United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACTS

Keynotes

Stroeve, Julienne
National Snow and Ice Data Center, Cooperative Institute for Research in Environmental Sciences, University of Colorado
Overview of Changes in the Arctic Sea Ice Cover

Petersen, Aevar
Incoming Chair of the CAFF Arctic Council Working Group, Iceland
Arctic biodiversity and ecosystem services: How the Conservation of Arctic Flora and Fauna (CAFF) program can help

Lynge, Aqqaluk
President of the Inuit Circumpolar Council, Greenland
Facing the impact of global climate change: Recommendations from the Arctic's indigenous peoples

Treadwell, Mead
U.S. Arctic Research Commission, marine transportation, civil infrastructure, human health, natural resource development
Economic development and social transformations: Why the Arctic Matters…

Kullerud, Lars
President of the University of the Arctic
Education for Arctic Sustainable Development

Hattingh, Johan
Professor of Philosophy at the University of Stellenbosch, South Africa, member of UNESCO COMEST
Sustainable development of the Arctic: A view from environmental ethics

Larsen, Joan Nymand
Stefansson Arctic Institute, Iceland, president of International Arctic Social Sciences Association (IASSA)
Arctic Monitoring Systems

Ice, ocean and atmosphere

Frolov, Alexander
Deputy Head of Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET), Russian Federation
Climate change: Consequences for the Arctic physical environment

Gascard, Jean- Claude
Co-chair of the EU framework project "DAMOCLES", France
Ice, oceans and atmosphere

Goodison, Barry
World Meteorological Organization, Switzerland
Cryosphere and Climate: The Arctic Challenge

Haugan, Peter M
Director, Geophysical Institute, University of Bergen, Norway
Observatories for understanding Arctic change

Itta, Edward S.
President, Inuit Circumpolar Council, Alaska; Major, North Slope Borough, Alaska
Concerns of Indigenous People in Response to the Effects of Climate

Kielsen, Lene Holm
Director of International Sustainable Development with Inuit Circumpolar Council (ICC) in Greenland
Siku-Inuit-Hila, "The Dynamics of Human-Sea Ice Relationships: Comparing Changing Environments in Alaska, Nunavut and Greenland"

Yamanouchi, Takashi
Professor, National Institute of Polar Research (NIPR), Japan
Arctic Change in the Flow of Global Warming: Need for Long-Term Monitoring Observations

Biodiversity and ecosystem services

Apressyan, Ruben
Professor; Head, Sector of Ethics, Institute of Philosophy, Russia; Member of COMEST UNESCO
Impending Social Changes in Arctic: Providence, Thoughtfulness, and Shared Responsibility

Crump, John
Acting Manager, Polar Unit, UNEP/GRID-Arendal
Sustainable Development or Sustaining Development? Arctic governance in a changing climate

Gill, Mike
Chair, Circumpolar Biodiversity Monitoring Program, Environment Canada
Coordinating for Arctic Conservation: Towards Integrated Arctic Biodiversity Monitoring and Reporting

Huntington, Henry
Huntington Consulting, specialising in Arctic research and related activities, Alaska USA
Connections between Arctic Peoples and Their Environment

Koeck Günter
Executive Secretary, Austrian MAB National Committee, Austrian Academy of Sciences, Austria
Fish from sensitive ecosystems as bioindicators of global climate change (High-Arctic 1997-2009)

Laine, Kari
Director, Thule Institute, University of Oulu, Finland
Northern Long-term Socio-ecological Research Platform (Northern LTSER Platform) cooperation in Finland: possibilities and challenges for long-term socio-ecological research

Metcalf, Vera
Eskimo Walrus Commission, Kawerak, Inc., Nome, Alaska
Sustaining a Healthy Human-Walrus Relationship

Minaeva, Tatiana
Arctic Senior Technical Officer, Wetlands International, Russia
Wetlands - key Arctic ecosystems: vulnerability to climate change and adaptation options

Retter, Gunn-Britt
Head of the Arctic and Environmental Unit of the Saami Council, Norway
Biodiversity and ecosystem services

Circumpolar indigenous peoples and intangible cultural heritage

Abryutina, Larisa
Vice-president, Russian Association of the Indigenous Peoples of the North (RAIPON), Russia
Indigenous people of the Russian North and social and climate changes

Baer, Lars-Anders
President of the Sami Parliament in Sweden; Member of the UN Permanent Forum on Indigenous Issues
Circumpolar indigenous peoples, culture heritage, and development with identity

Lebedeva, Anastassia
Scientific Research Institute of the national schools in the Republic of Sakha (Yakutia)
The role of nomadic schools in the revival and preservation of the cultural heritage of indigenous peoples of the North and the Arctic

McClintock, Sharon
President/Alaska Native Claims Land Specialist for McClintock Land Associates, Inc., USA
Indigenous land claims in Alaska

Motzfeldt, Jonathan
Former president of the Greenland Assembly, former prime minister of Greenland
Sustainable Development of the Arctic in the face of Global Climate Change seen from a Greenlandic viewpoint

Näkkäläjärvi, Klemetti
President, Finnish Saami Parliament, Finland
The effects of climate change and international politics on indigenous cultures

Parkinson, Alan
Deputy Director, Arctic Investigations Program Centers for Disease Control and Prevention, USA
Climate Change, Human Health and Sustainable Development in the Arctic

Smith, Duane
Inuit Circumpolar Council, Canada
The Sea Ice is Our Highway: The Importance of Sea Ice to the Inuit Way of Life

Southcott, Chris
Research Outreach Program Team (MIMIR), University of the Arctic, Canada
Climate Change and Sustainable Development in Canada's Northern Communities

Economic development and social transformations

Andreassen, Ann
Director of the National School of Special Education, Ummannaq, Greenland
On Thin Ice

Barr, Susan
Senior Advisor (polar), Norwegian Directorate for Cultural Heritage, Norway
Protecting cultural heritage and community roots

Funston, Bernard
Executive Secretary to the Arctic Council Sustainable Development Working Group
Sustainable Development of the Arctic: the Challenges of Reconciling Homeland, Laboratory, Frontier and Wilderness

Kelman, Ilan
Senior Research Fellow, CICERO (Center for International Climate and Environmental Research) Oslo, Norway
Ethical Livelihoods

Pelyasov, Alexander
Director of the Center for Arctic and Northern economies, Council for Research for Productive Forces, Moscow, Russia
Arctic in the New Creative age (Arctic dimension of the knowledge economy)

Rogne, Odd
Senior Advisor to Arctic Monitoring and Assessment Programme) & the International Programme Office for the International Polar Year), Norway
The Need for Arctic Data (Sustaining Arctic Observing Networks - SAON)

Thomsen, Marianne Lykke
Senior Policy Advisor, Dept. of Foreign Affairs Greenland Home Rule Government
Sustainable Development of the Arctic in the face of Global Climate Change: Challenges and Opportunities in the case of Greenland.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

KEYNOTE ABSTRACT: Oceans, ice and atmosphere

Julienne Stroeve
National Snow and Ice Data Center,
Cooperative Institute for Research in Environmental Sciences,
University of Colorado,
USA

Overview of Changes in the Arctic Sea Ice Cover

Arctic sea ice extent has declined over the past several decades, showing downward trends in all months, with the smallest trends in winter and the largest trends at the end of the melt season in September [*Serreze et al*., 2007]. However, the rate of decline is accelerating. In 2001, the linear trend in September monthly mean extent over the available satellite (1979 to present) record stood at -7.0% per decade. By 2006, it had increased to -8.9% per decade. Then, in September 2007, Arctic sea ice extent fell to the lowest value ever recorded, 23% below the previous record minimum set in 2005, boosting the downward trend further to -10.7% per decade [*Stroeve et al*., 2008]. Including September 2008, which ended up as second lowest in the satellite record, the trend stands at -11.8% per decade (Figure 1).

All coupled global climate models used in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) show declining September ice extent over the period of observations [*Stroeve et al*., 2007; *Zhang and Walsh*, 2006]. Although this is strong evidence for a role of greenhouse gas (GHG) forcing on the observed trend, the simulated trends, as a group, are smaller than observed. This finding has raised concern that ice-free summers might be realized as early as 2030 [*Stroeve et al*., 2007]. Some of the IPCC (Intergovernmental Panel on Climate Change) simulations also show that the September trend becomes steeper with time, but only later into the 21st century.

Why has the observed downward trend steepened? While natural variability in the coupled ice-ocean-atmosphere system has certainly been a player [see *Stroeve et al*., 2007 and papers cited therein], the rate of decline of sea ice extent in response to

external GHG forcing is now being enhanced by three inter-connected processes. First, because of the extensive open water in recent Septembers, ice cover in the following spring is increasingly dominated by thin, first-year ice (ice formed during the previous autumn and winter) that is vulnerable to melting out in summer, especially under the influence of anomalous atmospheric circulation patterns that favor summer melt. Thus, back in the early 1980s when the Arctic Ocean in winter was dominated by old, thick ice, an unusually warm summer, such as what occurred in 2007, could promote a strong negative anomaly in summer ice volume, but only a modest negative anomaly in ice extent. However, at the same time that the overall spatial extent of sea ice has been declining, the winter ice pack has correspondingly become much younger and therefore much thinner [*Maslanik et al*., 2007], leaving little of the old, thick ice that can help stabilize the summer ice cover. Today a given summer decline in ice volume translates into even larger declines in ice extent simply because more of the icepack is so thin.

Second, the existence of more thin ice in spring allows open water areas to develop earlier in the melt season, leading to a stronger ice albedo feedback. Ice albedo feedback has always been part of the sea ice system - as the melt season commences, bare ice is exposed by melting snow, melt ponds form and areas of dark open water are exposed, which readily absorb solar radiation, fostering further melt. However, with the trend towards more thin ice in spring, open water areas form earlier and are present longer in the melt season so that the ice albedo feedback has grown in importance, accentuating summer ice melt and steepening the downward trend of September ice extent. It is this “boosting” of the ice-albedo feedback mechanism that has been implicated in rapid transitions towards a seasonally ice free Arctic in climate model simulations [*Holland et al*., 2006].

Third, the Arctic has warmed in all seasons, meaning that the likelihood of unusually cold conditions that could bring about temporary recovery through natural climate variability has declined. For example, Figure 2 shows 925 hPa temperature anomalies for an Arctic Ocean domain (the same as used in the Arctic energy budget analysis of *Serreze et al*. [2007]) from JRA-25 by year and month (top) and averaged for extended summer (MJJAS, middle) and extended winter (ONDJFMA, bottom) seasons. Anomalies are computed with respect to the period 1979-2007. In the earlier part of the record, it was common for an anomalously warm summer, contributing to a negative anomaly in September ice extent, to be followed by an anomalously cold winter or cold summer, helping to bring about recovery of the ice cover. Since about the year 2000, there has been warming in all months. Thus with rising air temperatures in all seasons, prospects for the ice to recover through a sequence of cold years have dimmed.

Climatic Implications of Loss of Sea Ice

A seasonally ice free Arctic Ocean is expected to have widespread socio-economic, ecological and climatic impacts. One climatic impact already being observed is amplified warming during autumn. The concept of Arctic amplification is a near universal feature of climate model simulations [*Holland and Bitz*, 2003]. Arctic amplification refers to the idea that rises in surface air temperature (SAT) in response to increasing concentrations of atmospheric GHGs will be larger in the Arctic compared to the Northern Hemisphere as a whole. This is because as larger expanses of open water areas develop in summer, the oceans absorb the incoming solar radiation that would normally be reflected back out to space by the sea ice cover. The sensible heat content of the ocean increases, and ice formation in autumn and winter is delayed. However, before the ocean can once again refreeze in winter, it must first lose the heat it gained in summer. This promotes enhanced upward heat fluxes, seen as strong warming at the surface and in the lower

troposphere. This vertical structure of temperature change is enhanced by strong low-level stability which inhibits vertical mixing. Arctic amplification is not prominent in summer itself, when energy is used to melt remaining sea ice and increase the sensible heat content of the upper ocean, limiting changes in surface and lower troposphere temperatures. Loss of snow cover contributes to an amplified temperature response over northern land areas, but this temperature change is not as pronounced as over the ocean.

Coinciding with the large ice losses observed since 2002, Arctic amplification has emerged in autumn [*Serreze et al*., 2009]. Evaluation of surface air temperatures from atmospheric reanalysis products show that Arctic Ocean SATs were 3 to 5^{o}C warmer in autumn (OND) for 2002 to 2007, compared to the long-term 1979-2007 mean (Figure 3b). The warming is centered directly over the areas of ice loss, but is also spread out over the adjacent land through atmospheric circulation. This warming associated with the loss of the summer Arctic sea ice cover may hasten permafrost degradation [e.g. *Lawrence et al*., 2008], leading to even more release of carbon to the atmosphere in the form of methane. With the expectation of continued summer ice loss, fostering more sensible heat gain in the upper ocean, autumn freeze-up will be further delayed, such that Arctic amplification should start to be seen in winter. Eventually, ice extent and thickness will be sufficiently reduced so that low-level warming will emerge in spring.

We also expect that warming associated with the loss of the summer ice cover will alter atmospheric circulation and precipitation patterns, not only in the Arctic, but also at lower latitudes. In a recent study by *Deser et al*. [submitted], climate model simulations were used to investigate the atmospheric response of a seasonally ice free Arctic Ocean. Results from the study reveal large impacts on atmospheric temperature, precipitation and snow cover in autumn and winter. Over Siberia and Canada, the largest temperature and precipitation responses are seen in November and December. Although the model experiments only addressed the direct impact of Arctic sea ice loss on atmospheric circulation and climate, the study serves as a guide. Oceanic feedbacks, in particular warming of the Arctic Ocean due to enhanced absorption of solar energy, may provide additional forcing to the atmosphere. In addition, warming of the high latitude Pacific and Atlantic Oceans may also alter the atmospheric circulation response through feedbacks with the midlatitude storm tracks [e.g. *Peng et al*., 1997].

Considering the potentially significant impacts that the continued reductions in Arctic sea ice will have on Northern Hemisphere climate during this century, scientific research needs to continue to focus on better understanding of the role of the Arctic in the global climate system.

References

Deser, C., R. Tomas, M. Alexander and D. Lawrence, Seasonal atmospheric response to projected Arctic sea ice loss in the late 21st century, *submitted to J. Climate.*

Holland, M.M, and Bitz, C.M. (2003), Polar amplification of climate change in coupled models, Clim. Dynam., 21, 221-232.

Holland, M.M., Bitz, C.M., and Tremblay, B. (2006), Future abrupt reductions in the summer Arctic sea ice, Geophys. Res. Lett., 33, L23503, doi: 10.1029/2006GL028024.

Lawrence, D.M, Slater, A.G., Tomas, R., Holland, M.M., and Deser, C.(2008), Accelerated Arctic land warming and permafrost degradation during rapid sea ice loss, *Geophys. Res. Lett*., doi:10.1029/2007JF000883.

Maslanik, J.A., Fowler, C., Stroeve, J., Drobot, S., Zwally, H.J., Yi, D., and Emery, W.J. (2007), A younger, thinner ice cover: Increased potential for rapid, extensive ice loss, Geophys. Res. Lett., 34, L24501, doi:10.1029/2007GL032043.

Peng, S.L., W.A. Robinson and M.P. Hoerling (1997), The modeled atmospheric rseponse to midlatitude SST anomalies and its dependence on background circulation states, *J. Climate*, 10, 971-987.

Serreze, M.C., A.P. Barrett, J.C. Stroeve, D.M. Kindig and M.M. Holland (2009), The emergence of surface-based Arctic amplification, *The Cryosphere* (in press).

Serreze, M.C., M.M. Holland and J. Stroeve (2007), Perspectives on the Arctic's shrinking sea ice cover, *Science*, 315, 1533-1536.

Serreze, M.C., Barrett, A.P., Slater, A.J., Steele, M., Zhang, J., and Trenberth, K.E. (2007), The large-scale energy budget of the Arctic, J. Geophys. Res., 112, D11122, doi:10.1029/2006JD008230.

Stroeve, J., Holland, M.M., Meier, W., Scambos, T., and Serreze, M. (2007), Arctic sea ice decline: Faster than forecast, *Geophys. Res. Lett*., 34, L09501, doi:10.1029/2007GL029703.

Zhang, X. and Walsh, J.E. (2006), Toward a seasonally ice-covered Arctic Ocean: Scenarios from the IPCC AR4 model simulations, *J. Climate*, 19, 1730-1747.

