciation for the knowledge that arctic indigenous peoples have about their environment.

From a shared understanding of what is occurring in the arctic system, we can then design appropriate response strategies. Those strategies must also be based firmly on an understanding of how they themselves will affect the human and natural systems in which they will be applied. Response strategies that do not reflect the values, priorities, and needs of society will fail, either because they are not acted on or because they destroy the very thing they were supposed to help protect. The same is true for the ecological relevance of responses—they must take into account the environmental feedbacks they establish in order to avoid unintended problems that may be greater than the threat the response sought to address.

Incorporating the knowledge and perspectives of arctic peoples is the starting point for working together to address an issue from start to finish. That knowledge has been used at times to generate various hypotheses and models that are then subjected to the rigors of scientific research. Such an approach is one way to make use of the knowledge of arctic peoples, which by this means has contributed a great deal to modern understanding of the Arctic. When we are concerned, however, not just with academic understanding, but with real-world responses that have consequences of their own, it is essential that the use of the observations and knowledge accumulated by arctic residents is not limited to the start of the effort.

Similarly, it is not enough to take into account only their ecological expertise. The dynamics of their societies and cultures are every bit as important to the study of their knowledge and the collaborative design of response strategies. This leads us back to the critical role of the social sciences in understanding environmental change and its implications across the Arctic. Arctic residents can certainly speak for themselves, but social scientists have a great deal to offer in this discussion, particularly from a comparative vantage point that can nicely complement the detailed but local understanding that a community has about itself. Building on the comparative studies of environ-

mental observations at many sites and in various areas around the North, we can and should establish true partnerships between social scientists, natural scientists, and arctic communities. In addition to researchers, such partnerships should include those within and outside arctic communities who are responsible for taking action to address the impacts of environmental change.

### **What Next?**

The study of the interactions between humans and the arctic system is not, perhaps, in its infancy, but certainly in its youth. Researchers have already described, both for the past and for the present, some of the direct links, such as people as predators, or people as consumers of environmental conditions. But the indirect links and feedbacks and the dynamics of these together, especially in connection with other social, biological, and physical variables, require more work. We can measure many inputs and outputs, but the inner workings of the system have not yet been discerned, even in schematic form. The relationships between all these variables are complex and changing. We need to devise new approaches for identifying and elaborating particularly the human components of the arctic system. The papers in this volume point us in the right direction, and the next steps are to follow their lead and take these ideas further.

As we do so, we must keep in mind that there are other sources of social change than a changing environment, and other sources of environmental change than climate. For many arctic residents, particularly in the Russian Arctic, the immediate struggle for survival far outweighs an abstract concern about future effects of a changing climate. In other areas, industrial development, competition for fish and other resources, and environmental contaminants are among the drivers of environmental change of most concern to local residents. Throughout the Arctic, the process of modernization, though it takes many forms, has caused rapid and often painful social and cultural transitions and it continues to do so. This process is largely independent of environmental conditions but must nonetheless be taken into account because it has powerful implications for the human-environment relationship.

As we develop a better understanding of the dynamics of the arctic system, we inevitably begin to speak in terms of prediction. As a means of testing and pushing the limits of scientific understanding, this is a useful exercise. But for planning our responses to environmental change, "predictions" in the midst of complexity and incomplete understanding remain vague and unreliable. Instead, as we move from pure research to the application of what we have learned, perhaps we should think in terms of anticipating what may happen, rather than predicting what will happen. This approach lowers the standard for looking to the future, but by doing so it gives us a more realistic target. By working towards anticipation, we can include a number of possible outcomes, each of which can be evaluated for magnitude and likelihood of the threat, as is done in risk assessments. From a list of what we can anticipate, we can in turn develop re-

sponse strategies based on the best current understanding of the threat and its implications, including the numerous implications of our responses.

Again, this must be undertaken as a collaborative enterprise. Linking social and natural systems together with arctic residents and those who are politically responsible for developing response strategies to environmental changes will not happen by accident. Nor will it occur simply because it seems to be the right thing to do. Instead, the challenge to polar social scientists is to demonstrate not only the relevance of their research and results but also their ability to work with others and to use social understanding to improve the collective understanding of the dynamics of the arctic system. Solid disciplinary research is needed to meet this challenge, but it must be matched by a strong commitment by the social science community as a whole to reach outwards as well. This, truly, is a frontier of arctic social science today.



