Climate Change
& Impacts on Human Health in the Arctic

An International Workshop on Emerging Threats and Response of Arctic Communities to Climate Change

Anchorage Alaska February 13–15, 2008

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Emerging Threats and Response of Arctic Communities to Climate Change

Egan Center, Anchorage Alaska, February 13–15, 2008

Agenda

This international workshop on climate change and human health in the Arctic will be held in conjunction with the *Alaska Forum on the Environment*, February 11–15, 2008. www.akforum.com.

This meeting is organized by the Centers for Disease Control & Prevention's Arctic Investigations Program, the Alaska Native Tribal Health Consortium, and the Alaska Forum on the Environment.

The purpose of this workshop is to bring together researchers from circumpolar countries to

- update current knowledge on the impact of climate change on human health,
- examine the principle conclusions and recommendations of *Arctic Climate Impact Assessment* report on human health (Chapter 15) to determine potential items for action,
- examine the feasibility of implementing community based monitoring strategy with and across regions to measure and report a common set of climate, health status, environmental, infrastructure and ecosystem indicators.

Things to know about this workshop

- *Arctic Climate Impact Assessment* was published in 2005 and was the first comprehensive scientific assessment of climate change in the Arctic. The assessment also provides recommendations by which communities, researchers and policy makers can begin to address the challenges posed by climate change. The full report can be access at www.acia.uaf.edu.
- The Climate Change and Human Health Workshop of the Alaska Forum on the Environment will begin on Wednesday at 8:00 AM, February 13, with a keynote presentation from Dr. Jeremy Hess, National Center for Environmental Health. The Workshop will continue through Wednesday morning (9:30–11:45), Thursday, February 14 (8:00–4:00) and conclude Friday, February 15 (8:30–12:00).
  see reverse for details

Wednesday, February 13th

— Egan Center, space 2, 11, 12

Keynote Presentation: (8:00–9:15 AM)

Dr. Jeremy Hess, National Center for Environmental Health
Please *refer to the AFE program for more details*

Session 6: (9:30–11:45 AM)

Climate Change—Human Health Impacts

Moderator—Joel Scheraga, U.S. Environmental Protection Agency

Overview—Joel Scheraga, U.S. Environmental Protection Agency
Temperature—Juhani Hassi, International Journal of Circumpolar Health (Finland)
Atmospheric Variables—Torbjom Messner, Umea University (Sweden)
Contaminant Transport—Jim Berner, Alaska Native Tribal Health Consortium (ANTHC) (USA)

Infectious Diseases

- Zoonotic Diseases—Eric Hoberg, USDA (USA)
- Human Diseases—Alan Parkinson, Centers for Disease Control & Prevention (USA)

Thursday, February 14th

— Egan Center, space 2, 11, 12

8:00 – 8:15 AM	**Welcome**
8:15 – 9:00 AM	Arctic Climate Impact Assessment: Recommendations to Deal with Threats to Human Health in the North —Jim Berner, Alaska Native Tribal Health Consortium (ANTHC) (USA)
9:00 – 9:30 AM	Community Relocation and Health —Rasmus Ole Rasmussen (Denmark)
9:30 – 10:00 AM	Infrastructure —John Warren, Alaska Native Tribal Health Consortium (ANTHC) (USA)
10:00 – 10:15 AM	**Break**
10:15 – 10:45 AM	Community Preparedness for Extreme Climate Events —Mike Bradley, Alaska Native Tribal Health Consortium (ANTHC) (USA)
10:45 – 11:15 AM	Community-based Monitoring—Chris Furgal, Trent University (Canada)
11:15 – 11:30 AM	Questions—Panel of Morning Speakers
11:30 – 11:45 AM	Instructions for afternoon breakout groups—Jim Berner & Alan Parkinson
11:45 – 1:00 PM	**Lunch Keynote**: Climate Change, Canada and the North: Perspectives on Adaptation, Vulnerability and Community Research—Chris Furgal
1:00 – 4:00 PM	**Group 1**—Physical Infrastructure —John Warren **Group 2**—Community-based Environment and Health Monitoring —Chris Furgal & Jim Berner

Friday, February 15th

— Egan Center, space 2, 11, 12

8:30 – 10:30 AM	Groups 1&2—Discussion, information exchange, questions/comments
10:30 – 11:00 AM	Wrap-up, Comments, Next Steps

For more information on the program please contact

Alan J. Parkinson, ajp1@cdc.gov or James Berner, jberner@anmc.org

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RATIONALE

Rationale

Arctic Climate Impact Assessment was published in 2005 and was the first comprehensive scientific assessment of climate change in the Arctic. The assessment also provides recommendations by which communities, researchers and policy makers can begin to address the challenges posed by climate change.

The impact of climate change on human health of Arctic residents will depend on many factors. Much research remains to be done on the relationship between climate change and individual and community health. Climate will continue to influence public health in small and remote communities of the Arctic. The recent record of warming, and potential continued warming of the Arctic, combined with the multiple mechanisms by which climate impacts health indicate an urgent need for adopting community based monitoring strategies that would identify both emerging threats and opportunities.

Purpose

The purpose of this workshop is to bring together researchers from circumpolar countries to: 1) update current knowledge on the impact of climate change on human health, 2) examine the principle conclusions and recommendations of the ACIA on human health to determine potential items for action 3) examine the feasibility of implementing community based monitoring strategy with and across regions to measure and report a common set of climate, health status, environmental, infrastructure and ecosystem indicators.

Workshop Sponsors

Centers for Disease Control & Prevention
www.cdc.gov

Alaska Native Tribal Health Consortium
www.anthc.org

Alaska Forum on the Environment
www.akforum.org

Workshop Coordinators

Alan J. Parkinson Ph.D
ajp1@cdc.gov
US Centers for Disease Control & Prevention
Arctic Investigations Program
Anchorage Alaska

Jim Berner MD
jberner@anthc.org
Alaska Native Tribal Health Consortium
Anchorage Alaska

Bridget McLeskey
confcoor@gci.net
Conference Coordinator

Background

Climate Change in the Arctic

The Arctic, like most other parts of the world has warmed substantially over the 20th Century particularly the last few decades. Arctic climate models project continued warming with a 3-5oC mean-increase by 2100. The winters will warm more than summers the mean-annual precipitation is projected to will increase, and continued melting of land and sea ice is expected to increase river discharge and contribute to the rising sea level. These changes will be accompanies by greater overall climate variability and an increase in extreme weather events (Arctic Council 2005).

The rapid warming in the Arctic is already bringing about substantial ecological and socioeconomic impacts many of which result from the thawing permafrost, flooding, and shoreline erosion resulting from storm surges and loss of protective sea ice. In many communities the built infrastructure is supported by permafrost. Loss of this permafrost foundation will result in damage to water intake systems and water pipes and may result in contamination of the community water supply. In addition, loss of foundation support for access roads, board walks, water storage tanks, and waste water treatment facilities will render water distribution and waste water treatment systems inoperable. Several villages already face relocation because village housing, water system and infrastructure are being undermined (Warren et al., 2005).