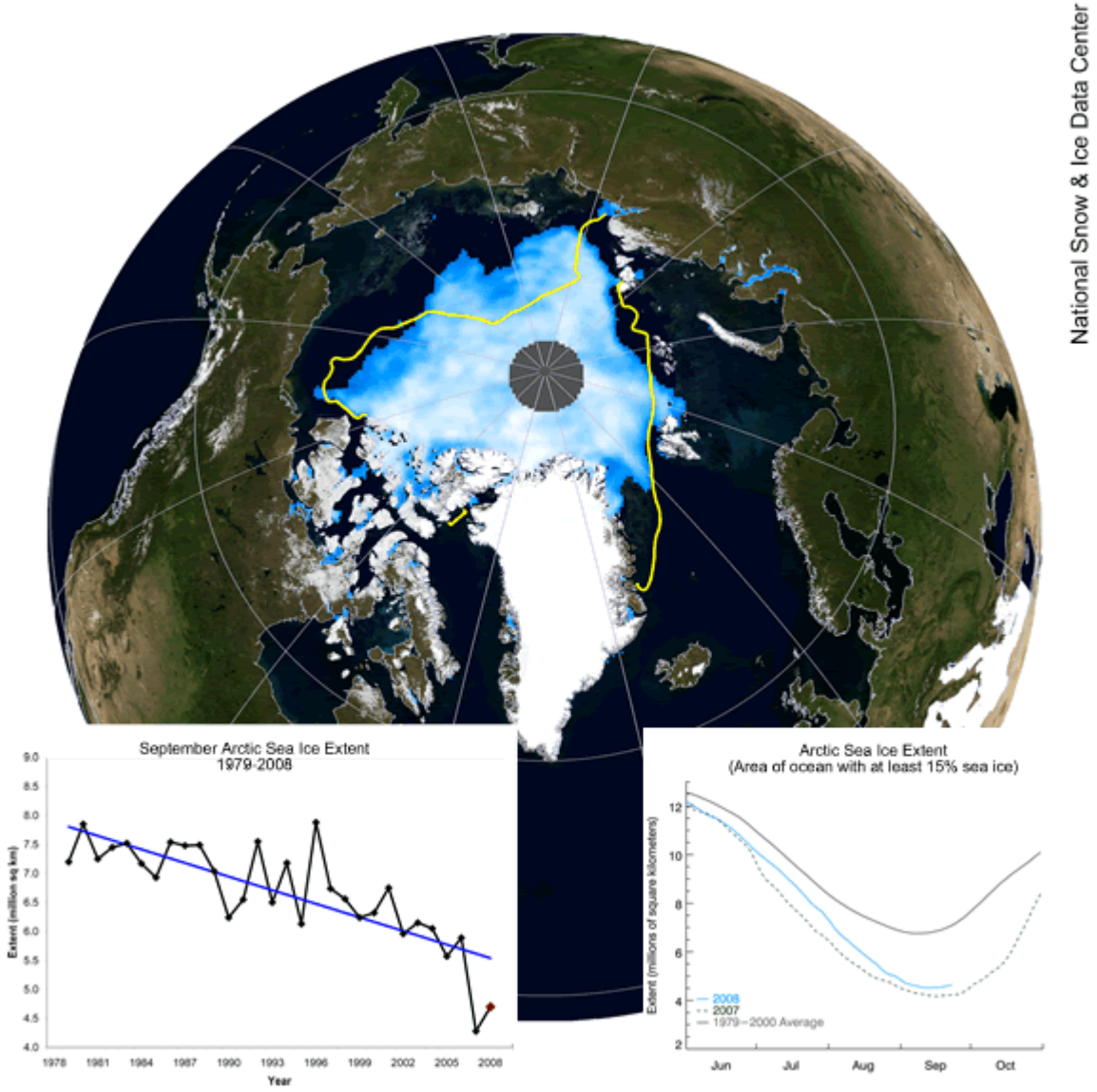

Figure 1. Color map: Sea ice extent on 14 September 2008, the date of the minimum, when ice extent was 4.52 million km^2. The yellow line marks the extent for September 16, 2007.Right inset: Time-series of ice extent from June 1 through 24 September for 2008, and through end of October for 2007 and climatology (1979-2000). Left inset: Time-series of monthly averaged September sea ice extent.

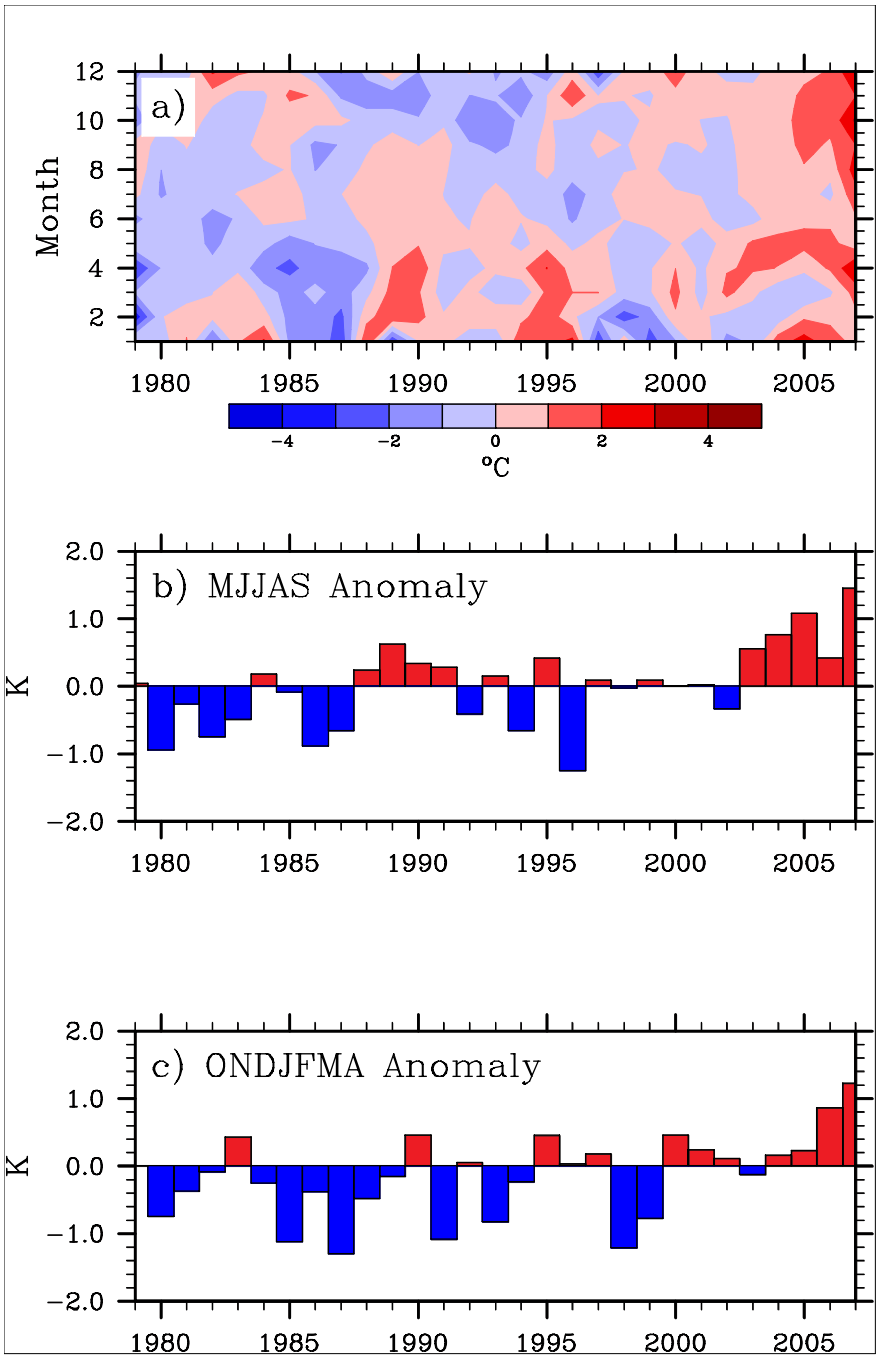

Figure 2. JRA-25 925 hPa temperature anomalies by year and month (top) and averaged for extended summer (MJJAS, middle) and extended winter (ONDJFMA, bottom) seasons. Results are for an Arctic Ocean domain. Anomalies are computed with respect to the period 1979-2007.

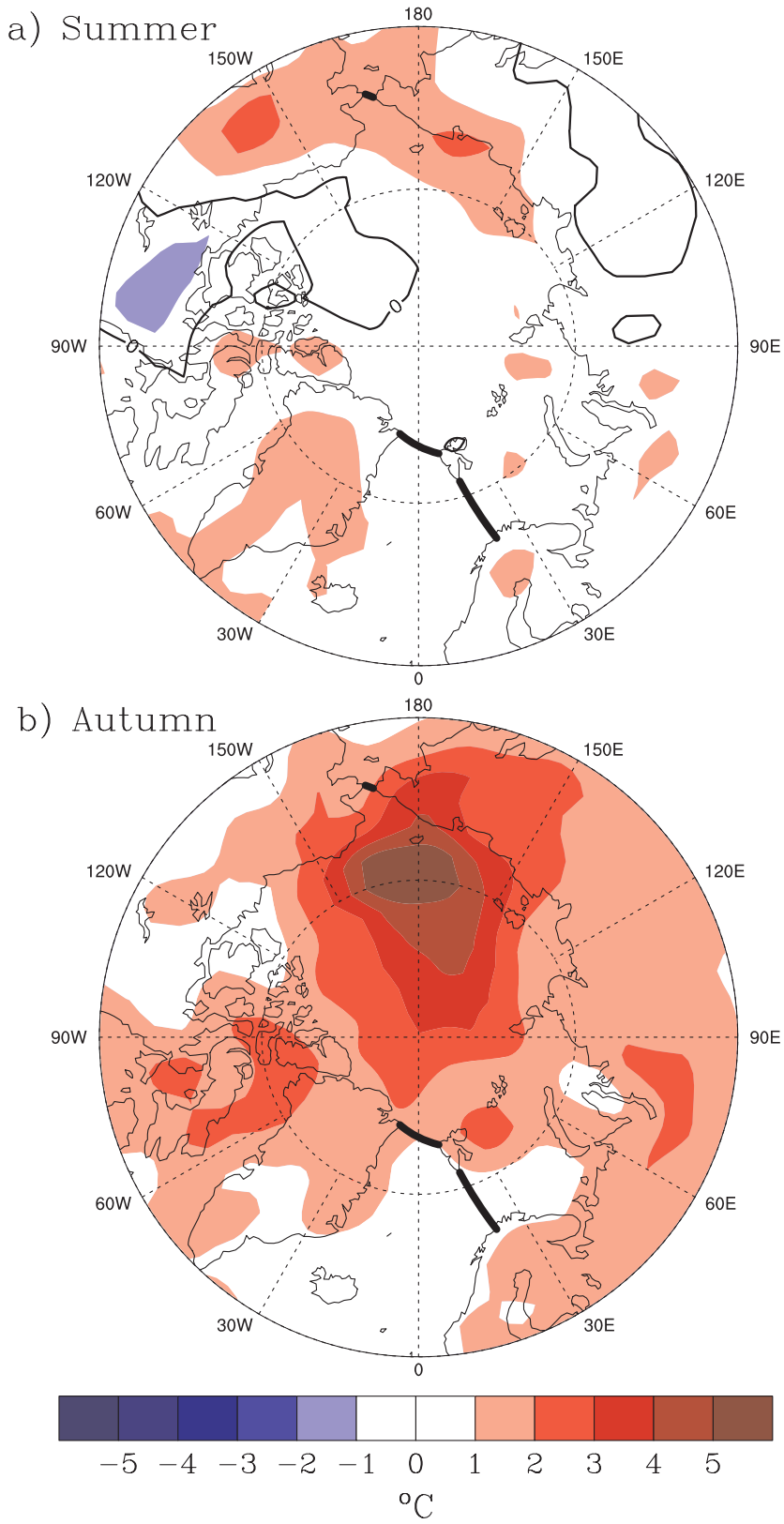

Figure 3. Surface air temperature anomalies from NCEP/NCAR reanalysis from 2002 to 2007, relative to 1979-2007 for (a) summer and (b) autumn.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

KEYNOTE ABSTRACT: Biodiversity and ecosystem services

Aevar Petersen
Icelandic Institute of Natural History,
Incoming Chair of the CAFF Arctic Council Working Group,
ICELAND

Arctic biodiversity and ecosystem services: How the Conservation of Arctic Flora and Fauna (CAFF) program can help

The Arctic covers 14.8 million km² of land and 13 million km² of ocean, including vast wilderness areas. Together with the Antarctic the Arctic holds the largest freshwater reserves on the globe but has also globally significant array of biodiversity and unique, diverse indigenous cultures. The Arctic ecosystems are critical to the biological, chemical and physical balance of the globe.

The natural resources in the Arctic are and have been used for millennia for hunting, grazing, fishing, and other resource use, more recently for commercial fisheries and tourism. Dramatic changes in biodiversity and ecosystem services are underway. For the economy of the region these changes can be both negative and positive. Changes generate threats to resilience and sustainability, and can have global repercussions for the planet's biodiversity.

Various pressures or stressors are taking place or are imminent. Climate change is predicted to cause greater warming in the Arctic than elsewhere, and this will be twice as severe over oceans than over land. Resource development is on the increase, such as oil and gas explorations, with increasing infrastructure, increased shipping and air traffic, leading to more extensive habitat destruction and fragmentation. Invasive species are a threat to indigenous biota, and potential overexploitation is a continuing challenge.

The Arctic Climate Impact Assessment (ACIA) report (2005) predicted rapid warming with worldwide implications. As a result there will be geographical and numerical shifts in Arctic biota. Coastal communities will experience increasing physical exposure, and

increased transport and resource access will result from less sea ice. Thawing disrupts infrastructure, and shifts will occur in important feeding areas for mammals and birds. These changes will have economic and cultural impacts for indigenous peoples, and elevated UV radiation will affect people and biota. Climate change, increased resource development, and other stressors will place greater pressure on Arctic biodiversity in the future. The results are multiple interactions impacting people and ecosystems. Increased challenges for Arctic people are inevitable as a result, both general relationship with and the economic use of the environment.

The Conservation of Arctic Flora and Fauna (CAFF) program is designed to establish more coordinated effort to conservation of Arctic biodiversity. CAFF is one of six working groups of the Arctic Council, with a focus on biodiversity conservation. Board members come from eight Arctic countries and six indigenous organisations. Observers are from international organisations and non-Arctic states. The CAFF mandate is *inter alia*:

- to address the conservation of Arctic biodiversity, and to communicate the findings to the governments and residents of the Arctic, helping to promote practices which ensure the sustainability of the Arctic's living resources …
- to monitor, assess, report on and protect biodiversity in the Circumpolar Arctic

What is urgently needed now for conservation of Arctic biodiversity is evaluation of status and trends, establishment of baseline data, and improving and enhancing capacity to monitor and understand changes. We need a more integrated approach to biodiversity monitoring on a circumpolar rather than a national scale. Such an approach allows for more coordinated gap analyses.

How is CAFF responding to these needs? CAFF uses several approaches of which there are two main but related programmes, the Circumpolar Biodiversity Monitoring Programme (CBMP) and the Arctic Biodiversity Assessment (ABA). Besides expert groups on seabirds, flora and protected areas, there are individual projects, e.g. ECORA which is an integrated ecosystem approach to conserve biodiversity and minimize habitat fragmentation in the Russian Arctic. CAFF furthermore endorses Arctic projects of others, which are considered important to Arctic biodiversity conservation.

The purpose of ABA is:
- to synthesize and assess the status and trends of biological diversity in the Arctic

Baseline information is gathered from the most recent scientific data and Traditional Ecological Knowledge (TEK) research, alongside identifying gaps in data records, main stressors and key mechanisms driving change, and producing recommendations. Co-leads are Greenland/Denmark, Finland and the US. ABA has three components; Arctic Biodiversity Highlights Report (2010), Scientific Report (2013), and lastly Overview & Policy Recommendations (2013). The Highlights Report is looked upon as an Arctic Council contribution to the UN International Biodiversity Year 2010, and measure of progress towards the 2010 CBD target … *to reduce the rate of biodiversity loss.* It will form a baseline for future assessments of Arctic biodiversity.

The CBMP has a direct link to the ACIA recommendation to:
- expand & enhance long-term Arctic biodiversity monitoring.

It is an international network to improve detection, to understand and to report on

biodiversity trends. It is looked upon as the biodiversity component of the Sustained Arctic Observing Network (SAON), if this is formed by the Arctic Council. The CBMP uses a ecosystem based management approach, currently with over 60 global partners, 33 of which are Arctic networks. CBMP is led by Canada, with current funding from Canada, US, Finland, Sweden, Norway, and the EU. It is a coordinating body of monitoring networks. Further details on the CBMP will be provided by Mike Gill, Chair of the CBMP, at the Monaco meeting.

One example of CAFF activity in focus, or a case study, is given on seabirds. The Seabird Expert Group (CBird) has main thrusts as follows:

- Identify principal conservation issues
- Develop conservation strategies and action plans
- Develop and implement an Arctic monitoring network
- Map seabird sites and analyse population trends
- Compile identified conservation issues and reporting
- Bi- or multilateral research on identified issues
- Contribute to other AC projects, e.g. oil and gas assessment

CBird has so far developed three conservation strategies, i.e. on eiders, murres, and Ivory Gull. The group attends to new, urgent conservation issues which arise and compiles reports on various issues, such as seabird harvest, bycatch, and disturbance. The status of individual species is currently under scrutiny (Glaucous Gulls, Arctic Terns). As part of seabird work breeding colonies are constantly being mapped (see figure) and Arctic data compiled for trend analyses in relation to stressors, e.g. climate change.