*Northern Native communities that participated in the arctic environmental change documentation projects discussed in this volume (illustration by Philippa McNeil).*

# Introduction

*Igor Krupnik and Dyanna Jolly*

This book has two main messages to its readers and to the polar science community at large. First, arctic residents are witnessing far-reaching changes in their environment, and they are ready to create partnerships with scientists, to document their observations and to make their voices heard. Second, interaction between local experts and academic scholars will require other patterns of collaboration than between, let's say, physical and social scientists. Familiar ways of doing research—scanning earlier data, disputing other people's concepts, and borrowing references across disciplines—will be inadequate for this new unfolding collaboration. We rather have to learn to act through sharing, listening, and accommodation to others' ways of observing and "knowing." This is why we put this issue as the starting point for a new publication initiative, *Frontiers in Polar Social Science*, advanced by the Arctic Research Consortium of the United States (ARCUS).

As with many other pioneer ventures, this volume is a product of an uncommon though highly successful collaboration. It represents a coming together of researchers, communities, and organizations, but in many different ways. Each of the volume's several chapters describes a long-term research and collaborative effort, with a potential to be a book project in itself, as some already are. Despite our separate projects and focuses, we share a common vision and, basically, we put the same message on paper. To us, this volume is neither a "silver bullet" nor a handbook for our colleagues of what indigenous people know about arctic change. First and foremost, it is a collection of studies and reflections on how indigenous peoples see changes and what they say about changes around them.

What gave this book its specific edge? We believe we can disclose some driving forces behind our joint venture in this volume introduction. Our first "secret" is that this initiative found an immediate and enthusiastic response from a small, though growing community of Native experts and researchers who already work together in documenting Native observations of environmental changes occurring across the Arctic. Our second resource was what we call "the magic of the science frontier." It

looks increasingly obvious to polar scientists, arctic residents, and the general public alike that arctic indigenous people have a special stake in modern studies of global environmental change. They also have a lot to contribute—when and if they are given the chance and the appropriate means to participate fully in the ongoing global change discourse.

Records of local observations are created in dozens of indigenous communities across the circumpolar zone, by human inquisitiveness and people's interaction with each other and the environment. Such records are constantly reinforced and immediately tested in discussions with neighbors, fellow hunters, and experienced elders. This observation process is nonstop, daily, and intergenerational, without any granting agencies and science planning involved. This is indeed an exciting impetus for partnership and THE new research frontier to guide the course of today's environmental change research and to draw public attention and debate.

Last but not least, the "frontier" paradigm is a specific pattern of human vision as well as the powerful and universal drive to expand the boundaries of the known into the unknown. This drive pushes researchers' explorations in remote arctic villages and at university labs alike. In fact, the lure of the frontier existed ages before modern professional scholarship was established. As humans, we are always anxious to know what is beyond the horizon but also what is—or will be—our next challenge to face.

Current environmental change in the Arctic offers a testing challenge to our ability to observe, to analyze, and to respond, by using the tools and resources of today's society. If this change is coming (and some of us believe that the challenge of rapid environmental shift is already here), then this volume may well become one of the first coordinated efforts in response. By focusing on local observations and interpretations of change, it opens paths to the next "frontiers" in science analysis and public actions. This was the third major appeal that worked on behalf of our venture at every stage. It was also the critical bond that helped generate our project design, recruit volume contributors, and bridge several individual papers into a common message.

### **Why "The Frontiers"?**

Several project papers collected in this volume document various aspects of Native observations of current environmental change across the Arctic—from weather to sea ice to caribou to marine mammals to permafrost to plant communities. Our purpose, of course, is to bring to light the richness of local expertise of northern residents as they witness and interpret shifts, transitions and/or abnormal events in their familiar habitats. What people actually know is closely connected to both historical and current land use and occupancy. It reflects their various daily encounters with the arctic environment—where they hunt, fish, and travel; when they do it; and what factors are significant in framing the scope of their seasonal activity. As will be illustrated below, such a broad observational base contributes to a unique reliability of local environmental monitoring, where change is often traced by and related through personal life histories and experiences. Individual living memory is then extended through

storytelling and information sharing. Such an exchange of oral traditions takes place daily in the family and community setting, and it expands the time-depth of personal expertise and observations.