Rapid warming has resulted in loss of annual Arctic sea ice. On September 11, 2007 the Arctic sea-ice cover reached the lowest extent recorded since observations began in the 1970s, exceeding the most pessimistic model predictions of an ice-free Arctic by 2050 (Richter-Menge et al., 2008). This dramatic reduction in sea-ice will have wide spread affects on marine ecosystems, coastal climate, human settlements and subsistence activities. For the first time the reduction in annual sea-ice has created ice-free shipping lanes to the Northwest, from northern Labrador through the Arctic archipelago in northern Canada, to the Bering Strait, and has almost completely cleared a passage to the Northeast, from the Bering Strait along the northern coast of the Russian Federation to Norway. Both routes represent time- and fuel-saving shortcuts between the Pacific and Atlantic Oceans and will bring an increase in marine transport and access to vast oil, gas, and mineral reserves once inaccessible to exploration and exploitation. Such access will bring many benefits as well as risks to once isolated Arctic communities. Construction of new coast guard or military bases, and other industrial ventures will bring employment opportunities to local populations but will also affect population distribution, dynamics, culture and local environments. Tourism will most likely increase. Public sector and government services will then increase to support the new emerging economies. These events will greatly challenge the traditional subsistence way of life for many communities and lead to rapid and long term cultural change and loss of traditional culture which will create additional stress on an already vulnerable population (Curtis et al., 2005).

Climate Change and Human Health

The direct health effects of climate change will result from changes in ambient temperature, altered patterns of risk from outdoor activities, and changes in the incidence of infectious diseases. As ambient temperature increases, the incidence of hypothermia and associated morbidity and mortality may decrease. Conversely hyperthermia may increase, particularly among the very young and the elderly (Nayha S. 2005). However because of the low mean temperature in many Arctic regions the likelihood of such events having large impacts on public health for the general population is low. More significantly, unintentional injury, mostly related to subsistence hunting and fishing, already a significant cause of mortality among Arctic residents, may increase (Arctic Council 2005). The reduction in river and sea-ice thickness, curtailed ice season, reduced snow cover and permafrost thawing will make hunting and gathering more difficult, dangerous, and less successful, thereby increasing the risk of injuries and death by drowning. Permafrost thawing erosion or flooding can result in damage to the sanitation infrastructure increasing the risk of water-borne infectious diseases, respiratory diseases and skin infections and force village relocation. Community and families undergoing relocation will have to adapt to new ways of living, may face unemployment, and will have to integrate and create new social bonds. Relocation may also lead to rapid and long-term cultural change and loss of traditional culture which will increase individual and community stress, leading to mental and behavioral health challenges.

Climate change already poses a serious threat to the food security of many Arctic communities because of their reliance on traditional subsistence hunting and fishing for survival. Populations of marine and land mammals fish, and waterfowl may be reduced or displaced by changing habitats and migration patterns further reducing the traditional food supply. Release of environmental contaminants from the atmosphere, melting glaciers and sea ice may increase the levels of these pollutants entering the food chain making traditional foods less desirable (AMAP 2003). Many host-parasite systems are particularly sensitive to climate change. Specific stages of the life-cycles of many helminths may be greatly affected by temperature. For example small increases in temperature can substantially increase the transmission of lung worms and muscle worms pathogenic to wildlife important as a foods source for many northern communities (Hoberg et al., 2008). Reduction in traditional food supply will force indigenous communities to increasingly depend on non-traditional and often less healthy western foods. This will most likely result in increasing rates of the so called modern diseases associated with processed foods, including obesity, diabetes, cardiovascular diseases, and outbreaks of food- borne infectious diseases associated with imported fresh and processed foods (Bjerregaard 2004; Orr 2004).

Increasing mean ambient temperature may result in an increase in food-borne diseases, such as botulism, and gastrointestinal illnesses. An increase in mean temperature may also influence the incidence of zoonotic and arboviral infectious diseases by changing the population density and range of animal hosts and insect vectors (Parkinson 2005).

Resident indigenous populations of the Arctic are

uniquely vulnerable to climate change because of their close relationship with, dependence on, the land, sea and natural resources for their cultural, social and economic and physical well being. Communities must be prepared to identify document and monitor changes in there are in order to adapt to shifts in their local environment. The basis of this understanding is the ability to collect organize and understand information indicative of the changes taking place and their potential impacts. This information is essential for developing strategies to minimize the negative effects of climate change on the health of Arctic residents in the future (Arctic Council 2005).

Arctic Climate Impact Assessment Principal Conclusions and Recommendations (Arctic Council 2005, Chapter 15, p844–845)

1. There is a lack of comparability in health status data between countries

   A core group of health status indicators, gathered and defined identically should be a high priority for Arctic Council Countries

2. There is a need for a carefully planned strategy, at the community and regional level, to monitor and document environmental change

   Arctic Council members and program workgroups should provide technical assistance regarding monitoring strategies, climate impact mitigation and pilot studies, data analysis and evaluation.

3. There is a lack of an organized effort to collect and utilize indigenous knowledge regarding climate and climate changes

   Indigenous knowledge, and its preservation, should be encouraged among Arctic council member nations

4. There are few data on the impact of changing UV-B exposure in the Arctic, on the biota and human residents. there is little systematic monitoring of ground level UV-B radiation

   Academic and United Nations organizations have created UV-B research strategies. With regional and community collaboration, research and monitoring strategies relevant to circumpolar populations should be created

5. There are few data on climate change impact on regional biota. A critical need exists for the monitoring of wildlife diseases, and human-wildlife disease interactions. There are few data on climate-induced changes in the diet of subsistence species, which affects their nutritional value in traditional diets.

   Arctic Council programs have expertise to design effective regional and international monitoring programs in cooperation with communities. This critical activity should be given a high priority.

6. There is no systematic monitoring in all regions for safety in snow and ice conditions for local/regional travel and subsistence activities

   Regional governments should collaborate with communities to establish appropriate monitoring and communication networks; dissemination of appropriate traditional and modern survival skills should be systematically taught to children and young people.

7. Monitoring is critical in regions of the Arctic where

physical infrastructure depends on permafrost or where a village site depends on sea ice protection from storm erosion

Regional governments should assist in developing community-based monitoring

8. Data on contaminant transport into and out of the Arctic is critical for projecting impact and risk for arctic wildlife and residents. changing climate makes monitoring essential

   International coordinated research and monitoring of changing contaminant transport pathways should continue and expand where needed.

SUMMARY

Summary

The purpose of this workshop is to bring together researchers from circumpolar countries to: 1) update current knowledge on the impact of climate change on human health, 2) examine the principle conclusions and recommendations of the ACIA on human health to determine potential items for action 3) examine the feasibility of implementing community based monitoring strategy with and across regions to measure and report a common set of climate, health status, environmental, infrastructure and ecosystem indicators.

Summary of Presentations

Climate Change: Place, Health, and the Public Health Response—*Jeremy Hess*

This presentation provided an overview of global climate change, impact on human health, the importance of Place, the health effects of displacement and the role of CDC and public health in mitigating the human health impact of climate change.

Overview of the Health Implications of Climate Change in the Arctic—*Joel Scheraga*

The presentation provided an overview of existing human health challenges that face Arctic peoples, and the potential health impacts that climate change bring to an already vulnerable population.

Northern Climate Change:Human Thermal Health Impacts—*Juhani Hassi*

Discussed the impact of cold and heat on morbidity and mortality. Effects are largely preventable. Key recommendations included: the development of outreach education and communication programs targeting those at most risk (the elderly, those with underlying health conditions, those with oudoor occupations).