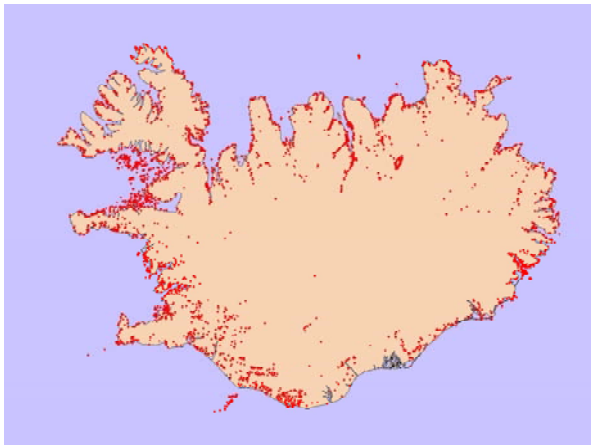

Figure 1: Distribution of Icelandic seabird colonies

CBird has developed a framework for an Arctic Seabird Monitoring Network, with the following main components:

- Colony monitoring
- At-sea surveys
- Harvest statistics
- Breeders/non-breeders lists
- Red lists

Physical and biological data needed for interpretation of results will be sought from other sources and partners outside CAFF.


Figure 2: *Ivory Gull. Photo: Maria Gavrilo*

One example relating to population trends includes the Ivory Gull (see figure 2), which is an entirely High-Arctic breeding species for which the Arctic countries have special responsibility. Its distribution is linked with Polar Bears, and the species is red-listed nationally and by the International Union for Conservation of Nature (IUCN). Dramatic decline has been observed in Canada (see figure 3) while Russia holds the bulk of the world population.

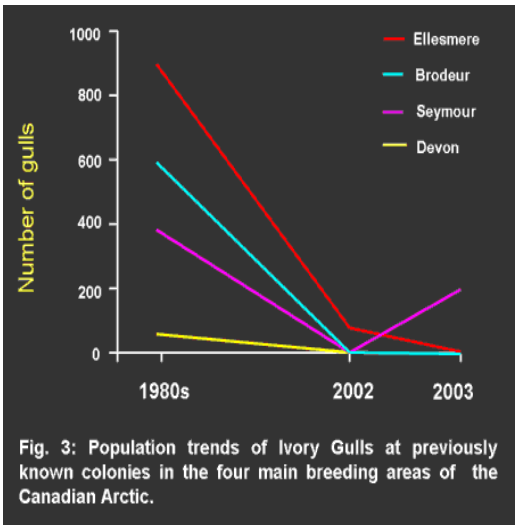

Figure 3: *Population trends of Ivory Gulls in Canada*

The Ivory Gull is a CAFF-priority species and an International Conservation Strategy and Action Plan has been developed for its conservation.

CAFF faces a number of challenges in its work. Perhaps the main ones are to ensure sustained funding, Arctic-wide participation and access to scientific and TEK information. Management and dissemination of data to stakeholders are also challenging, as well as continued political commitment. Identification and filling of obvious gaps in knowledge is an integral part of the work. Lastly, evaluation of the effects of stressors on biodiversity is ongoing and the research needed for interpretation of monitoring results.

Recommendations:

- Acknowledge challenges to biodiversity from climate change and other stressors

- Realising dependence of Arctic Peoples on biodiversity, and importance of Traditional Ecological Knowledge (TEK)
- Endorse Arctic Biodiversity Assessment (ABA) Highlights Report as a contribution to the UN International Year of Biodiversity 2010
- Endorse Arctic biodiversity monitoring through CBMP
- Recognise CBMP as a component of the Sustaining Arctic Observing System (SAON) and IPY legacy

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

KEYNOTE: Circumpolar indigenous peoples

Aqqaluk Lynge
President of the Inuit Circumpolar Council, Greenland

Facing the impact of global climate change: Recommendations from the Arctic

In the coming decades, the effects of climate change in the Arctic will include faster rises in sea levels, more frequent and extreme storm winds and flooding, a decrease in the extent of the sea ice, higher temperatures, and increased erosion due to higher waves, melting sea ice and thawing permafrost. Already, Inuit villages in Canada and Alaska are being destroyed by erosion. And Greenland hunters tell us that their traditional knowledge is not as reliable as it was in the past for predicting safe ice conditions.

Across the Arctic, Inuit are studying the effects of climate change and proposing many strategies for adaptation. The Inuit Circumpolar Council (ICC) has done much lobbying internationally, especially through the Arctic Council, to try to limit climate change and lessen its impact on indigenous peoples and their lands.

This past October, under the auspices of the Sustainable Development Working Group of the Arctic Council, ICC organised the "Symposium on Arctic Indigenous Languages" in recognition of the importance of language, culture and traditional knowledge to the health and sustainability of Arctic communities.

Inuit communities are very aware of the need for education and awareness-raising, among our own people and among global peoples, about sustainable development and climate change. In collaboration with our university in Greenland, Ilisimatusarfik, ICC Greenland is currently coordinating the establishment of a new "Centre for Indigenous Studies." Canadian Inuit have proposed the establishment of an Inuit Knowledge Centre and an Inuit Language Development Institute.

The ICC is seeking a post-Kyoto-2012 process that includes international cooperation to support urgent action on adaptation to climate change, and the engagement of Inuit in the development of a circumpolar Arctic science and research infrastructure. Next month, the ICC is hosting in Anchorage, Alaska a Global Summit on Climate Change that will bring together indigenous delegates and observers from around the world to exchange their knowledge and experience in adapting to the impacts of

climate change.

Notwithstanding such involvements, Inuit recognise that their capacity to achieve sustainable development in the face of climate change is dependent on their progress toward autonomy and self-government. Yet Inuit and their interests are being excluded from national and international deliberations on Arctic sovereignty. In acknowledgement of the right of indigenous peoples to self-determination, we believe that Inuit must be included, as active partners, in all future international and domestic policy making for the Arctic, and in all future deliberations on Arctic sovereignty.

Indigenous peoples are looking forward with courage and hope to a future filled with effective partnerships that will allow us to make our own contributions to the solutions of world problems and at the same time to protect our ways of life as unique groups of people. How should we work together, as partners, to solve the world's problems?

First, we need to forge meaningful and mutually respectful relationships among scientists, policy-makers, business leaders, funders and indigenous peoples. Second, we need to consult each other at the early stages of our research. Third, we need to share our knowledge and the results of our research with each other. Fourth, we need to make a commitment to each other as partners, recognising that we all have knowledge and skills that we can bring to our joint enterprises.

The magnitude of the climate change challenge is such that a response of a higher order is needed. Given the overwhelming extent to which the earth, and certainly the Arctic, have already changed, and the seemingly desperate situation in which we find ourselves, I dare say that something very strong and spiritual must happen if we are to survive. I think we need to find the ethical principles at the core of our humanity and create solutions to this very grave problem of climate change. Without these solutions, sustainable development in the Arctic will be impossible.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

KEYNOTE: Economic development and social transformations

Mead Treadwell
Chair, U.S. Arctic Research Commission

I thank the Prince of Monaco, the Secretary-General of UNESCO, and the organisers for inviting me to join this conference. I come as Chair of the U.S. Arctic Research Commission which reports to the President and the Congress on goals for U.S. Arctic Research Policy, and as an explorer, academic, and businessman. I believe the Arctic presents many opportunities to the world, and that expanding knowledge will help us be responsible as we pursue those opportunities.

1. Why the Arctic Matters…

The importance of the Arctic region of the world is often overlooked. It is overlooked, despite its strategic significance in the security of Europe, Asia, and North America. It is often overlooked despite its major contribution to the global economy, through its significant contributions of food and fuel. It is often overlooked, despite its major contribution to biodiversity from the lowest end of the food chain to the highest. It is often overlooked, despite its rich and enduring "ethnosphere" tying us to our past, and the contribution the Bering land bridge made as a venue linking the continents for prehistoric global human migration. It is often overlooked, despite its major role today in global aviation, and its potential role tomorrow in global shipping. It is often overlooked, despite the fact that natural processes in the cryosphere govern sea level, and regulate the climate of the earth itself, as the world's major storehouse of terrestrial carbon, and, with the southern polar region, as the reflector of major solar radiation through the high albedo of the polar ice cap. The Arctic is overlooked even for the contribution it makes to allow life on earth itself to exist…for it is the deflecting power of the magnetosphere, manifested at the North and South magnetic poles, which protects us from deadly solar radiation.

Dramatic change in the Arctic may mean our region is overlooked no more. People of the world increasingly understand that change in the Arctic affects them no matter where they live. With change, the Arctic now matters. People further

understand that without global action, many of the attributes of the Arctic we all hold dear may disappear in our time.

2. Timing of this meeting.

Thus, this meeting is important and timely. Many of the participants here have become good friends in the process of Arctic cooperation. When we work together, it is usually in a regional rather than global setting. We have a chance, in this UNESCO meeting, to stand back and look at the Arctic in the context of global issues. As a global forum, this meeting stands to reinforce responsible actions being taken in the Arctic region, and it could help bring attention and resources to the region. Moreover, the meeting can help us identify which precautions and protections are necessary for sustainable development in the Arctic. This can be achieved best with global action – climate change mitigation and a safe shipping regime come to mind. This meeting will help all of us prepare to take those actions.

In the United States, a Presidential decision document was released January 9, 2009, which revised U.S. comprehensive Arctic policy for the first time since 1994. The policy is focused on international objectives in the Arctic, and gave us a list of major work that needs to be done - from ratification of the U.N. Law of the Sea Treaty to increasing both bilateral and multilateral scientific cooperation. As a result of the policy, the U.S. will seek search and rescue arrangements in the Arctic. A regional fisheries agreement will be discussed. Our nation is now directed to work with others to see that shipping in the Arctic, as it increases, is safe, secure, and reliable. Mandatory ship standards, vessel traffic systems in areas such as the Bering Strait, and other agreements will be sought through the International Maritime Organization. Arctic-wide monitoring, referred to as the "Sustained Arctic Observing Network," to support a number of scientific research objectives, is another goal adopted by the policy. And access throughout the Arctic Ocean for scientific research – something enjoyed now in Antarctica, but not in the Arctic – is now an official objective.

3. Conclusions and Recommendations for the Conference

In this paper, I want to suggest four major forces of change occurring in the North and two forces now promoting further political cooperation in this region. Second, I offer two sets of recommendations I urge this conference to consider and adopt in its deliberations.

A. Conclusion #1: Four forces of change are giving the world an "accessible Arctic."

We are witnessing four forces making the Arctic region far more accessible the people of the world. They are:

- Dramatic change in the climate of the Arctic region
- Dramatic changes in transport, satellite communication, navigation and remote sensing technologies
- Increasing global demand for Arctic resources, including food, energy, and the convenience of its location between global population centres. Global demand for experiencing the Arctic's dramatic landscape and culture is also bringing more tourists to the region.
- The interest of Arctic residents to involve the outside world in improving living conditions in the North.

B. Conclusion #2: An "accessible Arctic" is accompanied by growing local and global political cooperation

In the response to these forces of change, listed above, two forces are helping to knit political cooperation in the North into a fabric which is stronger than ever, and is, in many ways, a model for the world in regional cooperation:

- Circumpolar proximity: the end of the Cold War allowed the governments of the eight Arctic nations, its regional governments, indigenous, business, academic and professional groups to take advantage of their proximity to work on common problems and opportunities. These efforts are resulting in increasingly stronger institutions. Sharing knowledge brings sustainability.
- Other nations, besides the "Arctic 8" are recognising national interests in the Arctic region. The observer list to the Arctic Council is growing. While most of the Arctic region will soon find itself within the sovereign boundaries of Arctic nations, global interest in the high seas region of the north, and in the global contribution of Arctic resources, has brought the question of global cooperation on Arctic issues to the forefront.

C. Overarching Recommendation #1: Keep exploring. Research in the Arctic is vital to understand Arctic change.

Arctic change requires us to keep exploring. New features underwater are being added to the charts, and new territory, uncovered by ice melt, is being added to the map. Understanding Arctic processes is essential to predicting the threats to the planet caused by tundra thaw, methane gas release, sea ice retreat, glacial ice sheet melting, changes to habitat, ocean currents, ocean salinity. I single out ocean acidification as one phenomenon caused by rising greenhouse gases. It is dangerous to shellfish stocks, and perhaps other species. More needs to be understood, and short-term mitigation options appear to be limited.

Within the United States, the Commission I chair will soon publish a report establishing goals for federal agencies conducting Arctic research. Already, detailed research plans are being formed, across the U.S. government, for each of the five research themes the Commission has set out:

- Climate change and understanding of the Bering Sea and Arctic Ocean ecosystems
- Arctic human health
- Arctic civil infrastructure
- Arctic resource assessment and earth science
- Preservation of indigenous languages, identities and cultures.

(On the last theme, the Commission is concerned that in the Arctic, we are losing indigenous languages in the space of a generation. Much human knowledge is lost when a language disappears.)

Each of these research themes I listed above would be better fulfilled with international cooperation.

The U.S. Arctic Research Commission is also putting special attention to several areas. We urge this meeting to address these issues in its own set of recommendations:

- **Shipping:** The Arctic Marine Shipping Assessment, being completed this April by the Protection of the Arctic Marine Environment (PAME), a working group of the Arctic Council, has been funded and directed in large part with resources from our agency. That assessment will show that regular Arctic shipping is not just a "future" thing, but is a "now" thing. Several global action items are included

in the draft recommendations being submitted to Ministers, primarily focused on proposals that would forward through the U.N.'s International Maritime Organisation. Business and government entities from around the Arctic cooperate now on improving oil spill prevention and response in the Arctic through a "Joint Industry Program" being conducted in Norway. We are urging the U.S., which increasingly relies on oil and gas produced and/or shipped in Arctic waters, to expand its contributions to this, and to domestic spill research programmes with similar objectives.

- **Health:** As we work to improve Arctic Human Health research in the U.S., the alarming epidemic of youth suicides in rural Alaska, primarily among indigenous youth, is of great concern. With the U.S. National Institutes of Health, we are cosponsoring a meeting on behavioral and mental health research issues in the Arctic in Anchorage in early June. An Arctic-wide health research conference will be held in Yellowknife, NWT, in July of this year. The potential death rate for Alaska's indigenous peoples is among the highest in the U.S., and we do not face this problem alone. International support for this effort would be welcomed.

- **Fishing:** The United States is finalising a moratorium on almost all commercial fishing inside its 200 mile exclusive economic zone in the Arctic Ocean. It is doing so even as preliminary research tells us that valuable fishing stocks are moving north. The United States will host an international conference this October, in Anchorage, Alaska, to discuss fishing with others interested in the fate of fish stocks and wildlife in the Arctic Ocean. One outcome of this initiative must be a stronger commitment to joint marine science in the Arctic Ocean and Bering Sea region. We have much to do, even with our closest neighbors, Canada and Russia. A second outcome might be a concerted effort toward a regional fisheries regime, recognised under international law. Appropriate proposals for marine protected areas should also be discussed.

- **Climate change mitigation:** As the nations from across the globe convene in Copenhagen in December to again attempt to establish an effective mitigation regime to stem climate change, the Arctic should get special attention. We are a resilient species living on a resilient planet, but it is not well-understood by residents of the temperate zone that a slight change in global average temperature is magnified, greatly, in the Polar Regions. With temperature magnification comes the potential destruction of many Arctic attributes we hold dear, and indeed rely upon. The Commission is urging a special assessment of the timing and level of greenhouse gas targets set on a global scale to understand how the range of options will affect the Arctic region. Some research we've seen suggests one course could return sea ice to a "normal cold" condition, with extensive multi-year ice, and that another course might see that ice gone for centuries. As well, our call for extensive Arctic monitoring comes because the contribution our region makes to the greenhouse gas and heat budget of the globe is not just from tailpipes, but increasingly from a reduced albedo effect resulting from declining sea ice. Warming causes greater carbon dioxide and methane releases from melting permafrost. A successful Copenhagen meeting is vital to a sustainable Arctic.

- **Monitoring and research platforms:** Last Wednesday, a ceremony in Geneva marked the completion of the International Polar Year, 2007-2009, where the world's science community came together to dramatically improve our knowledge of the polar regions. The Commission is working to ensure that whatever the scientific legacy is of this IPY, the first in 50 years, that we leave the Arctic "wired for sound" with an extensive monitoring system. The pan-Arctic science community is addressing this with plans for SAON: the Sustainable Arctic Observing Network. It is tied to global observing initiatives, such as the Global Earth Observing System of Systems (GEOSS). We face the problem of better "scaling" in climate prediction. Local observations must be used to support global decisions, and vice-versa. I appeal to this meeting to give strong support to this observing initiative. We also need support for other individual and mutual investments nations are making in Arctic research infrastructure – icebreaking ships, satellites, laboratories, cabled observatories, ocean buoys, and training for researchers to work with these assets.

- **Access to the Arctic Ocean for research:** there is a contrast between the access enjoyed by scientists in the Arctic and the Antarctic: The Antarctic continent and adjacent seas are open for research while access to the continental shelf of Arctic Ocean is not guaranteed. Ocean science cannot deliver results the world expects of it if national rules bar access to science. This shortcoming of the Law of the Sea needs to be addressed.