By bringing together a series of projects in documenting what people really see and talk about these days in their communities, we argue that indigenous arctic residents are clearly noticing changes across their regions. Many common themes and stories arise from voices to be heard in this volume. These are themes of increasing variability and unpredictability of the weather and seasonal patterns and thus of the need to be more careful when hunting, travelling, and forecasting the weather. These are stories of the extensive loss of multiyear sea ice, the appearance of species never seen in living memory, and of a growing concern for the health of game populations upon which the communities depend.

We see our mission here in terms of finding new ways to document things that are already emerging as the issues of public concern at both elders' meetings in distant northern villages and at scientific symposia. These should be better ways, creative ways, more appropriate ways. The chapters in this volume explore new methods and research tools for learning about and sharing data generated through observations in "another kind of science," which is indigenous environmental knowledge. They address new models of community partnerships and research cooperation that go well beyond the now-dominant pattern of "us" scientists informing "them" (that is, Native residents and public at large) on what we learn through "our" scientific research in "their" areas. This is our vision of the frontier of polar social science, in terms of the science's philosophy, research goals, and ethics.

Still, there is much more in local observations that justifies this volume's headline as "Frontiers in Polar Social Science." Tied to the themes of complexity, unpredictability, and increased variability are many indications of how current environmental change is part of a larger group of challenges and changes that people face as northern residents. To many people on the ground, their daily concerns about weather and sea ice shifts are hardly separated from other critical issues, such as oil and mineral exploration, contaminants, animal rights campaigns, and land-claim negotiations. Scientists often forget to acknowledge that their cause-driven research models are, nevertheless, rather simplistic approximations of a real life. Whereas scientists love to talk about "independent links," "critical factors," and "stratified impacts" in their abstract scenarios of change, arctic residents have their own vision of recent change, which is always a multifaceted process. There is no need for any special "interdisciplinary" dimension, because complexity is a phenomenon of daily existence. To any scholarly approach, this local perspective, if properly understood and accurately documented, is an invaluable reality check.

There is one more critical aspect of environmental observations by Native elders and subsistence experts. Their understanding of what is happening with the weather, the lands, and the oceans is often articulated as community-based assessments of change. Such assessments translate the global-scale process of change into local-scale

evidence. Hence, the observations described in this volume are the best arguments for the value (and the urgency) of doing local-scale, place-based research and modelling of the global process. This is what current science-based understandings of climate change are often missing—an indication of how changes are affecting places. The discourse of global climate change so far is largely on modeling studies, global predictions, and international policy. Little is known about local places—communities, ice floes used for spring sea hunts, caribou calving grounds, historical sites and protected areas, airports, travel routes and camping areas, the spring nesting sites of snow geese, and the river mouth where the fish spawn.

A common (though usually unspoken) question within the community of polar physical scientists is, what is the reason to be engaged in listening to some hunters' stories and elders' recollections in the era of global modelling, supercomputers, and satellite imagery? Why should we bother to document indigenous knowledge and perspectives of environmental change in the first place? To social scholars (at least, to some of us working in the Arctic), the answer is simple—because indigenous people really want this done. A striking motive that can be seen in almost every paper in this volume is the amount of community initiative and support for these types of projects across the Arctic. Rarely, if ever, does polar science enjoy such an unprecedented level of public backing and readiness to share data and expertise from local residents.

These and other similar projects also highlight the human context of environmental change—another “frontier” topic in global change science and in related public debates. The stories collected in this volume are not just about changes to the sea ice, weather or caribou. They are about how people see these changes in the context of their lives. As the global change issue is going to shift from being the subject of scientific research to the matter of political discussions to the focus of public actions, there is a growing need for transitional mechanisms from science to practical policies. Such a need to translate local, place-based pictures of change into public policy finds an almost natural venue through community-based observation projects like those presented in this volume. It also provides additional impetus of the value and urgency of documenting Native observations of environmental change.