Environmental variables and the risk of disease/symptoms—*Torbjorn Messner*

Conflicting results of epidemiological studies of weather and disease have emerged, depending on the population and geographical setting. The bulk of these studies, mainly from temperate climate zones, find that cold weather increases the risk of suffering an acute myocardial infarction (AMI). His studies, carried out in a climate similar to that of Alaska, have shown that temperature, barometric pressure, or humidity extremes are not related to changing rates of cardiovascular disease. Changes in temperature, but not in barometric pressure or humidity were related to the risk of having an AMI.

SUMMARY

Climate Change and Contaminant Transport to the Arctic—*James E. Berner*

The perspective of this discussion is that of the effect of the recent climate trends, and those that climate models predict, on the contaminant exposure of Arctic human residents. Topics discussed include basic Arctic climate processes, observed trends in Arctic climate, model predictions for Arctic climate, potential impacts of predicted changes on Arctic levels of contaminants. Recommendations include the making serial observations over time in the environment, biota and human residents.

Climate & Pathogens: Consequences for Human Health & Subsistence Food Chains Across High Latitudes of the North—*Eric Hoberg*

This presentation noted that climate change will modify the interface for people and the environment. For example exposure to pathogens through water-borne and food-borne pathways will be altered. Diseases in key mammalian, avian and fish species will influence availability, sustainability and suitability of traditional food resources.

Climate Change and Potential Infectious Disease Emergence in the Arctic—*Alan J. Parkinson*

This presentation discussed the impact of climate change on the spread of infectious diseases in humans. For example increased ambient temperatures may lead to the northward spread of infectious diseases from temperate regions as well as southward spread of infections that are most common in the Arctic and sub-Arctic. Key recommendations include enhancing the public health infrastructure, and engage communities in actions that can be taken to reduce the health impacts of climate change.

Community Relocation and Health-Case Greenland—*Rasmus Ole Rasmussen*

The presentation focused on four processes and their consequences: Politics, Food access and the formal and the informal economies, gender differences in aspirations and mobility and generation differences in aspirations and mobility. Conclusions were that the relocation processes have a marked influence on lifestyles and physical and social health. Perception of lifestyles and physical and social health have marked influence on the relocation processes and the ongoing climate changes are generally enhancing these processes.

Infrastructure and Climate Change: Potential Indirect Impacts to Human Health—*John Warren*

Climate change can include changes in precipitation, reductions in sea ice, and climate warming and cooling. These changes can increase the frequency and severity of storms, flooding, or erosion. Other changes may include drought or degradation of permafrost. Climate change can result in damage to sanitation infrastructure resulting in the spread of disease. Through monitoring of some basic indicators communities can begin

to develop a response to climate change. With this information, planners, engineers, health care professionals and governments can begin to develop approaches to address the health challenges related to climate change

Community Preparedness for Extreme Climate Events—*Michael J. Bradley*

Developing community based emergency plans and programs for extreme climate events such as storms, floods, wild land fires were discussed and included the Emergency Disaster planning process, community and community clinic model disaster plan templates, and resources communities can use to develop emergency plans and improve emergency response capacity. The Incident Command System can be used for any type of emergency including climate change related events.

Community-based Monitoring for Climate and Health in the Canadian Arctic—*Chris Furgal*

Rapid environmental changes such as climate, weather and contaminants, have begun to disrupt the relationship between Northern Inuit populations and the ecosystems in which they live. In response, a series of studies have taken place bringing together community residents, University researchers and regional public health representatives to identify, select and begin to monitor, in a proactive way, aspects of environment and health relationships in northern Canadian Inuit communities. The intent of these projects is to support community capacity for monitoring and surveillance, in the hopes that it will enhance adaptive abilities at the local scale in the face of climate and other forms of environmental change threatening various elements of health.

Climate Change, Canada and the North: Perspectives on Adaptation, Vulnerability and Community Research—*Chris Furgal*

Through the evolution of assessments done on climate change, impacts and adaptation since the last Intergovernmental Panel on Climate Change report, released in 2001, there has been a movement towards including an assessment of adaptation and identification of key vulnerabilities that make people susceptible to potential impacts of climate change. The most recent IPCC report (IPCC, 2007), the Arctic Climate Impact Assessment (2005) and two more recent Canadian Assessments (2007, 2008) include an assessment of key factors influencing human vulnerability to climate change related hazards. With this approach, it is argued that there is a greater understanding of where climate change is more likely to impact in a negative way. Recent community-based projects in the Canadian Arctic are now adopting this “vulnerability approach” to understand where adaptation support is most needed now and in the future. The Canadian government is supporting a number of research and policy initiatives in this direction.

VILLAGE VIEW

Climate Change and Human Health—Village Perspective

The workshop was attended by number of village community members. These are their comments and observations on climate change and impacts on human health at the village community level, what monitoring is being done now, what things are needed, and what things could be monitored.

What is happening at the village level

Most visible is the effect of melting permafrost and damage to the sanitation infrastructure, erosion and impact on waste sites and sewage lagoons.

Some lakes that once had fish have drained and dried up.

Ice cellars once used for food storage have melted.

Roads remain stable so long as the permafrost remains protected by a heavy layer of moss.

The traditional food supply is changing.

Will my diet change when there are no more salmon?

The geese come much earlier in the season

Children are not learning to survive in the Arctic

Hanging meat seems to dry earlier and faster

The ice is much thinner and more dangerous for hunting.

There are new species of fish because the water is warmer. No studies being done on invasive species?

The Walrus are moving to different areas because of the loss of sea ice. More Walrus on beaches.

Fish and Beaver are relocating depending on the temperature of the water- this affects the distribution of water.

The traditional way of food preserving is changing. Hung food is discoloring (moldy). Perhaps we can measure discoloration or food taste.

Everything is either early or coming late.

Notice less fat on fish.

Harder to dry fish because of rain, moisture, not windy enough to keep flies away. There are more flies because of warmer weather.

Noticed problems with Silvers (Silver Salmon), discoloration on stomachs.

We are using more modern appliances than before. Used to dry meat in summer, in the fall they would freeze meat on permafrost to provide meat for winter and spring. Now use refrigerator, vacuum seal and store.

Making changes to the way we preserve food. Used to dry fish and seal meat-now we cook it in 5 gal buckets to keep it from going moldy.

Now we preserve fish in rock salt.

Elders are unable to read weather anymore. This has impacted the annual Beluga hunt which is now two weeks earlier. Ice is breaking up two weeks earlier. Have to constantly change what you know to what you are seeing. Bears are coming out earlier.

Some villages are losing sanitation. The Landfill floods the village, sand dunes are eroding, things are changing rapidly now.

Plants are growing taller—covering the lichen that caribou eat.

What monitoring is being done in Alaska?

Lifeline Project-EPA and Health Canada
www.thelifelinegroup.org

This is a software program that has been adapted specifically for monitoring dietary risk and exposure analysis for tribal communities.

The Alaska Native Tribal Health Consortium has been monitoring the impact of climate on built infrastructure for the past 5 years. www.anthc.org

The International Polar Year Project Bering Sea Sub network.
www.bssn.net,
www.aleut-international.org.