- **Energy:** Hydrocarbon production is a major source of revenue to several countries in the Arctic. Nations outside the Arctic depend on this energy, and all should work to ensure its safe development. We are working to expand renewable energy research and demonstration projects in the Arctic region. Hundreds, if not thousands, of Arctic settlements and villages are off national road systems and power grids, and energy is thus much more expensive. There is no better place to test newer, more costly technologies than where people are spending more money already for power and propulsion. An Arctic Energy Summit held in 2007 showed this is true across the Arctic region. Alaska is rich in tidal energy, hydrothermal, wind, and hydro potential, and has plans to use these sources for power generation, transportation fuels, and ultimately, export.

D. Overarching Recommendation #2: Keep cooperating: Global support for Arctic sustainability, with accompanying investment, is necessary.

The world should recognise and help strengthen the work of the many cooperative arrangements that focus on the Arctic. The Arctic Council convenes nations, and brings indigenous representatives as permanent participants to sit at the table. The Northern Forum convenes governors, and helps regional leaders find solutions to common problems. International cooperation in science and research is carried out by a number of bilateral and multilateral efforts, notably the International Arctic Science Committee, the International Union of Circumpolar Health, the Northern Research Forum, and the Pacific Arctic Group.

The fascinating situation of the Arctic is this: nations can dictate what happens inside their borders. Soon, those borders will expand with extended continental shelf claims allowed by the Law of the Sea (UNCLOS). Article 234 of UNCLOS allows other rules to be made in traditional ice-covered waters outside national boundaries. Nations in the region can act in concert, and issue harmonious rules or make joint investments,

as the U.S. and Canada have in the St. Lawrence Seaway/Great Lakes region to facilitate safe shipping. Even then, some parts of the Arctic Ocean will be extra-jurisdictional to any nation. In such a case, if rules are needed, they can be set only at the global level.

The United Nations has important work ahead on sustaining the Arctic. When it comes to protecting the Arctic from further abrupt climate change that we cause, or allowing rules to ensure safety of Arctic shipping, or reducing trans-boundary contaminants, sustaining trans-boundary populations of wildlife, or establishing extraterritorial marine protected areas, it is to the world diplomatic community that we have to turn to get the best results.

In the last year, the five Arctic Ocean nations have rejected the need for an Arctic treaty. Arctic treaty or not, our rulemaking must be comprehensive. Our common investments – in research and monitoring, in aids to navigation, in technologies and techniques to reduce greenhouse gas emissions – must also be robust. Thank you.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

KEYNOTE: Education for sustainable development

Lars Kullerud
President, University of the Arctic,
NORWAY

The United Nations Decade of Education for Sustainable Development
The goal of the United Nations Decade of Education for Sustainable Development (2005-2014), is to integrate the principles, values, and practices of sustainable development into all aspects of education and learning. UNESCO is the leading UN agency for the Decade of Education for Sustainable Development, and the objectives of the decade of are to

- facilitate networking, linkages, exchange and interaction among stakeholders in ESD;
- foster an increased quality of teaching and learning in education for sustainable development;
- help countries make progress towards and attain the millennium development goals through ESD efforts;
- provide countries with new opportunities to incorporate ESD into education reform efforts.

The Arctic and the World[1]

Today's world is more dependent on the North[2] than ever - a dependency that will only grow in the future. The North represents invaluable resources, globally vital ecosystems, an important platform to conduct research and understand our dynamic planet, as well

[1] This article is partly based on Uarctic Shared Voices, IPY legacy, 2008, authored by Kullerud and Snellman.

[2] The term "the North" is here used synonymous with the wider definition of the word "the Arctic", as it is used in the Arctic Council, Barents Euro Arctic council, by the University of the Arctic as well as by Arctic Indigenous Peoples (Permanent Participants of the Arctic Council). In this test Arctic is not limited to the high Arctic i.e. Arctic ocean with its archipelagos. Many discussions and articles often confuse those two possible understandings of what is the Arctic.

as a dream of a different land: a pristine part of the earth for the mind to explore. Seen from the south, the Arctic may be a frontier or a modestly relevant periphery, but the Arctic is also a fifth[3] of the earth's surface, and similarly important for the services the nature provides to humankind. Sustainable development of this region is thus critical to the rest of the world.

The North has been a homeland for people for thousands of years. For a few centuries it has been an arena for exploration, exploitation, and land claims by national states. The last decades have given us a melting of the political ice but also melting of sea ice from rapid climate change. The Rovaniemi process, which started in 1991 led to a unique partnership between governments and indigenous peoples to safeguard the Arctic environment and ensure the sustainable development of the region through what is now the Arctic Council. Now, 18 years later, it is more imperative than ever that indigenous and state political leaders work in cooperation with local communities, academic institutions and the private sector to build a resilient and strong North.

Challenges for the North

As a source of vital resources, the North for centuries has been managed as a distant "colony" within each nation state. It has been a place where one sends experts, soldiers, doctors, managers, workers and teachers, while resources and young northerners are sent to the South. The new international cooperation, different types of local governance, and the establishment of new higher education and research institutions, all show hope for a new future. The North can become a region which is empowered to provide goods and services globally on equal terms with other regions in the world.

The norths of the different Arctic States face many similar challenges. They need to build capacity for daily governance, develop human as well as natural resources in a sustainable way, create jobs and develop opportunities for their population. Furthermore, they need to provide the world with vital resources like lumber, metals, fish, oil and gas, and services like transportation routes, pristine nature for recreation, and local knowledge about the North as well as opportunities for research vital to understand the earth system. These developments need to be done in a region with an extremely low population density, and a history of "colonial style" management by the national capitals.

Unfortunately the North has generally been perceived as a periphery, and investments in education have historically been done from a 'help' and 'frontiers' perspective, even if there are shining exceptions in several countries. The governments of the Arctic countries have met the challenges of the north with school systems more often identical to the system provided in large towns in the south, than with education systems adapted to local needs. Different kinds of higher education institutions in the North have been established, ranging from those focusing on training students for the local job market through professional education, to science based universities, often modeled on higher education institutions in the southern parts of the country.

Primary and Secondary education

The UNESCO led "Education for All" movement has led to a Canadian and Norwegian Arctic initiative which produced a preliminary overview[4] report on the state of education in the Arctic. This report confirms the general picture described above, and the findings

[3] Dependingding on the definition, Arctic may be from 14-20% of earth surface

[4] Rønning & Wiborg: Education For All in the Arctic? A survey of available information and research; Nordland Research 2008.

also expressed in the Arctic Human Development Report[5] and by Indigenous leaders of the Arctic.

There is a clear correlation between the level of education and income in the Arctic. An important observation[6] is that both those completing an ordinary school system and those who receive good training in traditional skills have better economy than those who drop out from traditional or ordinary forms of education. Not surprisingly, do those who have higher education have the highest income in the communities.

Arctic communities, and in particular rural areas, face high drop-out rates in primary and secondary school. There is for all of the Arctic a history of education systems that tried to force central school models on local people including different degrees of suppression of local language. This is today improved to various degrees in the Arctic states. Lack of skilled teachers with local roots, in particular in rural areas, is a circumpolar challenge.

Even if there are exceptions, the school systems provide an education modeled by western values and content and local and traditional knowledge is only valued in good-will speeches and normally not valued in admission to further education, jobs, or in evaluations of education systems. The education is normally driven by central norms and poorly fit the local needs, and does not provide education and training relevant for local job markets. This leads to a continuation of the old system with a high degree of unemployment, import of, often short term, experts, and outmigration of youth. It is normally the females that leave and males who stay behind, leading to many social problems.

It is time for a shift from viewing knowledge as a standardized commodity to seeing it as a distributed resource, decentralization of control and decision making in education and local adaptations of curriculum, and increased use of alternative approaches to access knowledge from any place at any time[7].

Higher Education

There is a global trend towards bigger units and more centralization both in the private and public sectors. This is a general challenge when one aims at sustainable development of the sparsely populated Arctic region. This trend is also evident in higher education: larger universities provide the benefit of more comprehensive programming, the ability to develop world class research in some areas, and the capability to promote themselves in a competitive research and education market. This strategy, based on the need to be robust, dynamic and well known in one's own right is resource demanding and, therefore, a driver towards larger entities.

The less populated North cannot easily host comprehensive universities and professional education institutions with a size that can match this development. It is, however, not the total size of a university which determines its excellence in a specific area at a given time, as good research groups tend to be modest in size. Many of the same challenges can be solved by smaller institutions if they cooperate in networks , share resources, and divide roles in an efficient manner. The circumpolar network of smaller and larger institutions can form the critical mass for expertise in any field by their collective size. Through a well organized network, partnering universities will be better equipped than any single institution, even if large, to develop and maintain world class excellence in several disciplines as well as foster education, research, and training, that

---

[5] Arctic Human Development Report, http://www.svs.is/AHDR/

[6] Poppel et al. http://www.arcticlivingconditions.org/

[7] Rønning & Wiborg: Education For All in the Arctic? A survey of available information and research; Nordland Research 2008.

is relevant to sustainable development of the Arctic region.

To address this the Higher Education institutions in the circumpolar north have formed the University of the Arctic (UArctic). UArctic allows for a dynamic development of the shared education systems through this kind of cooperation. Smaller learning centers can provide relevant quality education for people who seek higher education within their community or region, based on curriculum developed through circumpolar cooperation. The same learning centers may be developed to serve the infrastructure needs of shared research projects and thus benefit universities that do not have access to such infrastructure. A complete network in the Arctic Region can be a very efficient tool to deliver relevant curriculum for a changing North.

Research

The global academic community has practiced international cooperation in Arctic research since the first Polar Year 125 years ago. It laid the groundwork for a century when the Arctic has become an increasingly attractive arena for scientific research. The International Polar Year, now ending, represents hope for a future with intensified research and increased attention to the Polar regions, including the human perspectives. The people of the North are no longer only an object of study; instead, indigenous peoples and other northerners together take active part in the development and governance of the region, and in defining the research agenda for the North, with "shared voices". After this IPY the global research community, in particular that located in southern latitudes, who seek to study in the North, will benefit from partnering with a growing well educated northern population and the Arctic higher education and research structure.

The University of the Arctic is ready to take the lead to provide stewardship for a sustainable long-term legacy of the Polar Year in higher education and research cooperation in the Circumpolar North that promotes both western academic traditions as well as traditional and indigenous knowledge in the northern knowledge base. It is a goal we hope we share with the whole science community, that future leaders of polar science are just as likely requited among youth from the North than from today's southern based research communities. UArctic will provide this leadership in close cooperation with the global polar research community, in particular the major polar science organizations, IASC and SCAR, as well as IASSA. We hope that UNESCO and other global organizations will support this endeavor.

Further, UArctic is committed to ensuring that the northern universities and colleges become key players in the development and sharing of knowledge in and about the North and that such knowledge is based on indigenous and local traditional approaches as well as modern science approaches to knowledge generation and sharing.

The University of the Arctic

Practically all northern universities, colleges, and organizations engaged in higher education have come together in the University of the Arctic (UArctic), currently a network of 116 members. The leaders of UArctic higher education institutions have signed a declaration, the UArctic Charter, which demonstrates an unparalleled will to share resources and goals across national and institutional boundaries to ensure research, education and training in and about the North. The ambition is for a dynamic UArctic that uses its members' resources and capacity in a flexible and adaptive manner to meet the needs of the North as it changes over time.

UArctic members are ready to take a collective responsibility as leaders of

research and education relevant to northern communities both to serve the North's internal needs as well as the equip the North with the capacity to serve the rest of the planet. In UArctic, through its members, the North has the higher education opportunities needed to ensure leadership and competence to develop its own relevant strategies for knowledge generation and sharing, as well as for education to ensure sustainable development of the north.

Recommendations:

UNESCO's International Experts Meeting is recommended to adopt the following:

- Emphasizing the importance of relevant education, research, and knowledge building for sustainable development of the Arctic both to benefit Arctic Inhabitants and its Ecosystems as well as to ensure sustainability of the goods and services from the Arctic the rest of the world is so dependent on
- Acknowledge both western science and research as well as Indigenous and local traditional knowledge as basis for knowledge generation and sharing
- Recognising that concerns about the Arctic regarding environment, climate, and adaptation to global change can only be solved with an Arctic population equipped and sufficiently skilled to address these challenges.
- Encourage Arctic states to work together to develop primary and secondary education systems that are flexible and relevant to the population and that relevant adjustment to education systems and education of relevant teachers with a local knowledge base is prioritized
- Recognise the potential of the University of the Arctic network among all the higher education institutions of the Arctic and recommend to UNESCO and other international organisations that promote higher education to use this network in their Arctic Initiatives
- Recommend that UNESCO establish an Arctic initiative, where Science, Higher Education and primary education are seen as a whole, based on amongst other the Education for Sustainable development and Education for all initiatives

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

KEYNOTE: Environmental ethics

Johan Hattingh
Professor of Philosophy,
Stellenbosch University,
SOUTH AFRICA

Sustainable development of the Arctic: A view from environmental ethics

In this paper I will argue that the principles of environmental ethics can make a substantive contribution towards sustainable development in the Arctic in the face of global climate change, if we are prepared to put some work into it, and take seriously considerations from a variety of angles from within this newly established field of applied ethics. I will argue that it is not a single principle, but rather a network of values and ideas working together that can create this positive contribution, and that a thorough, critical understanding of this network can provide a platform on the basis of which we could at least start a rational conversation among the key stakeholders who have a direct and critical interest in establishing what it would entail to ensure sustainable development in the Arctic in the context of the challenges of global climate change. Thus, I will argue in this paper that the complexity of the challenge will require a complex environmental ethics. The most important nodal points in this web of considerations, have to do with the following:

The history of the emergence of environmental ethics

Since its emergence in the 1970s in response to concerns about industrialization, pollution, nuclear war, the depletion of natural resources, the destruction of nature and ecosystems, the unjust distribution of the benefits and burdens of industrialized society, a continuously growing population and the ability of future generations to meet their needs, environmental ethics has gone through various stages of development, exploring a wide variety of intellectual avenues and value orientations. However, in all of its diversity, environmental ethics seems to have one central message: that current patterns of production and consumption in the world has put the flourishing, as well as the survival, of all life on earth under serious threat, and that something seriously should be done to reverse this trend. In its theoretical form all forms of environmental ethics entail, each in their own way, a search for a language, or a value theory that is profound

enough to articulate this message and support the practical task it alludes to (Rolston 1991; Attfield 1994).

Since its inception, one of the defining characteristics of environmental ethics is its suspicion and critique of instrumental value theory in which intrinsic or inherent value is reserved for humans (or for some humans, for that matter) only, leaving everything else with nothing but resource value: it has no value other than some kind of use value to humans. This view is challenged by many environmental ethicists who argue that humans cannot be the only morally valuable entities on earth, and that some intrinsic or inherent value can be discovered and appreciated in non-human entities – which not only include non-human living entities such as individual animals and plants, but also larger entities such as species, communities of life, ecosystems, and even non-living entities such as land, landscapes, regions, geographical formations, water cycles, carbon cycles etc.

From this perspective, different forms of animal, nature, wilderness, life or ecosystem oriented ethics were articulated, each emphasizing the meaning, significance and implications of acknowledging some inherent (non-use) value of parts or the whole of nature, generating still raging debates about the basis or sources of this inherent value: does it exist objectively, independently of all human valuing, or is this inherent value anthropogenically constituted by the very act of human valuing? While this ontological-epistemological debate about anthropocentrism and intrinsic value dominated much of the debates in environmental ethics during the 1970s and 1980s, the emphasis started to shift to a set of socio-ecological questions that are still hotly discussed to this day: should we at all accept the notion of an isolated and decontextualized nature “out there” that should be conserved, or rather work with the idea of interconnectedness in which entities become what they are because of their relationships with others – which implies, among other things, that humans and natural entities are not atoms interacting externally with one another, but mutually constituting one another, as nodal points in a web of life (Brennan 2009: 373; Naess 1973).

This last set of questions paved the way for a wide variety of concerns that currently preoccupy environmental ethicists, such as the restoration of damaged land, urban environments, pollution and resource depletion and their connections with poverty, dispossession, housing, environmental and economic policy, social justice (Brennan 2009: 376), and learning again how to live sustainably in a place. Similarly, more and more emphasis has been placed in recent developments in environmental ethics on participative decision-making procedures in which interest groups in local communities work together with authorities to find solutions to socio-environmental challenges within the contexts and time scales that they will be experienced – not only by humans, but also by other members of the community of life. Since these participative decision-making procedures are never politically or ideologically neutral, and since their success is never guaranteed because of asymmetrical power relations, some streams in environmental ethics also focus on radical ideology critique, as well as strategies to translate that into a fundamental transformation of society, including organisational forms, thinking patterns, and processes of identity formation and self-realisation. Within the latter context, the “environmental crisis” is seen as an opportunity to free humanity from the burden of a destructive praxis, and to start moving towards a cultural, political, social and economic revolution that may move us beyond our current predicaments.