Raising awareness and reaching wider audiences will be better facilitated through documentation within the context of collaborative, community-supported initiatives—rather than through the more conventional scholarly studies generated by the governmental science agencies and introduced “from without.” The papers collected here illustrate the power and ingenuity behind such innovative projects, since their authors pioneered many creative ways to do this—through community workshops, bilingual CD-ROM's, videos, school classes, and community knowledge sourcebooks.

Finally, there is a growing emphasis on recording Native observations of change as part of a larger effort to alter the status of knowledge shared by elders and local experts vis-à-vis the samples of data collected by scientists. The “frontier” zone here is, actually, in interpretation rather than documentation, as the need to document what locals see in their environment becomes gradually acknowledged by scholars and

policy-makers alike. There is already an established respect among many northern specialists of the expertise of indigenous arctic residents, particularly in areas such as wild-life management. In some cases, such as the Northwest Territories in northern Canada, indigenous knowledge now holds a government-mandated place in any developmental assessment and decision-making. Still, documenting Native observations of an issue as potentially controversial as climate change is only just emerging and has yet to reach its full potential. We all have a long way to go before the paradigms and interpretations of change advanced by Native experts and community scholars are given the credits and attention they deserve in research planning as well as in science funding.

As with science-based understandings of arctic environmental change, community-based assessments are evolving. The difference, however, is that while much of the science research is focused upon predicting what might happen, local experts are talking about what is happening. They also want to do something about it—and to take action quickly. Arctic residents, through projects such as described in this volume, are clear in saying that monitoring of changes needs to start immediately and that monitoring should be facilitated by both science and indigenous knowledge, in genuine sharing and full cooperation.

### **How This Volume Originated**

This volume came out of an almost fortuitous meeting of the two present co-editors (as well as a few other key backers—see Acknowledgements) at the thirteenth annual ARCUS meeting in May 2001. At the time, both of us were actively engaged in independent collaborative efforts in documentation of indigenous knowledge on environmental change in Alaska and the Canadian Arctic, respectively. Similarly, we had both been publicly advocating the value and the importance of indigenous scholarship to the interdisciplinary study of arctic climate and environmental change at several meetings and in our previous publications. Between the two of us, we had a good network of colleagues—Americans, Canadians, and Europeans—who were fast exploring the same field and who shared the same passion and ideology (though none of them was present at that same meeting). When the key volume's headline, "Frontiers in Polar Social Science" was introduced to our discussions, it came through as a lightning rod.

Once advanced, this book progressed along some unconventional lines in science cooperation. It took exactly a full year from the moment the possibility of such a "science frontiers" collection was discussed for the first time at the ARCUS meeting in Washington, D.C., to the day this volume is to be released at the fourteenth annual ARCUS meeting in May 2002. Such a year-term is a remarkably short lifespan for a full-size international collection of papers to materialize, by any standards of modern scholarly publication. Maybe it was the very title of our volume, *The Earth is Faster Now*, that worked on its behalf.

We believe it was this magic of the science "frontier" that pushed us to shelve many other personal commitments and to vow to the ARCUS leadership that we could

organize a collection of project papers about the documentation of indigenous knowledge of arctic environmental change in one year's time. This was a risky pledge to make, since most of the potential contributors we were thinking of had never met each other. There was not enough time to organize one of the usual symposiums that both brings authors together and produces a symposium volume. In fact, in a full reversal of the usual science practice, we instead considered the issue of a symposium, but as a post-volume venture (!). Nevertheless, we soon succeeded in commissioning pledges for volume papers from a dozen enthusiastic colleagues—in less than three months. The magic of the “science frontier” worked again; modern technology of e-mail communication made it technically possible.

If, in accordance with the “frontier” theory, the frontier acts as an advancing zone of activity driven by the high level of energy and the concentration of human resources, then we struck at the true “frontier” community in science research. Beyond shared enthusiasm, most of the projects presented in this volume are the outcomes of many years of work and of elaborate planning and development processes. They are collaborative scientific and public enterprises that engage the energy and resources of many people and agencies. They are also products of long-term and trusted partnership between researchers and arctic communities.