The Bering Sea Sub-Network: International Community-Based Environmental Observation Alliance for Arctic Observing Network (BSSN), endorsed by IPY Joint Committee, will involve six local indigenous communities, three each in the U.S. and Russia, to monitor and share the changes they observe. Changes could include the shift of southern species north, changes in distribution and abundance of fish and other temperature-sensitive species, changes in ice patterns, and weather observations. Observations will be collected using surveying methods across the network based on standard protocols. BSSN will address the questions of: 1) historical and present distribution and properties of economic and subsistence important species as derived from collective indigenous and traditional knowledge; 2) types of major variables and indicators that could be correlated with western science to develop predictable models based on indigenous and traditional knowledge; and 3) spatial and temporal convergence and divergence of community-derived and western science data. This project will assess large scale environmental changes in the Arctic by looking at both the physical and human dimensions of change and its impact.

Aleutian Pribilof Island Association (APIA) project "Response and Intervention System for Climate Change Induced Paralytic Shellfish Poisoning (PSP) in Aleut Communities". The PSP project objectives include developing methods for communities to monitor the occurrence and distribution of PSP toxins that occur in connection with climate change observations. The project goals are: 1) devise a mechanism to better respond to the threat and minimize the risks of poisoning, 2) develop a process of interlinking modern technology and traditional knowledge, 3) educate local residents about PSP and 4) train local technicians to use test kits to monitor for PSP toxin. Project activities include workshops, development of a manual on how to set up a community-based surveillance system, and public outreach materials. (link)

What is needed

Need to lobby to get funding and come up with a plan to market and begin research funding sources.

Need studies like the Henry Huntington quantitative research study which received information from elders to establish baseline data. Elders are not depended-on as they once were for traditional knowledge as they were in earlier days.

Important to preserve language so that we can communicate with our elders to find out how they see climate change, how to traditionally harvest food.

Need a system to monitor ice thickness, warning system. Internet based perhaps using Satellite imagery.

Develop use of Incident Command System. This could be used for any climate related event.

Need more collaboration with non profits, scientists, Corps of Engineers, US Army.

Alternative Model- Harriman Expedition-Assembly of people from all walks of life. Artists, scientists, writers-visited and observed peoples in villages to gather baseline data which could be entered into an on-line data base.

Studies on food and food storage are needed.

Use of the internet- Create a web-blog for recording and sharing of information and diaries. Another example of internet use is at the Alaska Native Science Commission website at www.nativeknowledge.org.

What things could be monitored in a village setting?

- Permafrost melting
- The effect of permafrost melting on buildings, water pipes, sewage lagoon.
- Salmon health
- Important to get historical (baseline) data
- Local timing of river break-up, shore-fast ice,
- Appearance of subsistence species, animal condition, invasive species
- Local water sources, lake drainage into permafrost, shoreline erosion
- Local weather instrumentation for fine scale forecasts
- Blood of subsistence animals, harvested by village hunters to test for the present of zoonotic diseases, and trends in the incidence of diseases

Recommendations

The workshop continued to support the conclusion that resident indigenous populations of the Arctic are uniquely vulnerable to climate change because of their close relationship with, dependence on, the land, sea and natural resources for their cultural, social and economic and physical well being. That direct health threats from climate change continue to include morbidity and mortality resulting from increasing extreme events (storms, floods, increased heat and cold) and an increased incidence of injury and mortality associated with unpredictable ice and storm conditions. Indirect effects continue to include increased mental and social stress related to changes in environment and loss of traditional lifestyle, potential changes in bacterial and viral diseases, and access to quality water sources. Some regions will be at risk for increasing illness due to failing sanitation infrastructure resulting from melting permafrost foundation. Some regions will also experience changes in diet resulting from changes in subsistence species distribution and accessibility. This may have negative impacts on health as diet shifts from a traditional diet to a more western diet are associated with increases in “modern diseases” such as obesity, diabetes, cardiovascular disease and cancer. The presence of environmental contaminants threatens the safety of the traditional food supply. Projected warming will affect the transport distribution and behavior of contaminants and human exposure in northern regions.

It was reemphasized that these changes are taking place in the context of ongoing cultural and socioeconomic changes. Climate change represents another of many sources of stress on these northern societies and cultures as it affects the relationship between the people and the land and environment, which will further stress communities and individual psychosocial health.

Communities must be prepared to identify, document, and monitor changes in their region in order to support adaptations to shifts in their local environment. The basis of this understanding will be the ability to collect, organize and understand information that indicates changes taking place and their potential impacts.

The workshop reaffirmed the principle conclusions and recommendations of the ACIA report on potential actions needed to address the impact of climate change on human health in the Arctic. Much still remains to be done to establish a relationship between climate change and individual and community health. There remains an urgent need to implement community based monitoring strategies. A network of such communities, within and across regions, reporting a common set of similarly measured climate, health status, and infrastructure and ecosystem observations would serve to identify both emerging threats as well as new opportunities. In addition this would allow use of public health data to measure impact and provide the basis for resource advocacy.

There remains a need for

- Standardized, comparable health data for Arctic populations
- Further descriptive analysis and measurement of mechanism of climate change impacts on human health
- Standardized local monitoring of environmental changes and effects on health

  Examples:
  - *Availability and safety of subsistence food species*
  - *Conditions of snow and ice conditions and safety for travel*
- Greater coordination of monitoring and research of change in contaminant transport and bioavailability
- Documentation, assessment and communication of current adaptive measures being used by others
- Utilization of indigenous perspectives and knowledge in monitoring and understanding of change and impacts
- Enhanced local capacity to take advantage of the opportunities that are created by local environmental change.

Recommendations for monitoring Snow, ice and Arctic community health

Establish surveillance and communication networks at the community level to support early warning of dangerous conditions for travel and land-based activities (weather, ice conditions). Monitor:

- Rates of cold injuries (eg frostbite)
- Mortality and coronary heart disease
- Rates of unintentional injury
- Local timing of river break-up, shore-fast ice break-up,
- Weather extremes and stability

Infrastructure and Arctic human health

Establish local level monitoring programs for data collection on permafrost and infrastructure stability. Monitor:

- Basal depth of permafrost and compare to historic measurements
- Incidences of flooding caused by storm surges or heavy precipitation

Wildlife, diet and health

Establish community based and regional scale monitoring programs for:

- Harvest data by species of interest (subsistence species; sentinel species)
- Local arrival/departure dates of migratory species
- Important subsistence species disease frequency using blood testing (eg brucellosis, trichanella, rabies, echinococcus, toxoplasmosis)
- Appearance of a new zoonotic disease (eg West Nile)
- Local hunter reports of animal/fish abnormalities
- Incidence of human cases of zoonotic diseases
- Incidence of foodborne illness (botulism)

The workshop concluded that there are currently relatively few programs examining the feasibility of implementing community based monitoring strategies in the Arctic. However there are several pilot programs underway in the Canadian North, assessing current surveillance networks, and capacity at the community level to monitor acute and chronic disease, and other health determinants related to climate change.
www.arcticnet-ulaval.ca;
www.qanuippitaa.com