Challenges related to the dominant decision-making model informing resource extraction in the Arctic

Much of the intellectual effort in environmental ethics is devoted to an analysis and critique of the dominant, decision-making model informing economic thinking the world

over: cost-benefit analysis. While cost-benefit analysis in its cruder forms is an easy target for the critique that its internal logic opens the way to any and all forms of environmental pollution and destruction, as long as this is offset by an aggregate of more gains than losses, cost-benefit analysis in its more sophisticated and refined versions are also not exempted from criticism, even if it is moderately successful in internalizing externalities in various forms of full-cost accounting. The difficulties that many environmental ethicists have with this model of decision-making, is that it allows for only one kind of value to be accounted for – resource or use value – while there are many other kinds of values that need to be taken into account when decisions are made about resource extraction and its transformation into commodities. The challenge is, therefore, how to make provision for these other kinds of values in economic policy and decision-making, if the dominant model precludes them from the start.

Environmental justice issues in the Arctic

Environmental justice issues emerge when the benefits and burdens of resource use, or of conservation, are distributed unequally within or between societies, regions, nations or generations. While examples of such unequal distribution are often fairly easy to point out, and while the excruciating details of many instances of such injustices are well-documented, the ethically vexing question that begs to be answered, is why it is at all possible that cases of environmental injustice continue to emerge in an apparently never-ending stream; and when they have been exposed and made public, why it is apparently so difficult to address and overcome these injustices – for instance to claim compensation for harm suffered, or restitution for past unequal treatment.

For the purposes of our discussion on the prospects of sustainable development in the arctic in the face of global climate change, it seems as if a special kind of analysis is called for (if it is indeed the case that people indigenous to the Arctic are suffering from environmental injustices): one that focus on the one hand on the social, political and economic processes and structures through which victims of environmental injustice are created; and on the other hand, the linguistic and symbolic strategies through which these injustices are legitimized, glossed over, and removed from the realm of public scrutiny, discussion and critique, and thereby reinforced and perpetuated. One task of such an analysis will surely be to expose these processes, structures and strategies, and to show the way towards effectively resisting them and subsequently moving on from what is exposed. Another task will entail devising strategies of assisting and supporting the victims of environmental injustices in the different phases of their exposure and resistance to it, as well as in the different stages of “rehabilitation” – which are tasks that in fact fall squarely within the realm of advocacy, or, if you will, environmental ethics in practice.

Fault lines in the notion of sustainable development

Given that the main characteristic of the world’s economic system seems to be that of un-sustainable development, and given that the term sustainable development can mean anything to anyone, it is important to ask serious questions about the concept of sustainable development itself, and how it is related to development in the Arctic. One of these questions that need to be asked, is how the notion of sustainable development can regain its critical, normative edge; and this in turn can be done by recognizing the fields of tension that emerge between different possible interpretations of sustainable development. These fields of tension are captured in the differences between weak and strong interpretations of sustainable development, egalitarian and non-egalitarian interpretations of it, bottom-up and top-down models of implementing sustainable

development, and narrower or wider interpretation of its scope, where narrower interpretations focus on nature conservation only, while wider interpretations view nature conservation as but one of many goals that should be pursued in sustainable development. (Jacobs 1999) Accordingly, a number of test questions can be formulated with a view to distinguishing between notions of sustainable development that leaves the world as it is, and notions of it that strive to make a difference. The questions include the following: What is so important that it should be sustained indefinitely? For the sake of whom or what should we sustain this valuable something? How should we do so? By making use of which kinds of knowledge? What are the appropriate indicators so that we can know if we move towards sustainable development or further away from it?

The characteristics of global climate change

The characteristics of global climate change makes it very difficult to develop an ethics of responsible action with regards to the mitigation of its causes and thus its intensity, and adaptation to its effects. Gardiner (2004; 2006) argues that these characteristics include a dispersion of causes and effects, the fragmentation of agency, and institutional inadequacy that plays itself out in both the global and intergenerational contexts, and that in there mutual interaction, these characteristics can place us in the untenable positions of resignation and inaction in the face of global climate change, or of having to make tragic choices in the process of defending ourselves against the negative effects of climate change. As such, these characteristics challenge our conventional modes of moral decision-making, and compel us to rethink our notions of responsibility, accountability, harm, justice, human rights etc.

* * *

Having said this, and taking into account that life in the Arctic, like life in Antarctica, is lived at the margins of its very possibility (Rolston 2009), I conclude that the conventional values emphasized in environmental ethics (such as the inherent value of non-human entities, the beauty of nature, the ruggedness of wilderness, the flourishing of biodiversity, the resilience of ecosystems, respect for the community of life, the constitutive function of relations and differences, the transformation of society, the limitations of our knowledge, and the power of the precautionary principle, to mention a few (see Ten Have 2006)) can acquire radically new meanings and connotations if related to the challenges of sustainable development in the Arctic in the face of global climate change. We could choose to ignore these meanings and leave the world pretty much as it is, but we could also choose to articulate and explore these meanings with a view to acknowledging the scope and limitations of our knowledge, to sharpening our abilities to determine what the morally right things to do are, to determining what we can legitimately hope for, and thus contributing to changing things in the world, changing what we have become in this world.

Recommendations:

- When we deliberate on serious issues like sustainable development in the Arctic in the face of global climate change, we tend to go directly from problem formulation to policy proposals or action, without reflecting on the aims, the extent and the justification of these policies or actions. (Ten Have 2006)
- Fundamental ethical questions should be asked about the manner and language in which we formulate the challenges of sustainable development and global climate change, and link it to a particular region on the earth.
- Some of the questions that need to be asked in such a fundamental questioning are:

    - What does the notion of sustainability and sustainable development mean?
    - What is so important that it should be sustained indefinitely?
    - For the sake of whom or what should we sustain this valuable something?
    - How should we do so? By making use of which kinds of knowledge and which kinds of decision-making procedures?
    - What are the appropriate indicators so that we can know if we move towards sustainable development or further away from it?
    - How do the characteristics of global climate change affect our ability to appropriately interpret the conventional environmental values offered to us by environmental ethics?
    - What difference, if any, do the characteristics of the Arctic make to our ability to appropriately interpret the conventional environmental values offered to us by environmental ethics?
- There exists a real danger that we can interpret sustainable development in such a manner that it makes no difference at all, leaving the world pretty much as it is.

Bibliography

Attfield, R. 1994. *Environmental Philosophy: Principles and Prospects.* Aldershot *et al*., Avebury.

Brennan, A. 2009. Environmental philosophy. In: J. Baird Callicott and Robert Frodeman (eds.), *Encyclopedia of Environmental Ethics and Philosophy*, Detroit *et al.*, USA: Gale, Cengage Learning, pp. 372 – 381.

Gardiner, S. M. 2004. Ethics and global climate change, *Ethics* 114, (April 2004): pp. 555 – 600.

Gardiner, S. M. 2006. A perfect moral storm: Climate change, intergenerational ethics and the problem of corruption. *Environmental Values*, 15 (2006): 397-413

Jacobs, M. 1999. Sustainable development as a contested concept. In: Andrew Dobson (ed.), *Fairness and Futurity. Essays on Environmental Sustainability and Social Justice*. Oxford: Oxford University Press.

Naess, A. 1973. The shallow and the deep, long-range ecology movement. *Inquiry* 16: pp. 95 – 100.

Rolston III, H. 1991. Environmental ethics: Values in and duties to the natural world. In F. Herbert Bormann and Stephen R. Kellert (eds.), *The Broken Circle: Ecology, Economics, Ethics*. New Haven: Yale University Press.

Rolston III, H. 2009. Antarctica. In: J. Baird Callicott and Robert Frodeman (eds.), *Encyclopedia of Environmental Ethics and Philosophy*, Detroit *et al*, USA: Gale, Cengage Learning, pp. 53 – 58.

Ten Have, A.M.J. (ed.) 2006. *Environmental Ethics and International Policy*. Paris: UNESCO Publishing.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

KEYNOTE: MONITORING AND OBSERVING SYSTEMS

Joan Nymand Larsen
Stefansson Arctic Institute &
University of Akureyri
ICELAND

Arctic Monitoring Systems

The Arctic Human Development Report (AHDR), ACIA, the International Conference on Arctic Research Planning (ICARP II), projects of the IPY, and others, have documented in detail the changes occurring in the Arctic and the need for monitoring to assess the impact of change. Arctic societies and cultures are faced with multiple stressors and challenges related to the ongoing and combined effects of environmental processes, industrial development, cultural development, and economic changes. The Arctic Human Development Report (AHDR, 2004) presented the first overview of human development in the Arctic. The goal of the AHDR was to identify and synthesize existing knowledge in the interests of presenting an integrated picture of human development in the Arctic. The report details the challenges faced by Arctic societies, and shows that Arctic peoples are susceptible to changing environmental conditions. It concludes that Arctic societies have a "well-deserved reputation for resilience" in the face of change. But today they are facing an unprecedented combination of rapid and stressful changes.

The ICARP II process also identified critical research needs and outlined practical steps and organization to be considered. One such proposal was the establishment of coordinated and integrated Arctic observation systems that focus on social, biophysical, and ecological dimensions and include local- to global scale monitoring; and the build up of a meta-database of case studies on socio-ecological change and with it, a standardized format and common set of key variables. Indeed, ICARP-II, ACIA, IPY projects – in particular SAON (Sustaining Arctic Observing Networks) - and many others, have pointed to the need for close and long-term monitoring of Arctic change, including observations and data management. Improved monitoring of the Arctic is needed to gain full understanding of these processes and their impacts.

The IPY project on Community Adaptation and Vulnerability in Arctic Regions (CAVIAR) is a programme of interdisciplinary research to identify insights essential for the development of adaptive responses to changing conditions in the Arctic (CAVIAR,

2008). The purpose of CAVIAR is to better understand how Arctic communities are affected by environmental changes in order to contribute to the development of adaptive strategies and policies. Data collection or monitoring of change is part of the CAVIAR programme. The programme seeks to characterize vulnerabilities or risks, to document the processes and forces that facilitate adaptation or management of risks, and to identify and evaluate means to improve the capacity of communities to adapt to changing conditions. This involves interdisciplinary integration and collaboration with Arctic community partners (CAVIAR pp. 2-3).

Among the gaps in knowledge and action with respect to the challenge climate change poses for Arctic sustainable development are the lack of Arctic monitoring systems, coordination of Arctic observing, timely and reliable data, and long-term commitment to funding of observing networks. The amount of research on climate change and its impacts is growing, but significant gaps in knowledge concerning the nature of global change risks and ways to deal with them persist. Environmental and societal changes and other processes occurring at a rapid pace, combined with limited observational infrastructure, and a lack of timely, appropriate and reliable data and information networks, present Arctic stakeholders, government and the research community with new challenges. In social science research, new demands are placed on access to data for the study and modeling of these processes, and for understanding, measuring and predicting the impacts of change on social systems at various scales, and understanding the links with the rest of the world and their feedback mechanisms. The integration of knowledge across disciplinary boundaries adds to data and information requirements. We lack access to relevant, reliable, accurate and timely data and information, and data which is appropriate and relevant to the Arctic context. Much data is currently based on southern or national data protocols, where models are often designed and legitimated in institutional contexts outside the Arctic. There is a lack of more complete data sets that enable more comprehensive and accurate research and analysis at various scales, across disciplines and across the circumpolar Arctic, and that can facilitate comparisons and contrasts, modeling, evaluation, assessment and monitoring of changes and their impacts. As well, there is a need for timely and more conclusive data and information from the natural sciences, e.g. for studies of the socio-economic impacts of climate change. A more complete understanding of the current and future environment requires access to year-round data, including improved and disaggregated data series.

The Sustaining Arctic Observing Networks (SAON - www.arcticobserving.org) – the collective effort of 350 Arctic researchers - is one of the most recent developments in Arctic observing and monitoring. An IPY and Arctic Council project, SAON's work on monitoring and observing across interdisciplinary boundaries has contributed significantly to moving us closer to a pan-Arctic observing system. As stated in the SAON report (2008), SAON is a process to further multinational engagement in developing sustained and coordinated pan-Arctic observing and data sharing systems. The goal of such a system is to serve societal needs, particularly related to environmental, social, economic and cultural issues (SAON, 2008). In its 2006 Salekhard Declaration, the Arctic Council agreed to "urge all member countries to maintain and extend long term monitoring of change in all parts of the Arctic, and request the AMAP to cooperate with the Arctic Council Working Groups, IASC and other partners in efforts to create a coordinated Arctic observing network, that meets identified societal needs". "The foundations of SAON are the existing networks and programs that already provide high quality Arctic observations" (SAON, 2008).

Better coordination within and among existing networks is needed. There are currently several observing systems, observatory networks, evaluation/assessment

programmes, monitoring programmes, indicator projects, and Arctic data bases. A range of problems and limitations related to data and observing sites were identified during the SAON process: Arctic observing sites do not adequately cover the Arctic region, observing data are fragmentary and not easily available, and only a part of the Arctic observing is funded on a long-term basis (SAON, 2009). The work of SAON is an important new development in the effort to achieve better coordination within and among existing observing networks and the broad range of existing programmes.
A key SAON recommendation is to create the Arctic Observing Forum (AOF).

The AHDR (2004) identified several gaps in knowledge that has relevance for Arctic data and monitoring activities. The report recommended a series of follow-up activities including the construction of a small number of indicators to be used in monitoring changes in human development in the Arctic over time. The Arctic Social Indicators (ASI) project - a follow-up to the AHDR - is working toward filling this critical gap. The Arctic Social Indicators (ASI) project seeks to fill a critical gap in user needs in Arctic research and data information. ASI has been identified as one of the potential human dimensions' building blocks within the AOF recommended by SAON. ASI aims to devise a limited set of indicators that reflect key aspects of human development in the Arctic, that are tractable in terms of measurement, and that can be monitored over time at a reasonable cost in terms of labour and material resources. The development of indicators fall within six domains, all of which seek to address key aspects of human development that are particularly prominent in the Arctic: Fate control and or the ability to guide one's own destiny; cultural integrity or belonging to a viable local culture; contact with nature or interacting closely with the natural world; material well-being; education; and health/demography. Such a database with unique long-term series of data could be immensely useful to decision-makers, planners, and others concerned with the future of the Arctic. The work on Arctic social indicators is directed at a broad audience, including the science community, inhabitants of the Arctic, policymakers at all levels, and in particular the Arctic Council and its Sustainable Development Working Group (SDWG).

The construction of valid and useful indicators is a challenge. Indeed, several of the indicators suggested by the ASI team have weaknesses related to availability of data, affordability, and level and applicability to both indigenous and non-indigenous inhabitants of the Arctic. To be valid for tracking and monitoring an indicator should be the most accurate statistic for measuring both the level and extent of change in the social outcome of interest. It should adequately reflect what it is intended to measure, and ideally there should be wide support for the indicators chosen so they will not be changed regularly. It is critical that the chosen indicators are consistent over time and across places, as the usefulness of indicators is related directly to the ability to track trends over time and compare the well-being of regions. The chosen indicators should do well in terms of selection criteria such as data availability, ease of measurement, internal validity, affordability, robustness, applicability at various levels (household, local, regional), and applicability to indigenous as well as non-indigenous populations. To advance beyond the AHDR, ASI seeks indicators that can be compared for geographies more specific than the general Arctic regions. One obvious limitation is data availability. Statistical agencies do not provide breakdowns below certain minimum thresholds of population counts for example. Although specific thresholds vary from country to country, they sometimes preclude the release of accurate data on small Arctic communities, or make the released data a patchwork of true and artificially rounded or suppressed numbers. Communities with populations of a few hundred or a few thousand people can be of great interest to social science and policy makers, but social indicators on this scale must be interpreted with care.

At the outset of ASI, the stated intent was to identify a small set of indicators of human development relevant to the Arctic that could be monitored at reasonable cost. The ASI team hoped that “reasonable cost” could be operationally defined in terms of indicators that are based on existing information. The team also agreed on that a good indicator should have a clear meaning relevant to one or more of the six domains of Arctic human development (health and demography, material well-being, education, cultural integrity, contact with nature, and fate control); be sensitive to change over time; be available at least down to a regional level; and be applicable to, and reported separately for, indigenous and non-indigenous populations. This has proven to be a challenging task. The recommendations of the ASI deal with data issues and the need for an Arctic Social Indicator monitoring system. The Arctic Social Indicator monitoring system would meet the following objectives: data are available at a regional level; data are available separately for indigenous and non-indigenous populations; data are available on at least a five-year reporting period. Depending on the indicator and the nation one of three levels of effort are required to meet these monitoring objectives: Data are collected by a national agency and published in hard copy or electronic form; data are collected by a national agency and require special tabulations to be made available; data require primary data collection.