The opportunity and importance of translating research projects (documentation of indigenous knowledge) into the next stage (public action, policy, etc.) was immediately recognized by all the people we contacted as potential volume contributors. That, we believe, was one of the key reasons why they came on board with such enthusiasm. With each of us fully aware of the pioneer nature of the projects we were doing in distant arctic communities, we saw an opportunity for strength in numbers. Science frontiers may be launched by a few isolated pioneers, but they take shape and advance with the steady number of people involved and a certain level of (previously) accumulated activity only. Therefore, we consider the swiftness of this volume's preparation as one more demonstration of a highly developed status, if not maturity, of our common field of research.

The “frontier” paradigm also advocates a high level of communication within the advancing zone of interaction and change. Our “frontier” was driven and supported by today's most universal means of communication, the Internet, and it became possible because of the technology that was unimaginable even a decade ago. Whereas the volume's basic outlines were discussed in person during a few days of the ARCUS meetings, almost everything else was accomplished via e-mail. Stories of distant lands and images of isolated arctic villages that once took months to reach, traveled freely through cyberspace. They also came out of desk printers by mere computer clicks. All of this, of course, is a familiar practice in today's science. However, we think we probably pushed the envelope slightly. When one volume editor relocated from North America to New Zealand, a new virtual arctic research node was set in motion eighteen time zones, a full hemisphere, and a whole new day away. In daily communications between Washington, D.C., New Zealand, and the ARCUS headquarters in Fairbanks

(where our volume's publication office was located), it often created a twenty-hour-long business day. It also made us to acknowledge almost physically that this is truly a small world—which is another critical function of any frontier experience.

### **The Focus and the Structure of This Volume**

Communicating environmental change from the perspective of indigenous arctic people is a central theme to this volume. What emerges in the chapters to follow is a group of local, place-based stories that—taken together—reveal a much more extensive record of events to be put into circumpolar or, at least, in the North American continental perspective.

The projects presented here report ground observations from some twenty-three indigenous communities (see map, page xxviii). They cover thousands of miles—almost the entire stretch—of the North American polar zone, from the Bering Strait area to north Alaska to the central Canadian Arctic to Baffin Island and the Labrador eastern coast. Despite their differences in local geography, patterns of community involvement, and researchers' approach, the authors have structured their papers around the observations, stories and personal reflections of the people they work with and learn from. In this way, these papers offer Native residents various venues to speak for themselves, using their own words and explanations. They also all recognize the need to encourage more unconventional and better working relationships between researchers and local experts. Each chapter thus offers its own perspective on finding ways to make this kind of collaboration possible.

The title of the book, *The Earth is Faster Now*, also carries our common message. It comes from a comment of a local elder, first shared by Caleb Pungowiyi, then-the president of the Alaska Eskimo Walrus Commission. While talking to elders in his native village of Savoonga on St. Lawrence Island, Alaska, he recorded the following statement from Mabel Toolie (Legraaghaq, born in 1912). This is how Pungowiyi explained this statement himself:<sup>1</sup>

My aunt, Mabel Toolie, said [to me]: “The Earth is faster now.” She was not meaning that the time is moving fast these days or that the events are going faster. But she was talking about how all this weather is changing. Back in the old days they could predict the weather by observing the stars, the sky, and other events. The old people think that back then they could predict the weather pattern for a few days in advance. Not anymore! And my aunt was saying that because the weather patterns are [changing] so fast now, those predictions cannot be made anymore. The weather patterns are changing so quickly she could think the Earth is moving faster now.