A recommended strategy could include

1. The identification of communities and segments of the population at greatest risk. These should be targeted for assessment of existing or potential health risks, vulnerabilities, and engagement in the design of community based monitoring and formulation of intervention strategies.
2. Identification of community leaders or project managers. In Alaska, communities have access to training in emergency preparedness and implementation of the Incident Command System for managing community emergencies. This system could be utilized for the management of incidents related to climate change (eg village evacuation, unsafe ice conditions, threats to the sanitation infrastructure).
3. Evaluation of existing capacity, resources, motivation, and infrastructure needed to establish a community based monitoring system.
4. Identification and creation of regional partnerships. Linkage with, and engagement of, appropriate tribal, public health and wildlife agencies, non governmental organizations, and universities engaged in climate change activities and research.
5. Identification, selection and monitoring of basic indicators for climate change and community health. The selection of site- or village-specific indicators should be guided by local concerns and may include activities such as the surveillance of a key wild life or insect species in a region where climate changes may contribute to emergence of new zoonotic diseases, or the measurement of weather (precipitation, temperature, barometric pressure) and/or extreme events (flooding). Measurement of sea ice (thickness, annual fast-ice edge distribution, annual date-in, annual date-out). Measurement of water quality (turbidity and pathogens) and gastrointestinal illness (clinic visits) in a community. Recording of injuries, intentional and unintentional (location and circumstance).
6. Expansion of community based monitoring systems to include other communities both regionally and internationally to facilitate the sharing of standardized protocols for monitoring climate change,and community health indicators.
7. Develop contingency plans, communication networks, education programs and early warning systems. (eg Village evacuation contingencies, posting of dangerous ice or weather conditions, alternate travels routes, alternate food sources, food storage/ preservation methods, alternate water sources).

PRESENTER BIO

James E. Berner

James Berner has practiced medicine in the Alaska Native health care system since 1974. He directs the Alaska Native Traditional Food Safety Monitoring program, which assesses contaminant and micronutrient levels in pregnant Alaska Native women, and evaluates health effects in mothers and newborn infants. He has been the key national expert for the U.S. on the Human Health Advisory Group of the Arctic Monitoring and Assessment Program (AMAP), a Program of the Arctic Council, since 1999. Dr. Berner was co-lead author of the chapter on the impact of climate change on the health of Arctic residents in the 2005 Arctic Climate Impact Assessments, an international report on climate change in the north. In April 2005 he was appointed to the National Academy of Sciences Polar Research Board. Dr. Berner graduated from Oklahoma University Medical School in 1968. He spent three years in the U.S. Navy Medical Corps, completed residency training, and is board certified in Internal Medicine and Pediatrics. He served as Director of Community Health of the Alaska Native Tribal Health Consortium from 1984 until 2006, and now serves as Senior Director for Science within the Division of Community Health Services, as well as serving as part-time clinician in Pediatrics.

Alaska Native Tribal health Consortium
Anchorage Alaska
jberner@anthc.org

PRESENTER BIO

Jeremy Hess

Jeremy Hess is trained in Emergency Medicine and Global Environmental Health. He works in the Global Climate Change workgroup at CDC. The Climate Change Workgroup focuses on evaluating the health effects of global climate change, developing a robust public health response, and coordinating domestic and international surveillance activities of climate-related health outcomes. Dr. Hess is also an Assistant Professor in the Departments of Emergency Medicine and Environmental and Occupational Health at Emory University's Schools of Medicine and Public Health. He received his BA in International Health at Brown University, his MD and MPH in Global Environmental Health at Emory University in Atlanta, and completed his residency training in Emergency Medicine at Emory as well. His other areas of interest include complex humanitarian emergencies and disaster response, health systems, and injury prevention and control.

National Center for Environmental Health
4770 Buford Hwy, Building 106, MS F-61
Atlanta GA 30341-3717
Tel 404-386-7585
Fax 404.616.6182
jhess@emory.edu

PRESENTER BIO

Joel D. Scheraga, PhD

Dr. Joel D. Scheraga is the National Program Director for the Global Change Research Program and the Mercury Research Program in the U.S. Environmental Protection Agency's Office of Research and Development. He holds a federal Executive level Scientific and Professional level (ST) position. Dr. Scheraga is the EPA Principal Representative to the U.S. Climate Change Science Program (CCSP), which coordinates and integrates scientific research on climate and global change supported by the U.S. Government.

Dr. Scheraga has participated in the Intergovernmental Panel on Climate Change (IPCC), which was awarded the 2007 Nobel Peace Prize. He was a Lead Author of the 1997 IPCC North American Regional Assessment. In 1995, he was a Contributing Author to the Working Group II chapter on "Technical Guidelines for Assessing Climate Change Impacts and Adaptations" that appeared in the IPCC Second Assessment Report. He also served as an Expert Reviewer of the Second Assessment Report. And he served as an Assisting Lead Author for the 1994 IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations. Dr. Scheraga has been a member of several official U.S. Delegations to the international meetings of the IPCC.

As a National Program Director at EPA, Dr. Scheraga directs policy-relevant assessments of the potential impacts of global change (particularly climate change and climate variability) on air quality, water quality, aquatic ecosystems, and human health. These assessments are intended to provide timely and useful information to decision makers and resource managers, and include evaluation of adaptation options for responding to change. The Global Program also develops decision support tools to help resource managers cope with a changing climate. He directs a Mercury Program that studies the fate and transport of mercury in the environment, particularly in those areas where people harvest and eat fish that bioaccumulate the mercury.

Dr. Scheraga was Chair of the U.S. Global Change Research Program's National Assessment Workgroup from 2000-2002 and Vice Chair from 1998-2000. The Workgroup was responsible for managing the U.S. National Assessment process which resulted in the report to Congress entitled, "Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change."

PRESENTER BIO

Juhani Hassi

Juhani Hassi retired as Professor and Director of the Centre for Arctic Medicine, University of Oulu in 2006, Finland, and is currently at the Department of Public Health at the same university. He received his medical degree in 1969 from the University of Oulu and continued as a doctoral student from 1969-72. He was Director of the Oulu Regional Institute of Occupational Health (ORIOH) from 1973-1996 and Leader of the Cold Work Action Program, Finnish Institute of Occupational Health 1997-2000. He was appointed associate professor at the University of Oulu in 1981 and became Professor in Arctic Medicine in 2001.

He is currently the Editor-in-Chief of the International Journal of Circumpolar Health.

He initiated in 1976 and coordinated the development of the Cold Research Center in Oulu, serving in the beginning director of its core unit, ORIOH. He moved to the University of Oulu to lead the Research Program and Graduate School for Circumpolar Health and Wellbeing.

He has served on many national and international scientific and professional committees and societies, including: Finnish representative (medicine) in the Scientific Committee of Antarctic Research since 1988; International Arctic Scientific Committee 1999-2000; International Union of Circumpolar Health 1996-2004; Nordic Society of Arctic Medicine since 1995; Advisory Group for Human Health Activities in International Polar Year since 2005. In 2003 he was invited as a cold expert for WHO concerning health impacts of global warming and as a cold injury expert for NATO in 2005.

His research interests over the years have ranged from brown adipose tissue (1969-1976); thermophysiology of cold exposure 1977-2001; to cold related injuries and diseases (since 1988; and assessment of health effects related on climate warming in circumpolar North (since 2003).