Creating and refining suitable indicators of human development in the Arctic will take time. It involves a step-wise process in which initial proposals are vetted empirically and refined or replaced over time as our ability to capture the essential features of human development under the specific conditions arising in the Arctic rises. Viewed in this light, the work of the ASI constitutes a significant step forward in moving us toward an ability to track trends in key elements of human development in the Arctic and, as a result, guiding discussions regarding questions of policy. A follow-up to ASI is being planned which aims to test, refine, and implement the ASI indicators, with the overall goal to help facilitate the monitoring of change in human development in the Arctic. The first phase of the ASI project developed a social indicator system, having identified a set of Arctic-specific indicators to monitor human development and quality of life in the Arctic. The next phase of ASI aims to implement the constructed indicators, by testing, validating and refining the indicators across the Arctic, and then to measure and perform analyses of select cases, with the ultimate goal of moving toward adoption by Arctic governments and the Arctic Council of the indicators for the purpose of long-term monitoring of human development.

What needs to be done to ensure a comprehensive, interdisciplinary and multi-actor approach to achieving sustainable development in the Arctic? There is no easy, straightforward and simple answer. Part of the solution lies in information and coordination, which in turn requires networks and monitoring. SAON presents one such system. A long-term and sustained approach to addressing sustainable development in the Arctic requires appropriate indicators, data, coordination and a monitoring system, to provide us with the information about the presence or absence of sustainability, or threats to sustainability in the various systems that surround us. The observed and documented threats to Arctic systems and their sustainability require attention to the point at which the rate of change begins to approach the speed with which the various systems can adequately respond.

Recommendations:

- Support the SAON recommendations for an AOF
- Encourage commitment to on-going support and funding for primary data collection

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: OCEANS, ICE AND ATMOSPHERE

Alexander V. Frolov
Deputy Head of Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET),
RUSSIAN FEDERATION

Climate change: Consequences for the Arctic physical environment.

Average air temperature over the globe in the year 2008 took 10th place in top 100 warm year's list. In the year of 1988 air temperature reached its highest point and became more or less fixed, experiencing insignificant decrease since then.

Average surface temperature in the Arctic appears to have increased during most of the 20th century. The trend between 1966 and 2008 over the Arctic was 0.4ºC/decade, approximately four times greater than the average for the century (0.09ºC/decade). It is very probable that Arctic air has warmed faster than in any other region on planet since 1966, and is greater than temperature increase in 30th and 40th. Climate projections suggest continuation of the strong warming trend of recent decades in the Arctic, with the significant changes coming during winter months.

Severe Arctic ozone depletion events were observed in the majority of the last ten springs (up to 45% below normal in 1997). Although depletion of stratospheric ozone was expected to increase UV radiation at the earth's surface, actual correlations have become visible only now taking into consideration the short period of instrumental UV measurement.

UV radiation has a variety of harmful impacts on humans, flora and fauna. It certainly influences inanimate objects.

Long-term variation of sea ice extent is a good indicator of climate change in the Arctic. Satellite observations show a steady downward trend in sea ice for the last three decades. From the start of monitoring in 1979 the minimum seasonal sea ice area observed in September every year has been decreasing by 9% per decade. In 2007 the surface of sea ice had the lowest minimum value ever recorded, 4.3 million km2. However, the northward shift of the ice boundary did not occur everywhere. In the eastern sector of the Russian Arctic the boundary of multi-year ice shifted southward by 300 km on average relative to the previous two decades.

We have insufficient information about depth measurements of the sea ice thickness. Within the Arctic Ocean several occasional surveys of sea ice were measured with sonar from nuclear submarines since 1958. According to measured data average ice thickness lowered from 3,1 m to 1,8 m in the period 1958-1999, and overall volume decreased by 30%.

Ice surface of the Arctic influences marine economic activity. Along the Northern Sea Route at the end of the warm season (August - September) its condition became substantially more favorable for navigation in high latitudes, namely, to the north from the Arctic archipelagos Franz-Josef Land, Severnaya Zemlya and New Siberian Islands. However, the increased occurrence of icebergs amplifies risks for marine transport and fishery. Climate changes have also negatively affected coasts of the northern seas (erosion intensification) and their infrastructure.

In the last quarter of the 20th century, temperature amplification of the upper ground layer was observed at many sites of the permafrost zone, and the increase in depth of seasonal thawing took place in some regions. Annual surface temperature increased by 0.8-1.0°C at many sites of the permafrost zone. Enhancement of seasonal thawing of permafrost, especially near its southern boundary, poses a threat to infrastructure installations (houses and engineering blocks and communication lines, including oil and gas pipelines).

Changes in the permafrost enhance methane emissions from wetlands into atmosphere. However, in the 21st century the expected increase in emissions of methane from wetlands of Arctic permafrost regions will not have a remarkable influence on the global climate.

The annual runoff of Arctic rivers rose by 20–30% since 1978 relative to 1946–1977, basically due to winter flow increase. Freshening of the Arctic Ocean by increased precipitation and runoffs is likely to reduce the formation of cold deep water, thereby slowing the meridional overturn circulation. It is likely that meridional circulation slowdown would lead to a rapid rise of global sea level and exert chilling influence on the Arctic as Gulf Stream heat transport is reduced.

The risk of dangerous floods on rivers in the season of snow melt will grow in those regions where ice jams accompany runoff peaks.

The Arctic is an important part of the global climate system. It both affects and is affected by global climate change. For example, reduction or loss of snow and ice has the effect of increasing the warming trend as reflective snow and ice surfaces are replaced by darker land and water surfaces that absorb more solar radiation. Arctic exploration features the key value to a great number of climatic problems.

Recommendations:

- Observational database for the Arctic is quite limited, with few long-term stations and a paucity of observations in general, making it difficult to distinguish with confidence between the signals of climate variability and change. Steps to be taken now are to fill in observational gaps across the Arctic including oceans, land, ice and atmosphere.
- The Sustained Arctic Observing Networks (SAON) is seen as a means of addressing several of these problems, and improving the situation through involving all relevant partners (see http://www.arcticobserving.org for the details). UNESCO has the opportunity to significantly contribute to SAON, specifically, in the framework of establishing the development of a portal for archiving data and metadata, publishing of dataset and derived products.
- It is evident that further research is still needed. For example, models differ considerably in their estimates of the strength of different feedbacks in the

climate system, particularly cloud feedbacks, oceanic heat uptake and carbon cycle feedbacks. UNESCO has the capacity to push scientific research of Arctic climate in the framework of the World Climate Research Programme and IHP, IOC and MAB.

- Further evaluation of adaptation potential is required for the whole Arctic and its individual regions. Adaptation can reduce vulnerability, both in the short and the long term. Special attention should also be given to the development of early warning systems and techniques for prediction of extreme events leading to serious negative socio-economical and ecological consequences.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: OCEANS, ICE AND ATMOSPHERE

Jean-Claude Gascard
University Pierre & Marie Curie, Paris,
Coordinator of the European Integrated Project DAMOCLES,
FRANCE

Unprecedented events have been reported during the past 10 years in the Arctic Ocean, mostly related to the Arctic sea-ice summer minimum extent that retreated in September 2007 far beyond previous extreme minimum records. This is the first clear evidence of a phenomenon of planetary scale importance forced by global warming mainly caused by an earth energy imbalance due to greenhouse gas concentration increasing in the atmosphere. The Earth is now absorbing 0.85 watts per square meter more energy from the sun than it is emitting into space, raising the likelihood of the acceleration of sea-ice melting, ice sheet disintegration and a rise in the sea level (Hansen et al. 2005). According to the ARCSS consortium (Overpeck et al. 2005) the Arctic system is on trajectory to a new 'super interglacial age' seasonally ice-free state.

Over the past 20 years we observed a gradual long-term warming mostly characterized by ***milder winter*** freezing seasons and ***longer summer*** melting seasons evidencing strong albedo positive feedback effects. Less ice means more sea water being exposed to solar radiation that would be absorbed and transformed into heat by the ocean melting more ice and so on… Strong positive feedback accelerates the melting of Arctic sea-ice specially due to the sharp contrast of the high albedo for sea-ice areas covered with snow (>0.8) that reflects 80% of the incoming solar radiation back into space compare with the very low albedo (0.2) of the ocean absorbing 80% of the incoming solar radiation. Although long wave and short wave downwards solar radiation agreed rather well between models and observations, one of the biggest uncertainties in Arctic climate simulations still remains albedo effects affected by cloud cover and aerosols (Arctic haze). Warming amplification in the Arctic might also be attributed partly to atmospheric circulation (Graversen et al. 2008) and oceanic circulation (Zhang et al. 1998, Polyakov et al. 2005 and Dmitrenko et al. 2008) but this is still controversial. A drastic retreat of sea-ice minimum extent in summer has inevitably profound consequences during the following fall season. Then all the heat taken up by the ocean

has to be evacuated by the atmosphere, delaying the onset of freezing and consequently the amount of sea-ice formed during the following winter. Observations taken during the past 20 years indicate that sea-ice is becoming thinner, younger, moves faster and retreats more and more in summer. Sea-ice extent, ice thickness, ice drift and age of ice are all interrelated parameters best characterising Arctic sea-ice evolution.

Surprisingly, the 2007 Arctic sea-ice event was largely unpredicted, even if extreme sea-ice conditions were observed almost every September month each year over the past 10 years (Perovich et al. 1999, 2003, Serreze et al. 2003 and Stroeve et al. 2005). Premises of an Arctic sea-ice thinning and of an Arctic ocean warming were reported nearly 20 years ago by Wadhams (1990) and Quadfasel (1991). So why was the 2007 Arctic summer sea-ice minimum extent a complete surprise if it was not an exceptional and an extraordinary event? Most of the surprise came from the fact that it happened so soon and so suddenly. 2008 was another exceptional year characterized by an extreme sea-ice retreat approaching the 2007 summer minimum record. In 2008 an exceptional replenishment of the perennial ice by first year ice did occur in contrast with 2007 when it did not happen and that compensated for an exceptional loss of perennial ice observed in 2008. How well do we understand the 2007 and 2008 sea-ice extent minimum through modelling and data analysis including retrospective analyses of long-term observational records? As predicted by all IPCC models, Arctic Sea-Ice would most likely disappear in summer in the near future. However it seems like this is going to happen much sooner than models predicted as pointed out by recent observations and data reanalysis. This is raising a critical set of issues with many important implications potentially able to speed up melting of the Greenland ice sheet, accelerating sea level rise and slowing down the world ocean conveyor belt (THC). That would also have a lot of consequences on marine and terrestrial ecosystems, on the ocean carbon sink (Bates et al. 2006) and ocean acidification. Permafrost melting could also accelerate, during rapid Arctic sea-ice loss due to an amplification of Arctic land warming 3.5 times greater than secular 21st century climate trends, as pointed out recently by Lawrence et al. (2008). This permafrost evolution would have important consequences and strong impacts on large carbon reservoirs and methane releases either in the ocean and/or on land.

Recommendations:

- Establishment of an Arctic Treaty covering scientific needs, rights and access for exploring the Arctic in exchange of a fully transparent process for all activities occurring under the Treaty.
- Greater European involvement for Arctic exploration: promotion of the Aurora Borealis European icebreaker and European full partnership to the Arctic Council.
- Establishment of an international pan-arctic coordinated scientific network of polar stations including Tiksi (Siberia), Resolute Bay & Eureka (Nunavut), Longyearbyen & Ny Alesund (Svalbard), Nuuk (Greenland) and Point Barrow (Alaska).
- Establishment of an international pan-arctic coordinated scientific network of arctic researchers gathering ALL scientists working in ALL countries contributing to Arctic research with NO exclusion. This network should elaborate and keep updated a coordinated science plan for future arctic research covering all disciplines. Scientists should elect network coordinators for any given stretch of time. This network should also elaborate an implementation plan to be discussed with national and international polar agencies. UNESCO, UNEP, the European Union and the Arctic Council could provide the funding necessary for the foundation and functioning of this international network of scientists.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: OCEANS, ICE AND ATMOSPHERE

Barry Goodison
Visiting Expert,
World Meteorological Organization,
SWITZERLAND

Cryosphere and Climate: The Arctic Challenge

The cryosphere collectively describes elements of the Earth System containing water in its frozen state on land and sea and includes: snow cover and solid precipitation, sea-ice, lake-ice and river-ice, glaciers, ice caps, ice sheets, permafrost and seasonally frozen ground. The cryosphere is arguably the most visible and informative indicator of climate change over the Arctic region, as dramatically seen during the last decade. Through its influence on surface energy and moisture fluxes, clouds, precipitation, hydrology, and atmospheric and oceanic circulation, the cryosphere plays a significant role in not only the regional climate of the Arctic, but also in global climate. Yet monitoring and modelling of the elements of the cryosphere and assessing cryospheric change and associated impacts in an integrated manner in high latitude areas are complex and remain a major challenge.

Gaps in our knowledge on cryosphere-climate interactions and the impacts of the changing cryosphere on physical and socio-economic systems have been identified in recent years through national and international initiatives. Science Plans or Assessments of WCRP's CliC Project, the Arctic Climate Impact Assessment (ACIA), International Conference on Arctic Research Planning (ICARPII), UNEP's Global Outlook for Snow and Ice, the IPCC WG1 chapter on Observations: Changes in Snow, Ice and Frozen Ground, and currently, Arctic Council's SWIPA initiative, all articulate scientific gaps in knowledge and identify needed actions. Reports of the IGOS Cryosphere Theme and SAON focus on observational gaps and needs, complementing the reports noted above. The most recent, ambitious collaborative initiative addressing many of the gaps in our knowledge has come through the International Polar Year 2007-2008 (IPY) projects. Yet, challenges remain to improve our understanding and prediction of the past, present and

future of the Arctic and the Earth Systems. Some knowledge gaps in cryospheric studies which must be addressed include:

- Determination of the mass balance of ice sheets and glaciers and their contribution to sea-level change through improved/enhanced observation and modelling
- Accurate determination of sea ice extent and thickness and improved representation of sea ice in climate models to improve future prediction of changes
- Improved understanding and quantification of the role of permafrost and frozen ground in the carbon cycle through a coordinated measurement and modelling framework for the northern high latitudes
- Significantly improved accuracy of observation and model prediction of precipitation, especially snowfall, over the Arctic land and ocean
- Determination of the present and future freshwater balance of the Arctic and assessment of the impact of changes on bio-geophysical and socio-economic systems
- Improved prediction of the cryosphere using regional climate models leading to improved prediction on monthly to seasonal or longer time scales
- identification of climate and cryosphere information needs of people and groups living and working at high latitudes and provision of cryosphere products to users, along with information on their interpretation and use

The challenge now is to sustain the momentum that IPY generated. IPY Legacy initiatives, which would address gaps in cryosphere-climate knowledge and contribute to a comprehensive, integrated system of the Arctic include:

- Sustaining Arctic Observing Networks (SAON), with an Integrated Arctic Ocean Observing System (iAOOS), Arctic-HYCOS, and *Integrated* AON; Global Cryosphere Watch (GCW);
- Polar Satellite Constellation; and,
- Polar Regional Climate Outlook Forum (PCOF).

An integrated observation and data management system is essential, incorporating *in-situ* and satellite observations from operational and research networks and platforms and proposed polar reference stations or “supersites” following established standards and guidelines. WMO’s GCW initiative is being designed to provide reliable, comprehensive observations of the elements of the cryosphere through an integrated observing approach, in collaboration with relevant national and international programmes and agencies and to provide authoritative products and information on the current and projected future state of the cryosphere to support decision making and environmental policy development.

IPY has not only advanced scientific knowledge, provided a snapshot of the current state of the Arctic system, and shown the benefit of comprehensive, integrated Arctic observing systems, but also has engaged young scientists, who are ready to carry the research to an even higher level, and engaged northerners, especially indigenous peoples, in science projects in which they contribute their knowledge to an improved understanding of the Arctic environment. Now the challenge is to engage national and international support for maintaining and expanding a multidisciplinary Arctic research program that will support achieving sustainable development of the Arctic in a rapidly changing environment.

Recommendations:

1. International Polar Decade:

- *Noting that WMO and ICSU were the co-sponsors of International Polar Year 2007-2008 (IPY)*
- *Considering the large investments of nations to IPY 2007-2008, the continuing and growing requirements for information on environmental change in Northern high latitudes by scientists, communities, northern peoples, decision and policy makers;*
- *Recognising the need to build upon the surge of operational and research programmes conducted during IPY and the need to convert these into sustainable long-term research and monitoring capabilities;*
- *Noting the Declaration from the Monaco Conference on "The Arctic: Observing the environmental changes and facing their challenges" on the need to "uphold the impetus launched by International Polar Year 2007-2008 and capitalise on the momentum created by consolidating and sustaining the mobilisation of scientific research and monitoring initiatives"; and*
- *Noting that WMO Executive Council invited other international organisations to consider the launch of an International Polar Decade*

It is recommended that, following WMO's suggestion, ICSU and other international organizations consider the idea of an International Polar Decade as a long-term process of research and observations in Polar Regions to meet the requirements for climate change studies, assessments and prediction to benefit society.

2. Sustaining Arctic Observing Networks (SAON):

- *Recognising that observing systems are essential for monitoring the current state and changes in the Arctic environment, and for validating and improving climate predictions over the Arctic;*
- *Recognising that data and information for assessing climate variability and change and environmental sustainability are dependent on operational and research networks, on in-situ and satellite systems, and on effective data and information exchange;*
- *Considering that IPY provided an expansion of observations and stimulated international cooperation on data management and access; and*
- *Noting the Arctic Council/AMAP initiative, with other international organizations, on Sustaining Arctic Observing Networks (SAON), a process to further multinational engagement in developing sustained and co-ordinated pan-Arctic observing and data sharing systems and social, economic and cultural change; and, their recommendations for concerted action on sustaining Arctic observing systems;*

It is recommended that a mechanism be established to facilitate international collaboration among operators, funding bodies and users of observational systems and data over the Arctic region.