The contributions in this volume thus respond to a common urgent issue—the need to come to grips with what is happening in the North, as explained by the people who live there and who are experiencing changes firsthand. The first three chapters in the volume tell the stories of building a whole network (actually, three different types

of networks) of engaging communities in climate/environmental change documentation. The change is obvious to the people on the ground—the question is, what is the best way to reveal it and to send the message to those agencies who make management and policy decisions. In the opening chapter by Shari Fox, this task has been achieved by building a climate change observational record via a combination of techniques: from meetings, presentations, and informal discussions to semidirected interviews, focus groups, mapping exercises, and videography in four communities in Nunavut. The second paper by Gary Kofinas et al. presents a different model—when a whole system of community-based environmental monitoring was created across the U.S.-Canadian Arctic Borderlands via a cooperative of five northern communities, government agencies, and university researchers. The main purpose here was to build a long-term database and process of communication, through which evidences of change could be traced along many parameters and at many different levels. The third paper, by Jolly et al., describes how residents from the community of Sachs Harbour on Banks Island in the western Canadian Arctic decided to format their observations of and ideas about the recent changes into a powerful media message—by making the video *Sila Alangotok* to raise awareness in more southern regions and to make links with other communities.

The two next papers reveal documentation projects that are both heavy in researchers' and observers' reflections about their partnership, though not framed directly by the "arctic climate change" paradigm. David Norton expresses his own reservations about the "linear" nature of climate change scenario, a perspective which is shared by his native collaborators in northern Alaska. Instead, it was rather a concern for safety of hunters on the sea ice that worked as a key factor encouraging local participation in a comparative documentation of a series of abnormal ice events at the recent Barrow Symposium on Sea Ice and beyond. Krupnik's paper documents how the desire to preserve ancestors' knowledge on ice and weather monitoring practices became the key factor for local participation in sea ice observation project on St. Lawrence Island, Alaska. Thus, the St. Lawrence Island project was rather an experiment in creating a record of Native ice and weather observations by local residents themselves and by the way "we see it."

The next paper by Thorpe et al. presents a specific cross-section from a long-term collaborative effort in documenting Native knowledge related to the biology, behavior, and changes in arctic caribou population in arctic Canada. Here, again, the main message is that of urgency, because the QUITIRMIT in the Nunavut Territory are concerned that changes in the weather, environment, and wildlife populations seem to be happening too quickly for people and the environment to adapt.

In her paper on traditional navigation skills, Claudette Bradley illustrates how the sharing of knowledge always comes to the issue of change, even when the topic is the sky, the stars, and land orientation techniques. What originally looked (at least to an outside researcher) like a pure knowledge documentation effort to build a classroom curriculum in a Yup'ik community in western Alaska eventually emerged as a discus-

sion of environmental change, as elders observed their old techniques being altered by the new environmental realities.

The next two papers in the volume also focus on the people side of the human-environment equation. Both contributions describe the impacts of environmental change on indigenous people; Furgal et al. in terms of human health, and Nickels et al. with the need to support communities in finding ways to cope with the changes they are experiencing. For Furgal et al., the link between human health and environmental change is critical; links seen, for example, in the effects of environmental changes on the abundance or availability of country food, or the ability of Inuit to access these resources. In the next paper, Nickels et al. describe a definite role for national organizations such as Inuit Tapiriit Kanatami (ITK) in “putting the human face” on climate change. The authors show how ITK is partnering with local, regional, and national organizations to bring indigenous voices into climate change science and policy through a series of community workshops.

We were also very lucky to commission three of our colleagues with extensive experience and involvement in indigenous knowledge and climate change issues to contribute their more general perspectives on the subject of this volume. In his opening Foreword, Jose A. Kusugak, the president of the Inuit Tapiriit Kanatami, addresses the critical importance of the ongoing environmental change in the Arctic, both from his personal life experience and from the position of the organized Inuit community in general. In the following Preface, Henry Huntington, the current president of ARCUS and key author for the Indigenous Perspectives chapter in the forthcoming Arctic Climate Impact Assessment (ACIA) document, shares his remarks on understanding the Arctic environment system through the richness of knowledge of arctic people. Beyond the obvious value of such an approach, he also writes of the many challenges that lie on the paths that seem so smooth and straightforward from the outside. Finally, in the volume’s Epilogue, Fikret Berkes looks at arctic environmental change through the framework of a sustainability science that includes local knowledge and observations. He argues that traditional knowledge, and civil science in general, are essential ingredients of sustainability science because more conventional scientific approaches are limited in their ability to deal with complex systems problems such as climate change. His thoughts offer a challenging test to current stereotypes on how indigenous knowledge can be matched with, checked by, and recorded along the practices of modern science. We hope that those readers looking for “silver bullets” in comparative data from other sciences and fields will read this Epilogue with the intensity it deserves.