Department of Public Health and General Medicine
P.O. Box 7300
FIN-90014
University of Oulu
Finland
juhani.hassi@oulu.fi

PRESENTER BIO

Torbjörn Messner MD, PhD

Torbjorn Messner is an Associate Professor at Umeå University. He is a specialist in Internal Medicine, Cardiology and Gastroenterology. His main research interests involve cardiovascular epidemiology and the epidemiology of sudden cardiac death in the young. The major part of his clinical career has been in in Kiruna, in the far north of Sweden, above the Arctic Circle.

Store Västergatan 29
SE 271 35 Ystad
Sweden
tomessner@gmail.com

PRESENTER BIO

Eric P. Hoberg

Eric Hoberg is a Zoologist and Chief Curator of the US National Parasite Collection (USNPC) at the USDA's Beltsville Area Research Center in Maryland. The USNPC is the largest research-museum collection for parasites in the world and is a globally important center for studies of taxonomy and diagnostics, biodiversity assessment, evolution and biogeography. Current programs dealing primarily with domestic and free-ranging ungulates explore patterns of distribution for complex host-parasite systems and the biological and physical processes that have served as determinants in evolutionary and ecological time. Hoberg's background in zoology emerged from an undergraduate education at the University of Alaska-Fairbanks, and graduate research at the University of Saskatchewan and the University of Washington. Since the late1970's, studies by Hoberg have focused on high latitudes, examining diverse faunas in birds and mammals from marine and terrestrial environments of Alaska, Central Canada, Siberia and Antarctica. Most recently, over the past decade, survey and inventory of parasites and mammalian hosts has been conducted in the NSF funded Beringian Coevolution Project and in conjunction with the Research Group for Arctic Parasitology, international consortia for revealing and defining parasite and pathogen diversity across the roof of the northern continents. Through these integrated studies, we develop baselines for parasite biodiversity that are foundations for understanding and predicting the impact of ecological perturbations including climate change which influence the emergence of diseases of consequence for animal and human health.

USDA
Animal Parasitic Diseases
Zoologist
Eric.Hoberg@Ars.USDA.Gov

PRESENTER BIO

Alan J. Parkinson PhD

Dr. Parkinson is currently the Deputy Director of the Arctic Investigation Program of the US Centers for Disease Control & Prevention located in Anchorage, Alaska. Dr Parkinson's research interests include laboratory and epidemiological aspects of infectious disease detection, prevention and control in Arctic and sub-Arctic populations and is currently the chair of the International Union for Circumpolar Health's Infectious Disease Working Group, the coordinator of the Infectious Disease International Circumpolar Surveillance project, and a co-coordinator of the Arctic Council's International Polar Year Arctic Human Health Initiative.

US Centers for Disease Control & Prevention
Arctic Investigations Program
Anchorage Alaska
ajp1@cdc.gov

PRESENTER BIO

Rasmus Ole Rasmussen

Rasmus Ole Rasmussen, Danish citizen, born 1949, M.Sc. in Economic Geography from University of Copenhagen in 1973, and PhD in 1977 based on a thesis on “Natural Resources, Ecological Potentials, and Agriculture” including a simulation model of human controlled eco-systems. Tenure as Associated Professor at the department of Geography at Roskilde University since 1976, intervened by different short and long term assignments, including: Senior Consultant for Greenland Home Rule 1987-1991, Visiting professor, McGill University 1994-1995, visiting professor, Université Laval, Quebec 1996, Fulbright Research Fellow, UAF, fall 1995, Nordic Professor, University of Lapland, Finland 1999-2003, and council member and one of the founding members of University of the Arctic since 1999. From 2007 also Senior Research Fellow at Nordic Centre for Spatial Development, Nordic Council of Ministers, Stockholm. Has published extensively on demographic and socio-economic changes in the Circumpolar North, with special focus on Greenland. Most resent research is on socio-economic changes in hunting and fishing dependent communities in Greenland, with special focus on the role of climate change in these processes.

Institute of Environmental, Social, and Spatial Change
ERR - Environment, Resources, and Regions
Universitetsvej 1
Roskilde University 02.1
Roskilde
DK4000
Denmark
rasmus@ruc.dk

PRESENTER BIO

John Warren, P.E.

John Warren is the Director of Engineering Services for the Alaska Native Tribal Health Consortium, Division of Environmental Health and Engineering. He has over 19 years of engineering experience throughout all regions of Alaska. He previously worked as Engineering Manager at Larsen Consulting Group, and later at CE2 Engineers, Inc. Prior to his consulting experience, John worked for the US Public Health Service/Indian Health Service as a Construction Engineer, Design Engineer, and Engineer Consultant. John has received State and National awards and commendations for his work in engineering design and construction in the north. He has contributed a number of publications on sanitation infrastructure; was a contributing author of the "Cold Regions Utilities Monograph," a coauthor for the "Arctic Climate Impact Assessment," and author of "Climate Change and Human Health: Infrastructure Impacts to Small Remote Communities in the North" published in the International Journal of Circumpolar Health.

Alaska Native Tribal health Consortium
Anchorage Alaska
jwarren@anthc.org

PRESENTER BIO

Michael J. Bradley DVM, MPH

Mike Bradley currently serves as the Emergency Preparedness/Traditional Food Safety Coordinator with the Alaska Native Tribal Health Consortium (ANTHC). In this position he works with Alaska Native health organizations to development plans and resources to deal with disasters and public health emergencies. He has also contributed to the Arctic Council sponsored "Arctic Climate Impact Assessment Report" dealing with the effects of climate change in the Arctic. Prior to working with Alaska Native Health organizations he managed public health and environmental health programs in the US Air Force. He received graduate degrees in veterinary medicine and public health from the University of Minnesota.

Alaska Native Tribal health Consortium
Anchorage Alaska
mjbradley@anmc.org

PRESENTER BIO

Chris Furgal, PhD

Dr. Chris Furgal is an Assistant Professor in the Indigenous Environmental Studies Program, cross-appointed between the Departments of Environmental and Resource Studies/Science and Indigenous Studies at Trent University, Peterborough, Ontario Canada. He is the Co-Director of the Nasivvik Centre for Inuit Health and Changing Environments, one of eight centres funded by the Canadian Institutes for Health Research to look at Aboriginal environmental health research and training in Canada. His background is in the biological (BSc, MSc) and social sciences (PhD) and he conducts multidisciplinary research on Arctic environmental health issues. His current work focuses on environmental health risk assessment, management and communication in cooperation with northern Aboriginal communities. Much of his work has focused on the topics of environmental contaminants, food security and climate change in Inuit communities. Dr. Furgal has been a lead author of the Arctic Climate Impact Assessment Health Chapter, IPCC Fourth Assessment Report-Polar Regions Chapter, as well as two recently completed Canadian National climate change assessments soon to be released.

Indigenous Environmental Studies Program
Trent University, 1600 West bank Drive, Peterborough, ON. Canada
K9J 7B8; Tel: 705-748-1011 ext 7953; Fax: 705-748-1416;
chrisfurgal@trentu.ca

ABSTRACT

The ACIA Human Health Recommendations

James E. Berner

This ACIA discusses direct and indirect relationships and impacts, both positive and negative, between climate related changes and human health in northern communities. The likelihood of these impacts occurring in any specific community or region is difficult to determine. The risk of impact depends on many factors, both current and future. The most obvious conclusion that can be drawn is that much research remains to be done on the relationship between climate change and individual and community health in the Arctic. Climate will continue to influence public health in the small remote communities of the Arctic. The recent record warming, and the scenario of future warming, combined with the multiple mechanisms by which climate impacts on health indicate urgent need for adopting community-based monitoring strategies. A Network of such communities, within and across regions, reporting a common set of similarly measured climate, health status, infrastructure, and ecosystem observations would serve to identify both emerging threats, and opportunities.