3. User Focused Climate Services for Adaptation and Sustainable Development:

- *Considering the importance of identifying the climate information needs of people and groups living and working at high latitudes;*
- *Recognising the need to continue to improve the predictive skill of global and regional models for high-latitude areas, on all time scales;*
- *Noting the need to assist the users in interpretation and application of climate information and products in real life decision making;*

- *Given the need for capacity building, including technical training for climate scientists and product developers, and also for combined provider and user groups;*

It is recommended to establish a viable operational mechanism to facilitate effective interactions between climate professionals and users/stakeholders, such as a Polar Climate Outlook Forum (PCOF), recognized by IPY as an WMO legacy project.

4. Integrated Monitoring

- *Considering the ICARPII recommendation that "an integrated observation and data management system, incorporating all relevant disciplines, scales and observing platforms, is paramount and will make use of polar reference stations, so called "supersites";*
- *Noting the ICARPII recommendation that integrated observing plans require coordination of observations and modelling ensuring the same domains for modelling and observation work, thus leading to production of high-quality data sets representing the variability of essential parameters at dominant temporal and spatial scales;*
- *Noting the success of the approach of integrated observation by the WCRP Co-ordinated Enhanced Observing Period (CEOP) in creating a global reference network of observatories for water cycle studies, by collecting atmospheric and surface data from in-situ and satellite observations and output from atmospheric model over a reference area; and*
- *Noting the development of co-ordinated pan-Arctic observing through programmes such as WMO's Global Cryosphere Watch, IPY International Arctic Systems for Observing the Atmosphere (IASOA), and the Circumpolar Biodiversity Monitoring Program:*

It is recommended that an integrated polar reference observing network of "supersites" be established, building on existing infrastructure and facilities, where feasible, where in-situ, satellite and model data can provide long-term, multidisciplinary datasets suitable for environmental monitoring and prediction.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

**Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges**

3-6 March 2009, Monaco

ABSTRACT: OCEANS, ICE AND ATMOSPHERE

Peter M. Haugan
Director, Geophysical Institute,
University of Bergen,
NORWAY

Observatories for understanding Arctic change

The Arctic Ocean is probably the least explored ocean basin in the world. Rapid changes in the extent, thickness and characteristics of the sea ice cover are already occurring. The ventilation of the deep ocean, surface gas exchange, ocean circulation and physical conditions for marine life are expected to change with changes in the ice cover. The Arctic and sub-Artic region will be the first to experience ocean acidification in deep waters as well as surface waters. Several recent analyses suggest that a state change has occurred in response to atmospheric forcing. A return to ice-ocean conditions of previous decades may be unlikely even if accounting for responses to natural variability in atmospheric forcing.

Recent measurements and process studies allow improved understanding of vertical mixing in the Arctic Ocean and the role of ocean heat and sea ice melt water in the future evolution of the ice cover. However process understanding is still limiting our ability to make future projections. Complexities not only in the ocean circulation and ice-ocean interaction but also concerning the stable atmospheric boundary layer are not well described. In order to remedy this situation and provide a basis for development of improved global climate models, there is a need for dedicated observatories which not only monitor the evolution over time and produce consistent data sets but also allow in-depth studies of the interacting media.

Recommendations:

- Establish Arctic ocean-ice-atmosphere observatories which combine long-term reference measurements of core variables and ground truth for satellite observations with excellent working conditions for in-depth studies of geophysical and biogeochemical processes.
- Integrate long term observatories with satellite data and assimilation in models through regional mechanisms which are tightly linked to global

counterparts, like the Arctic Regional Ocean Observing System (Arctic ROOS), a component of the Global Ocean Observing System and GEOSS.

- Integrate studies of the present day physical climate system processes with studies of the past climate evolution and with biogeochemistry emphasising urgent topics like ocean acidification and seafloor gas exchange.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: OCEANS, ICE AND ATMOSPHERE

Edward Itta
President, Inuit Circumpolar Council, Alaska
Mayor, North Slope Borough, Barrow,
ALASKA

Concerns of Indigenous People in Response to the Effects of Climate Change

I represent people whose understanding of the Arctic is based on the accumulated environmental observations of generations of Inupiat (Eskimos) living in the region. Our survival depends on our ability to harvest Arctic wildlife in their seasonal migrations. These migrations are endangered by environmental shifts associated with climate change, and we are deeply concerned about the long-term stability of Arctic wildlife species and the habitat that sustains them.

To speak of sustainable development in the Arctic seems a bit like putting the cart before the horse. The real question is, "What must we do to sustain the Arctic environment as we know it?" Economic development in the region represents an additional layer of questions and concerns beyond the primary challenge of climate change and its profound impacts. In fact, some of the greatest development opportunities arise from the most significant impacts of climate change, especially sea ice retreat.

A recent resurgence of interest in offshore oil and gas development in the Alaskan Arctic has brought us face-to-face with many issues. These include severe limits to the scientific understanding of various animal species and natural processes of the ocean environment. How can monitoring agencies effectively protect species without baseline data to use as a starting point of comparison? Other issues revolve around questions of process. Since the Inupiat bear virtually all of the long-term risk associated with Alaskan offshore oil and gas development, what is their appropriate role in decision-making related to planning, monitoring and mitigation requirements?

How do we find a proper balance between economic, socio-cultural and environmental concerns in the Arctic? I believe we need a number of policy changes to insure a safe and respectful approach to Arctic development, including:

- greater reliance on international standards and protocols;
- increased funding for baseline scientific research;
- policy mechanisms that guarantee a “place at the table” for indigenous residents of the Arctic;
- protection of indigenous subsistence uses as a top priority;
- better incorporation of the traditional knowledge of indigenous people in scientific research;
- funding to offset community dislocation in the Arctic due to storm damage, coastal erosion, degrading permafrost and other effects of climate change.

If the Arctic is a bellwether of global climate change impacts ahead, the region’s indigenous communities represent the human dimension of these challenges that must be acknowledged and addressed.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: OCEANS, ICE AND ATMOSPHERE

Lene Kielsen Holm
Director of International Sustainable Development,
Inuit Circumpolar Council (ICC),
GREENLAND

Siku-Inuit-Hila, "The Dynamics of Human-Sea Ice Relationships: Comparing Changing Environments in Alaska, Nunavut and Greenland"
Henry P. Huntington, Shari Gearheard, Andy Mahoney, Lene Kielsen Holm, Yvon Csonka, Ilkoo Angutikjuak, Toku Oshima, Warren Matumeak, Joelie Sanguya, Igah Sanguya, Geela Tigullaraq, Mamarut Kristiansen, Qaerngaaq Nielsen, Joe Leavitt, Nancy Leavitt, Roger Barry

The Siku-Inuit-Hila (Sea Ice-People-Weather) project involves Inuit, Inughuit, and Iñupiat from Kangiqtugaapik (Nunavut), Qaanaaq (Greenland), and Utqiagvik (Alaska), respectively, along with academic researchers from several institutions in these three countries. The project has three major components.

The first component includes a series of "sea ice knowledge exchanges," visits by all participants (residents of all three communities plus the visiting researchers) to each of the study locations for participant observation. During these trips, the emphasis is on travelling the sea ice together. The sea ice itself acts as the common denominator for the participating hunters and elders from different communities and scientists from different disciplines. The host community leads each visit, allowing the visiting team members to experience local hunting and travel techniques and to exchange knowledge about diverse issues such as tools, clothing, food, and navigation.

The second component involves regular meetings of sea ice experts in each community. Led by local team members of Siku-Inuit-Hila, these working groups provide an opportunity to assess current sea ice conditions throughout the sea ice season and to document local knowledge of sea ice, ranging from traditional stories and mythology of sea ice, to sea ice terminology, to extreme events, to strategies for hunting and travelling in different sea ice environments.

The last component involves the establishment of a sea ice monitoring network in the three communities. Trained by the project's sea ice physicist and supported by a handbook created especially for the local monitors, local technicians measure physical properties of sea ice and snow on a weekly basis at 2 to 4 stations installed at each community. Local sea ice experts chose the location of the stations according to key areas of importance for sea ice use. In combination with local historical records, available climate data, and local knowledge, the data from the observing network provides detailed information about local and regional sea ice processes.

The different components of the project are tied together in a number of ways. Team members from the different regions have held workshops with elders and other knowledgeable persons in their respective areas. In these workshops they have been discussing sea ice and climate change issues, mapping changes, documenting related language/terminology, and talking about how recent climate and environmental changes have influenced their everyday lives. The data collected from these meetings are being incorporated into the work of Siku-Inuit-Hila, as is data collected from sea ice measurement instruments in these three arctic regions. Sea ice monitoring is part of the project and the instruments are maintained by local people in the partner communities. The outcome of Siku-Inuit-Hila is first and foremost the meetings and exchanges between and among the hunters and scientists, and a book that is projected to be launched in 2010.

Recommendations:

- Wherever it is possible I recommend aiming to involve local people with their knowledge and local ideas, so that they become part of the research plan and outcome/s.
- At least local authorities should be informed about research projects that are to be conducted.
- The knowledge gained from research projects should be disseminated in the local language/s.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: OCEANS, ICE AND ATMOSPHERE

Takashi Yamanouchi
National Institute of Polar Research and Department of Polar Science,
The Graduate University for Advanced Studies
Japan

Arctic Change in the Flow of Global Warming: Need for Long-Term Monitoring Observations

The Arctic, confronted by global warming, has shown an abrupt warming in the thirty years since 1980s. The warming in the Arctic is seen in a number of climate processes such as air temperature rise, ground temperature rise, decrease of sea ice extent and so on. The Arctic sea ice extent shows a drastic decrease and has reached a record minimum in summer 2007. The rate of reduction in ice cover exceeds twice that predicted by climate models, and has already reached the level simulated for 2040. Permafrost on the Arctic land has melted in a wide area, and is expected to release greenhouse gases such as methane, and outflow of large rivers to the Arctic Ocean has greatly increased. Retreats and melting of glaciers and ice caps surrounding the Arctic and Greenland ice sheet are contributing to the sea level rise. Following these changes, ecosystem/ biosphere will be changed and it will alter the exchange of greenhouse gases and surface albedo, and then feed back to the climate and environment. Additionally, there are many extreme changes such as decrease in the area and period of snow fall, reduction of snow surface albedo by anthropogenic black carbon and acidification of surface sea water due to the increase of atmospheric CO_2 concentration, and we are anxious about their effect on human life and the natural ecosystem.

A large warming during the 1920s and 40s in the Arctic, comparable to the recent 30-year warming is known. This was only concentrated to the high latitudes. Several explanations have been made; however, external forcings such as solar forcing and low aerosol loading, which were once able to explain global averages, failed to explain this, and one of the possible explanations is internal atmospheric variability of low frequency. Another candidate for the explanation was black carbon deposited on the snow and ice surfaces. We have to continue our study in discovering historical meteorological, aerological, and radiation data; investigating the PDO which shows

similar resemblance to the temperature curve; ice core analysis; Arctic system reanalysis together with long term reanalysis back to 1880s. Anyway, it is indispensable to recover historical data and to study these early twenty century warming in order to understand the recent abrupt warming and to predict future change in the Arctic.

Observing systems for monitoring change are essential for validating and improving predictions, especially of future global warming and its impacts. Starting from the first International Polar Year (IPY) in 1882/83 and through the second IPY 1932/33 up to the International Geophysical Year (IGY) 1957/58, a large part of the observation station network was established in the Arctic. However, a large amount of stations, especially in the Russian Arctic, have been closed since then due possibly to lack of financial support. Now, just at the end of our IPY 2007-2008, we should start to remake our solid network in the Arctic as a legacy of IPY, following the State of Polar Research (the statement from the ICSU/WMO Joint Committee for the IPY 207-2008) and Sustaining Arctic Observing Networks (SAON) initiatives.

Recommendations:

- Establish or enhance and maintain multidisciplinary sustained long-term observing systems in the Arctic
- Establish and maintain drifting ice or ship stations in the central Arctic Ocean
- Collect and analyze historical data archives in the Arctic, especially of early 20th century
- Increase communication between scientists and politicians about the Arctic change and keep the Arctic safe, peaceful and free area for science (need for "Arctic Treaty"? just similar as the "Antarctic Treaty")

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: BIODIVERSITY AND ECOSYSTEM SERVICES

Ruben Apressyan
Head, Sector of Ethics,
Institute of Philosophy,
RUSSIA

Impending Social Changes in Arctic:
Providence, Thoughtfulness, and Shared Responsibility

The global climate change has intensified the issues of sustainable development of the Arctic. However the progressive deterioration of the environmental situation in this vulnerable region had started long before the problem of global climate change was placed on the agenda. Regarding the unavoidable results of global climate change we have become concerned with possible transformation of landscapes, disturbance of permafrost, deforestation of vast territories; but most of these changes are the collateral outcome of aggressive and ethically irresponsible industrial activities, which are predacious towards nature and destructive towards traditional social space and indigenous cultural environments. Global climate change has worsened these tendencies.

It is most likely that global climate change will determine radical environmental and social changes, deep modification in sacral and historically significant places for indigenous peoples, and the disappearance or migration of their traditional settlements. Under these conditions the process of adaptation may appear extremely hard and painful, especially if it becomes associated with the probably inevitable transformation of more or less traditional societies into modern and postmodern societies, which the indigenous people have always been trying to avoid. In this respect particular long-term programmes for conservation and preservation of the cultural and historical heritage of indigenous peoples as an integral part of global cultural diversity and their education for their future needs should be developed.

The urgent tasks to mitigate and adapt to climate change require alteration in policy-making to avoid unacceptable environmental, economic, social, and cultural effects. The procedures of decision making should become transparent to the public, including indigenous populations. All business projects should pass environmental standards and be ethically verified according to such basic principles as precaution, non-harm, human rights, compensatory justice, care, and shared responsibility.

Recommendations:

- To stimulate national governments and corporations to develop programmes on the

reduction of industrial pressure on nature to mitigate environmental deterioration in the Arctic.

- To call national governments, corporations, and local communities in the Arctic to develop social infrastructure in forms and modes that are supportive to indigenous cultural traditions.
- To stimulate national governments and corporations to compensate the harm caused to indigenous people by industrial development and climate change through affirmative plans, education and support programmes.
- To encourage UNESCO to facilitate the academic community's intellectual and scientific support of efforts to improve the environmental, social, and cultural situation in Arctic.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: BIODIVERSITY AND ECOSYSTEM SERVICES

John Crump
Acting Polar Manager
UNEP/GRID-Arendal

Sustainable Development or Sustaining Development? Arctic governance in a changing climate

In the last 20 years, the Arctic has changed from a relatively static region on the periphery of the global consciousness to being central to the discussions about the impacts of climate change and development. This presentation will address the meeting's three key questions by examining Arctic governance issues related to biodiversity and ecosystem services. And it will raise a fourth question: "Given the rapid and accelerating effects of climate change in the Arctic, is sustainable development achievable?"

Under normal cold conditions, the Arctic provides vital ecosystems services to the planet by cooling it and keeping water and methane frozen, which in turn helps regulate the earth's climate. Global efforts to reduce greenhouse gas emissions will have a direct effect on the Arctic's ability to continue functioning as the earth's cooling system. We are already seeing the impacts of rapid warning in the Arctic and the 2007 IPCC IV Assessment identified it as being particularly vulnerable to climate change, along with other regions like the Small Island Developing States.

At its 2008 Governing Council meeting in Monaco, the United Nations Environment Programme issued a declaration that acknowledged "the efforts of Arctic States, individually and collectively, to protect the Arctic environment and manage activities in the Arctic to minimize the impact of those activities" on the region's environment. Entitled *Sustainable Development of the Arctic region*, this decision of the governing council encourages UNEP "to co-operate, as requested, with the Arctic Council, relevant Multilateral Environmental Agreements and other relevant regional and international bodies, as appropriate".[1]

This direction came at the same time as numerous political and policy efforts[2] to come to grips with how the Arctic should be governed in the face of rapid climate change. No discussion of biodiversity and ecosystem services in the Arctic can take place without

[1] United Nations Environment Programme. Report of the Governing Council/Global Ministerial Environment Forum on the work of its tenth special session. Monaco, 20-22 February 2008.

[2] Examples include the *Illulissat Declaration* by Five Arctic Coastal States (28.05.2008), *8th Conference of Parliamentarians of the Arctic Region* (14.08.2008), Nordic Council of Ministers – *The European Union and the Arctic* (24.06.2008), United States – *Arctic Region Policy* (09.01.2009)

considering the existing governance mechanisms, how they work or don't work, how they might be altered to help adapt to climate change in the Arctic, what gaps exist in the current regimes, what needs to be done to ensure an interdisciplinary approach is taken, and that arrangements are designed to secure the long-term sustainable development of the region.