The last (and the most recently joined) component of this volume is a report by a group of our European colleagues established in Tampere, Finland. Their project, Snowchange, is a multiyear education-oriented effort to document indigenous observations of climate change in northern regions, particularly across the Nordic countries, arctic Russia, and Siberia. Tero Mustonen, who chairs the Snowchange project

group, contributed his short report on their activities during 2001 and early 2002, which complements the primarily North American focus of this volume.

As our readers will see, by putting together this volume we bring under a common cover a network of researchers doing similar kinds of work and the communities who are supporting them. The ability of individual voices and projects to raise awareness about what is happening is thus multiplied by sharing the stories all across the North: from Alaska to the central Arctic to Nunavut to Labrador, and, finally, to the Eurasian Arctic. As these individual stories report, as (and if) the climate and landscape continue to change, many arctic residents wonder “what then?” Neither they nor us scientists have a definite answer, but both parties represented in this volume see it as extremely urgent to start the discussion.

### **Acknowledgements**

First of all, we are very grateful to all our volume contributors, whose work made this international collection of papers possible. There was no other magic in the integrity and swiftness of the editorial process other than your high discipline, dedication, and perseverance. It was a real pleasure working with you and we thank you all.

Despite all these daring efforts in scientific writing and analysis, there would never be a volume on documentation of indigenous knowledge if not for cooperation and goodwill of so many northern communities and dozens of individual local collaborators. Although each volume paper acknowledges this contribution and cites the names of particular Native participants, this book in general is a tribute to the scholarly explorations and research expertise of the arctic residents. Such knowledge is their special treasure, the best of their scholarship, and a pinnacle of generations of inquiries and achievements in mastering their beloved though often unforgiving environment. Many projects described here were, in fact, generated by the Native communities rather than by the intellectual curiosity and research agendas of individual scholars. In return, this contributed to the unique level of knowledge sharing among local experts and academic researchers, which, we believe, is the true mission and spirit of our common enterprise.

As volume editors, we are particularly grateful to Fikret Berkes and Henry Huntington for their many insights, friendly advice, and the willingness to share their perspectives on the role of indigenous knowledge in the study of arctic environmental change (eventually summarized in this volume’s Epilogue and Preface, respectively). This was often done on a very short notice, and we appreciate your help. Also helpful on short notice was the very skillful Philippa McNeil, from the Canadian Wildlife Service in Whitehorse, Yukon Territory, who produced our general North American Arctic map showing the communities covered in the individual volume papers. We are also thankful to our home institutions—the Smithsonian Arctic Studies Center (ASC) and the Centre for Maori and Indigenous Planning and Development at Lincoln University in New Zealand—for providing logistical support and other resources to work on this project. ASC’s timely financial contribution to this project also allowed us to increase

distribution of this volume to share with Native communities and colleagues in northern studies.

Three people made critical contributions to this venture and they deserve special thanks. Wendy Warnick, ARCUS executive director, embraced the idea of our “frontiers” volume on indigenous knowledge from its very beginning; she also backed it with the full support and resources of the ARCUS “powerhouse” office in Fairbanks. Fae Korsmo, former program manager of the Arctic Social Sciences Program at the National Science Foundation’s Office of Polar Programs, was always a source of inspiration and encouragement. Finally, this volume is very much the tribute to Sue Mitchell’s (our ARCUS editor’s) skills in style editing and design as well as to her patience in bringing several papers in different styles and colors, with dozens of illustrations, delivered in every format possible, under a common cover. We hope the readers will appreciate this final product of our “frontier” teamwork. We also hope that more similar “frontiers” volumes in other fields of polar social research will eventually come out of this initiative through the ongoing support of the ARCUS and the NSF Arctic Social Sciences Program.

- 
1. Caleb Pungowiyi (from Kotzebue) speaking at the Girdwood Workshop on Sea Ice and Environmental Change, February 15, 2000 (quoted in Krupnik 2000: 26). We are grateful to Caleb for his kind permission to use his story for the title of this book.