Thus, regional and national governments need to assist in the design, and provide support for community based monitoring and mitigation strategies to cope with climate change.

ABSTRACT

Climate Change: Place, Health, and the Public Health Response

Jeremy Hess

Climate change-related risks are place-specific and path-dependent. Accordingly, location is an important determinant of hazardous exposure, and certain places will bear more risk than others.

This paper reviews the major environmental exposures associated with risky places in the US, including coastal regions, islands, the desert Southwest, vector-borne and zoonotic disease border regions, cities, and the US Arctic (Alaska), with emphasis on exposures and vulnerable populations of concern. In addition to these hotspots, this paper considers the ways in which the concept of place—the sense of human relationship with particular environments—will play a key role in motivating, developing, and deploying an effective public health response.

In considering the importance of place, we highlight the concepts of community resilience and risk management, fundamental aspects of a robust response to climate change in public health and other sectors.

ABSTRACT

Overview of the Health Implications of Climate Change in the Arctic

Joel D. Scheraga, PhD

No Abstract

ABSTRACT

Climate Change: Human Thermal Health Impacts

Juhani Hassi

The dominant factors of thermally changing climate on human health are: average warming, increase of the frequencies of thermal extremities, increase of high winds, storms and autumn raining.

Average warming of the climate changes human behavior and thermal health impacts more like by humans today in the warmer regions. Urban lifestyle increases too light clothing and for health incorrect activities. These results are based on the comparison studies in the colder and warmer regions in Europe.

As a consequence of climate change heat stress is more frequent than today, but clearly less frequent than cold stress, which frequency reduces from today. The temperature of the minimum mortality increases. The frequencies of cold and heat related mortality increase from the level of 7% of total mortality today based on European and Finnish epidemiological studies. Hypothermic and probably hyperthermic deaths increase. Frostbite frequency decreases. Cold symptoms from respiratory organ and blood vessels decrease from the level 30% in adult population today. Cold caused performance decrease is more common based on European and US studies.

In many countries there are in use heat health warning system (HHWS) for the main population. The extreme weather health warning systems are most effective, if they are focused to risk populations/groups:

- people suffering certain chronic disease; cardiovascular diseases, asthma, COPD, diabetes
- elderly and especially alone living old population
- people involved frequently in recreational outdoor activities or outdoor work

European Union is preparing advise protocol for its member countries to use in climate change related heat and cold health warning system.

Juhani Hassi
Associated Professor of Arctic Medicine
Institute of Health Sciences
University of Oulu, Finland

ABSTRACT

Environmental Variables and the Risk of Disease

Torbjorn Messner, M.D., PhD.

Conflicting results of epidemiological studies of weather and disease have emerged, depending on the population and geographical setting. Most studies concerning climate and disease have focussed on cardiovascular disorders. The bulk of these studies, mainly from temperate climate zones, find that cold weather increases the risk of suffering an acute myocardial infarction (AMI). Our studies, carried out in a climate similar to that of Alaska, have shown that temperature, barometric pressure, or humidity extremes are not related to changing rates of cardiovascular disease. Changes in temperature, but not in barometric pressure or humidity were related to the risk of having an AMI – a 1 degree centigrade temperature rise increased the number of non-fatal AMIs by 1.5 %. A study of heart disease in relation to changes in the Northern Atlantic Oscillation gave similar results.

Variations in the earth's magnetic field, caused by the Northern Lights, did not cause any changes in the rates of cardiovascular disease.

ABSTRACT

Climate Change and Contaminant Transport to the Arctic

James E. Berner

Contaminants in the Arctic are either produced and released locally, or more often, they are transported to the Arctic from distant sites by a variety of mechanisms. Once in the Arctic, they can remain unchanged, or undergo some chemical or physical state change. During this process, they can move between compartments, enter the lower trophic levels, move between regions, undergo “burial” in sediment, or be removed from the Arctic by a variety of mechanisms. All of these processes can be accelerated or slowed by changes in one or more components of climate and local weather. The characteristics of the contaminant compound are equally important, in that transport, uptake and metabolic degradation, are all influenced by volatility, solubility characteristics, and attraction to particles.

The perspective of this discussion is that of the effect of the recent climate trends, and those that climate models predict, on the contaminant exposure of Arctic human residents. Topics discussed will include basic Arctic climate processes, observed trends in Arctic climate, model predictions for Arctic climate, potential impacts of predicted changes on Arctic levels of contaminants, and conclusions and recommendations.

ABSTRACT

Climate and Pathogens:

Consequences for Human Health and Subsistence Food Chains Across High Latitudes of the North.

Eric P. Hoberg[a], Lydden Polley[b], Susan Kutz[c], Emily Jenkins[d], Brett Elkinc[e], Alasdair Veitch[f]

Climate change and associated ecological perturbations are modifying the structure and function of terrestrial, aquatic and marine ecosystems across high latitudes of the North and globally. Patterns of distribution, timing of migrations, and seasonal changes that determine the life histories for many vertebrates (fish, birds and mammals) and invertebrates (e.g., arthropods and mollusks) are undergoing dynamic change. Although we recognize and predict direct and indirect impacts at the ecosystem-level, pathogens and disease have seldom been considered in the "equations" for environmental change. Pathogens including macroparasites (worms and arthropods, and arthropod vectors) and microparasites (prions, viruses, bacteria and protozoans) are critical components of these ecosystems, influencing mortality and disease, the dynamics for vertebrate and invertebrate populations, and a range of interactions from competition to predation. Across the North, many pathogens are important to people as agents of disease in populations of wild fish, birds, or mammals that are the foundations for subsistence food-chains, and as zoonoses- or those pathogens transmissible from animals to people.

Climate and environmental change are accelerating in northern ecosystems. These perturbations (particularly altered patterns of temperature and humidity) have a direct influence on the occurrence of pathogens and the potential for emergence of diseases in people and in wild animal hosts critical to northerners. Cumulative (long term) climatic processes and extreme (short term) events influence the occurrence of pathogens. Long term processes such as incremental increases in global temperature can drive the changing dynamics between hosts and pathogens (generation times, developmental rates and thresholds, amplification, and seasonal windows for transmission) and influence an array of cascading effects within ecosystems. In contrast, extreme weather events can result in the explosive emergence of disease leading to mortality and morbidity at local and regional scales. Concurrently, rapidly changing patterns of geographic distribution for many vertebrate and invertebrate species will create new opportunities for exposure of host populations to an array of pathogens not previously experienced. Emerging diseases, interacting with overall habitat change and other biological factors in the North, can affect the availability of food resources on which northern communities are dependant, and may increase the exposure of northerners to zoonotic pathogens.

We suggest that there is urgent need to fully incorporate consideration of pathogens and disease into policy and management plans for northern wildlife and

ABSTRACT

emphasize that disease-related issues should be on the agenda for wildlife and fisheries biologists and local communities. Synergy can be achieved through multidisciplinary teams working to integrate historical and local traditional knowledge, field observations and experimental studies and the development and validation of empirical models for pathogen and disease behavior in northern ecosystems. In particular, knowledge and predictions for linkages between climate change and pathogens should be incorporated into the design, implementation and evaluation of mitigation measures to limit the impacts of diseases for people and the wildlife resources that serve as critical foundations for northern communities. Additionally, baselines against which environmental change is assessed within ecosystems can be established through use and development of archival biological collections and museum based resources for informatics derived from targeted survey and monitoring for pathogens among populations of fishes, birds and mammals.

Research and concepts discussed here are contributions from the Research Group for Arctic Parasitology (RGAP) and from the Beringian Coevolution Project (BCP), with the latter funded in part by the National Science Foundation (DEB 0196095 and 0415668).

[a]US National Parasite Collection and Animal Parasitic Diseases Laboratory, USDA, Agricultural Research Service, BARC East 1180, Beltsville, Maryland, USA. (eric.hoberg@ars.usda.gov)

[b]Department of Veterinary Microbiology, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, Canada. (lydden.polley@mail.usask.ca)

[c]Department of Ecosystem and Public Health, Faculty of Veterinary Medicine, University of Calgary, Calgary, Alberta, Canada.
(skutz@ucalgary.ca)

[d]Environment Canada, Saskatoon, Saskatchewan, Canada. (emily.jenkins@usask.ca)

[e]Government of the Northwest Territories, Yellowknife, Northwest Territories, Canada. (brett_elkin@gov.nt.ca)

[f]Government of the Northwest Territories, Norman Wells, Northwest Territories, Canada. (alasdair_veitch@gov.nt.ca)

ABSTRACT

Climate Change and Potential Infectious Disease Emergence in the Arctic

Alan J. Parkinson, PhD

The health impacts of climate change and extreme weather events are likely to most impact those living in small isolated communities that are underdeveloped and have limited public health infrastructure may be particularly susceptible to increase risk of infections associated with climate change. Because the average Arctic temperatures have increased at almost twice the rate of the rest of the world in the past two decades, Arctic regions may serve as a critical sentinel for detecting the influence of climate change on infectious disease epidemiology. Increased ambient temperatures may lead to the northward spread of infectious diseases from temperate regions as well as southward spread of infections that are most common in the Arctic and sub-Arctic. Higher ambient temperatures in the Arctic may result in an increase in some temperature sensitive foodborne diseases such as gastroenteritis, paralytic shellfish poisoning and botulism. An increase in mean temperature may also influence the incidence of infectious diseases of animals that are spread to humans (zoonoses) by changing the population and range of animal hosts and insect vectors. An increase in flooding events may result in outbreaks of waterborne infection, such as Giardia lamblia or Cryptospordium parvum. A change in rodent and fox populations may result in an increase in rabies or echinococcosis. Temperature and humidity influence the distribution and density of many arthropod vectors which in turn may influence the incidence and northern range of vectorborne diseases such as West Nile virus. Recommended public health actions include enhancing the public health infrastructure to: ensure tracking of diseases and trends most likely to be influenced by climate; rapidly diagnose and investigate infectious disease outbreaks at a local and regional level; develop partnerships among federal, state and local and community governments, universities, non government organizations, and the private sector; engage communities and develop partnerships to identify and solve health problems created by climate change; develop policies plans that support individual and community health efforts that address threats related to climate change, including extreme events; link people to needed health care services disrupted by extreme weather events; inform and educate communities about the potential health risks of climate change and about steps that can be taken to reduce risk; and to conduct research to further our understanding of the associations between weather, weather extremes, climate and infectious disease emergence.

ABSTRACT

Community Relocation and Health—Case Greenland

Rasmus Ole Rasmussen

Demographic change and relocation have been important issues in Greenland for centuries, decisive for the changes in settlement structures and their socio-economic characteristics. And the contemporary changes are in the process of outlining not only the future of many of the settlements, but also the lifestyle approaches which will be characterizing the settlements in the future. In this connection health – both physical and social – are decisive factors. The presentation will focus on four processes and their consequences:

1 **Politics:** In the settlement history the town/village divide was enhanced during the modernization process, and in more recent times leading not only to differences in lifestyles and economic characteristics, but also to differences in health characteristics. In spite of rhetoric the contemporary policies are enhancing these differences.

2 **Food:** Local food has been an important contributor to health and wellbeing, and as a part of modernization the role of imported food increased. Due to the existence of the local markets and informal economies, however, country food has been maintained as an important part of the diet in both towns and village. The absolute role of the informal relations differs, but the existence of the informal marketplace has helped in pushing the products into the supermarket freezers, and thereby influenced the consumption pattern.

3 **Gender aspirations:** Presently the most important single factor in changes in settlement structure and community relocation is the gender and generation differences in approaches to changes. Gender biased out-migration pattern is driven by women who are looking for opportunities fitting better to their aspirations and qualifications, while males are more path-dependent, relying on the (dwindling) opportunities of maintaining a health economy based on traditional exploitation patterns of renewable resources.

4 **Youth aspirations:** And this is resulting in both economic and social conditions in villages eventually leading to increase in unhealthy lifestyles, and violent behavior, which is highly influencing the youth in their aspirations and preferences regarding their future – and consequently the future of the villages.

ABSTRACT

Potential Indirect Impacts to Human Health

John Warren

In northern regions, climate change can include changes in precipitation, reductions in sea ice, and climate warming and cooling. These changes can increase the frequency and severity of storms, flooding, or erosion. Other changes may include drought or degradation of permafrost. Climate change can result in damage to sanitation infrastructure resulting in the spread of disease. Through monitoring of some basic indicators communities can begin to develop a response to climate change. With this information, planners, engineers, health care professionals and governments can begin to develop approaches to address the health challenges related to climate change.

ABSTRACT

Community Preparedness for Extreme Climate Events

Michael J. Bradley, DVM, MPH

Developing community based emergency plans and programs for extreme climate events such as storms, floods, wild land fires will be discussed. The Emergency Disaster planning process at the community level will be reviewed. Community and community clinic model disaster plan templates will be presented. Resources communities can use to develop emergency plans and improve emergency response capacity will be reviewed.

ABSTRACT

Community-based Monitoring for Climate and Health in the Canadian Arctic

Chris Furgal, PhD

Rapid environmental changes such as climate, weather and contaminants, have begun to disrupt the relationship between Northern Inuit populations and the ecosystems in which they live. Hunters, elders and other residents have begun to observe and document changes in such things as animal migration patterns, the ability to find and hunt certain species, safe travel conditions on the land and ice, and access to clear, natural sources of drinking water. Such disruptions in environmental integrity are predicted to have a negative impact on northern populations, particularly in the areas of human health. In response, a series of studies have taken place bringing together community residents, University researchers and regional public health representatives to identify, select and begin to monitor, in a proactive way, aspects of environment and health relationships in northern Canadian Inuit communities. The intent of these projects is to support community capacity for monitoring and surveillance, in the hopes that it will enhance adaptive abilities at the local scale in the face of climate and other forms of environmental change threatening various elements of health.

ABSTRACT

Trends in Canadian Arctic Climate and Health Research:

Reflections on impacts, vulnerability and adaptation

Chris Furgal, PhD

No Abstract