As UNEP's Key Polar Centre, GRID-Arendal has the responsibility for coordinating a project that will assess and monitor the performance of MEAs in slowing the rate of biodiversity loss in the Arctic, analyze gaps and present options for improvement.

But while this work is being carried out, and while we are discussing governance and biodiversity in the Arctic, we need to examine the concept of sustainable development itself and come to some consensus on it. If sustainable development was ever possible in the Arctic, is it achievable in the context of rapid accelerating climate change?

The Brundtland Commission definition is widely known:

> *Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.*[3]

The second sentence in that definition is less quoted but perhaps more relevant to this discussion:

> *The concept of sustainable development does imply limits - not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities.*

At the end of 2008, new research demonstrated unequivocal evidence that the Arctic is warming faster than climate models predicted, and that it is happening about a decade before expected.[4] As the multi-year sea ice retreats and there are longer ice free periods in the Arctic, the pressure to exploit the region's natural resources will intensify. Given the long term *unsustainability* of hydrocarbon use and increasing inability "of the biosphere to absorb the effects of human activities," how do we have a conversation about "sustainable development in the Arctic"?

Recommendations:

- Recommendations on biodiversity and ecosystem services developed at the UNESCO meeting need to take into account other discussions on Arctic governance[5];
- Arctic nations need to recognize the importance and value of non-Arctic stakeholders in efforts to manage the common areas in the region and reduce the effects of climate change;
- The UNFCCC Copenhagen climate change agreement scheduled to be completed in December of this year must provide sufficient resources to allow the world's vulnerable regions to adapt to rapid climate change. In the Arctic, this means that these resources must be provided by the states which have sovereignty in the region;
- In light of the latest scientific findings, and in order to preserve the Arctic's role as the planetary cooling system, UNESCO needs to support efforts by the Small Island Developing States and other vulnerable regions, including the Arctic, to achieve a climate change treaty that will ensure that global average temperature increases are kept below 1.5 degrees Celsius (above pre-industrial levels).

---

[3] http://www.un-documents.net/ocf-ov.htm#I.3 (accessed 18.02.2009)

[4] The Independent, 16.12.2008. "Has the Arctic melt passed the point of now return?" http://www.independent.co.uk/environment/climate-change/arctic-melt-passes-the-point-of--no-return-1128197.html (accessed 18.02.2009).

[5] Perhaps this is better as part of the preamble.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: BIODIVERSITY AND ECOSYSTEM SERVICES

Michael Gill
Chair, Circumpolar Biodiversity Monitoring Program
Environment Canada
CANADA

Coordinating for Arctic Conservation: Towards Integrated Arctic Biodiversity Monitoring and Reporting

Arctic ecosystems and the biodiversity they support are experiencing growing pressure from climate change and resource development while established research and monitoring programs remain largely uncoordinated, lacking the ability to effectively monitor, understand and report on biodiversity trends at the circumpolar scale. The maintenance of healthy Arctic ecosystems is a global imperative as the Arctic plays a critical role in the Earth's physical, chemical and biological balance. A coordinated and comprehensive effort for monitoring Arctic ecosystems is needed to facilitate effective and timely conservation and adaptation actions.

The Arctic's size and complexity represents a significant challenge towards detecting and attributing important biodiversity trends. This demands a scaled, pan-Arctic, ecosystem-based approach that not only identifies trends in biodiversity, but also identifies underlying causes. It is critical that this information be made available to generate effective strategies for adapting to changes now taking place in the Arctic - a process that ultimately depends on rigorous, integrated, and efficient monitoring programmes that have the power to detect change within a 'management' time frame.

To meet these challenges and in response to the Arctic Climate Impact Assessment's recommendation to expand and enhance Arctic biodiversity monitoring, the Conservation of Arctic Flora and Fauna (CAFF) Working Group of the Arctic Council launched the Circumpolar Biodiversity Monitoring Program (CBMP). The CBMP is working with over 60 global partners to expand, integrate and enhance existing Arctic biodiversity monitoring efforts to facilitate more rapid detection, communication and response to significant trends and pressures.

Towards this end, the CBMP is establishing five Expert Monitoring Groups representing major Arctic themes (Marine, Coastal, Freshwater, Terrestrial Vegetation & Terrestrial Fauna). Each group, representing a diversity of expertise including both community-based and scientific-based monitoring capabilities, is tasked with developing pan-Arctic, comprehensive and integrated biodiversity monitoring plans for the Arctic's

biomes.

To facilitate effective reporting, the CBMP is developing a suite of indices and indicators and a web-based data portal that will be used to report on the current state of Arctic biodiversity at various scales and levels of detail to suit a wide range of audiences. The current and planned CBMP biodiversity monitoring underpins these indices and indicators.

Recommendations:

I offer the following recommendations, purposely focusing on the Biodiversity and Ecosystem Services theme that I will be specifically participating in and especially focusing on the cross-cutting theme of 'monitoring systems':

- Recognise that the conservation of Arctic ecosystems is a necessary condition for sustainable development of the current and future well-being of the Arctic region, its inhabitants and the entire globe.
- Recognise that Arctic ecosystems and the biodiversity they support now face growing pressure as a result of climate change and resource development; and acknowledge that, in order to successfully conserve the natural environment and allow for economic development, improved baseline data and trend analysis of Arctic biodiversity is needed.
- Endorse and expand support for CAFF's Circumpolar Biodiversity Monitoring Programme and its efforts to establish a comprehensive, cost-effective and integrated Arctic biodiversity monitoring and reporting system.
- Encourage Arctic and non-Arctic countries to contribute to and participate in the CBMP's Expert Monitoring Groups and encourage Arctic countries to expand biodiversity monitoring efforts and contribute the resulting data towards the development of the CBMP's indices and indicators.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: BIODIVERSITY AND ECOSYSTEM SERVICES

Henry P. Huntington
Huntington Consulting,
Eagle River,
Alaska,
USA

Connections between Arctic Peoples and Their Environment

The natural world in the Arctic provides materially and spiritually for the peoples of the Arctic. The relationship between humans and their environment is deep and multi-faceted. In the worldviews of indigenous people, it is a two-way relationship, with obligations and expectations for all beings that are part of the system. Most often in scientific work, we focus on the material connections between people and their environment. Those connections are vital, deep, and fascinating. But the spiritual connections are also vital, deep, and fascinating, even if they are harder to discover, assess, and address.

Indigenous knowledge can contribute greatly to the monitoring of biodiversity, ecosystem services, and the host of social and cultural implications they have. There are many examples around the Arctic demonstrating the detailed knowledge that local residents have and the depth of cultural experience that inform that knowledge. In Savoonga, Alaska, for example, one family resumed the tradition of bowhead whaling after several decades, using knowledge that had been handed down for generations even though no one still living had participated in whaling at their traditional site. In addition to providing the know-how and skills to sustain Arctic communities and peoples, indigenous knowledge has contributed greatly to scientific efforts around the Arctic. It is important that we maintain and increase our efforts to engage the holders of indigenous knowledge, involving Arctic residents not just as the subjects of study, but as full collaborators in joint research, monitoring, analysis, and action.

In doing so, we will inevitably also touch on the spiritual connections that are so important for Arctic peoples. At times, the spiritual dimension of understanding may seem at odds with scientific understanding. For example, Athabascan people in Alaska have a powerful relationship with the moose. Moose are taken for funeral potlatches, a rare instance of a spiritual practice that is recognized in state law, as people can take moose for potlatches when they need them rather than waiting for the usual hunting season. Athabascans believe that the number of moose in the world is constant, with moose offering themselves to worthy

hunters and then coming back again. Scientific counts of moose make little sense in this worldview, because the moose may choose not to be visible to the counters. Discussions about moose abundance, a key “ecosystem service” in one worldview, have a large cultural gap to cross before they can make sense to both groups participating in those discussions.

It is important to recognise such differences in viewpoint, not to sweep them aside and hope they do not reappear. Instead, collaborative approaches can help find common ground for discussions about past, present, and future, and a chance to learn other ways of seeing and knowing the Arctic. Much has been made lately of the difficulties faced by traditional people in applying their knowledge to a changing world where the patterns and lessons of the past no longer hold true. But there are also values and traits that endure, such as patience, humility, and adaptability. These values are closely tied to a deeper view of how people can and should relate to their environment. A good starting point to learning about and caring for the Arctic environment is first to learn from and about one another.

Recommendations:

- Study the ways that indigenous peoples have been adaptable—physically, psychologically, culturally, socially—to environmental change and variability. We need to understand more than the fact that they *are* adaptable. We need to understand how the skills, values, and traits that have been adaptive in the past may continue to be so into the future, and how some aspects of modern life have in fact reduced adaptability.
- Abandon the sectoral approach to understanding people and their environment and instead address the entire system as a dynamic, interacting whole. “Cumulative impact studies” are a start, but just a start. Both the natural world and the social world in the Arctic are dynamic and responsive; neither can be understood without the other, and neither can be understood if the other is treated as static or simplistic.
- Involve Arctic peoples, formally and informally, in collaborative management at all levels of planning and decision-making concerning the Arctic and its future. At present, major policies are typically set elsewhere, with Arctic peoples involved only in implementation, if at all. Greater involvement typically leads to less conflict and better decisions and outcomes.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: BIODIVERSITY AND ECOSYSTEM SERVICES

Günter Köck
Austrian Academy of Sciences, Vienna;
University of Innsbruck,
AUSTRIA

Fish from sensitive ecosystems as bioindicators of global climate change (High-Arctic 1997-2009)

Global Circulation Models (GMCs) predict maximum warming in high mountain and polar regions. Due to similar environmental characteristics (e.g. long ice-cover, oligotrophy) high-altitude and high-latitude lakes are very sensitive ecosystems where even slight environmental changes (e.g. input of pollutants, climate change) may substantially affect ecosystem function.

HIGH-ARCTIC 1997-2009, an ongoing multi-year study coordinated by G. Köck and D. Muir (Environment Canada, Burlungton Canada), and carried out in cooperation with various Canadian research facilities, is investigating the effects of short-term and long-term climate change on freshwater ecosystems in the Canadian High Arctic and in the Austrian Alps. The study illustrates that global warming may endanger fish populations from Arctic and alpine lakes by leading to an increase of both metal accumulation and stress. Comparison of metal levels (e.g. cadmium) and biochemical stress indicators in Arctic char (*Salvelinus alpinus*) collected from Canadian Arctic lakes revealed marked seasonal and interannual trends in the turnover of metals, as well as stress responses in the liver. Results indicate metal accumulation and level of stress to be higher the warmer the summers are in the Canadian Arctic. Predictive relationships between lake temperature and metal uptake were similar for high Arctic lakes and previously studied Austrian high mountain lakes, thus confirming water temperature to be a driving force of metal accumulation in char from these sensitive ecosystems. Furthermore, additional data indicate bioavailability of mercury to fish to increase with ambient temperatures.

The observed effects provide clues as to what would happen to the extremely vulnerable land-locked char populations in the event of a longer-term, synoptic warming trend associated with global climate change. We speculate that the projected warming conditions could be a serious threat to the stability of Arctic char populations in high latitude and high altitude lakes.

The study illustrates that fish from high latitude and high altitude lakes appear to be sensitive bioindicators of the interactive effects of pollution and global climate change.

Effects of climate warming on Arctic freshwater ecosystems:

- Increase of metal accumulation in freshwater fish
    - Negative effects on stability of fish populations
    - Risk of increasing contamination (in part. mercury) for humans
    - Effects on biodiversity: Animal species shifts (fish species from the South will move in; neobiota)

Recommendations:

- MAB Biosphere reserves are excellent sites for long-term monitoring. Furthermore, they could serve as learning sites for adaptation and mitigation processes. Taking into account that currently only five BRs (Russian Federation: Taimyrsky Biosphere Reserve, Laplandskiy Biosphere Reserve; Denmark: North East Greenland Biosphere Reserve, Sweden: Lake Torne Biosphere Reserve; USA: Lake Torne Biosphere Reserve) are existing in Arctic regions, it would be highly desirable to establish a circumpolar network of BRs.
- High mountain lakes and Arctic lakes are very similar ecosystems, in particular in their sensitivity to climate warming and pollution. Studies show that knowledge derived from high-mountain lakes can to a large extent be transferred to Arctic lakes (and vice versa). In consequence, comparative research in high-mountain BRs and protected areas (BRs, national parks) in Arctic regions should be facilitated and intensified.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: BIODIVERSITY AND ECOSYSTEM SERVICES

Kari Laine
Thule Institute,
University of Oulu,
FINLAND

Northern Long-term Socio-ecological Research Platform (Northern LTSER Platform) cooperation in Finland: possibilities and challenges for long-term socio-ecological research

The Northern LTSER Platform, founded as a part of the Finnish LTER Network in 2007, constitutes an environmental transect from northern boreal forest landscapes to arctic tundra. The main aim of the Northern LTSER Platform is to pool long-term research activities and monitoring data of the northernmost university research stations in Finland under five research themes related to socio-ecological changes in northern nature and communities. The platform is a good example of a comprehensive and interdisciplinary research cooperation. The platform covers northern parts of Finland almost entirely and the study design of the platform operates as a sensitive instrument to assess drivers, pressures and the state of the environment on multiple spatial scales both on nature and human systems and their interactions. The sites maintain high-quality infrastructures that enable research with a focus on complex interactions between environmental pressures (climate change, land use change, atmospheric pollution) and ecosystem functions and services. The sites cover a wide range of ecosystems and human induced pressures and serve as bases for socio-economic research. A well-developed network of university research stations (Oulanka, Kilpisjärvi, Kevo, Värriö) and northern units of research institutes (NorNet partners) offers the basic infrastructure for conducting collaborative research; basic laboratory facilities, competent personnel and office space as well as accommodation facilities for visiting scientists. The Pallas-Sodankylä Long-Term Ecological Research (LTER) Observatory, a part of the Northern LTSER-platform, provides for example the weather and atmospheric parameter monitoring data, land cover characteristics, hydrological and surface water quality monitoring and modelling data, forest ecosystem monitoring data, and environmental radioactivity data. About 30 senior researchers or professors with their research groups are involved in the work of the platform. LTER in Finland has objectives similar to that of the international LTER network. The research themes of the Northern LTSER Platform are the following: 1) Population dynamics and productivity of plant and animal populations living in the periphery of their distribution, 2) Effects of global change on

northern ecosystems, 3) Changing society and livelihoods in rural and peripheral areas, 4) Human health and wellbeing in northern communities, and 5) Information management and research infrastructure for scientific collaboration. Additionally, problems and challenges for long-term socio-ecological research will be discussed.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: BIODIVERSITY AND ECOSYSTEM SERVICES

Vera Metcalf
Eskimo Walrus Commission,
Kawerak, Inc.,
Nome,
ALASKA

Sustaining a Healthy Human-Walrus Relationship

The rapidly changing arctic environment has prompted concern about the impacts to marine mammals and those that depend on them. An important method to understanding the health of Pacific walrus, which is a species highly susceptible to the many changes arriving in the Arctic, is found in its relationship with the Alaska Native communities that rely on it for nutritional, cultural, and economic needs. Unique to each, coastal communities rely on a variety of resources found in marine waters. This dependence is a cultural foundation for Alaska Native communities.

Without these natural resources, Alaska Native communities are even more vulnerable to the many potential changes to come. Consequently, we are concerned about environmental, social, or political changes to our relationship to the Arctic marine waters.

Here, we summarise our contribution to the effort, focusing on the challenges facing co-managers and subsistence hunters of walrus in the dynamic Beringian environment. We describe how the ability of coastal walrus subsistence hunters to access, harvest, transport, store and utilise walrus is affected by a dynamic suite of endogenous and exogenous factors, including ecological, social, economic, and political conditions. Impacts specifically as a result of a changing climate will affect subsistence hunters within the context of these diverse and sometimes global factors. We finish by highlighting some of research areas relating to climate change that might contribute to the overall health of the human-walrus relationship.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: BIODIVERSITY AND ECOSYSTEM SERVICES

Tatiana Minaeva
Arctic Senior Technical Officer,
Wetlands International,
Russia

Wetlands - key Arctic ecosystems: vulnerability to climate change and adaptation options

The recent scientific findings of dramatic changes in Arctic biodiversity due to climate change and anthropogenic impacts has stimulated further cooperation of the existing Arctic networks to stop ecosystem degradation processes. Especially active during the last five years are the Arctic Council (CAFF, AMAP and related initiatives) and EuroBarents groups (Barents Habitat Forum etc.). However, there is a significant gap related to arctic wetlands, which are also poorly addressed by international conventions related to biodiversity.

Wetlands are widely distributed in the Arctic covering 60% of the total Arctic ecosystem area. They are present as permafrost peatlands (polygonal, shallow peat tundra, palsa mires), shallow lakes, rivers and deltas, coastal marshes, and shallow sea waters, which make up the greater part of wetland types defined by Ramsar Convention wetlands types.

Arctic wetlands are extremely fragile. Permafrost is the main ecosystem factor of Arctic wetlands determining their genesis and function. At the same time permafrost is most vulnerable to climate change.

Arctic ecosystems are characterised by low species, ecosystem, and population diversity. Species in the Arctic are, however, as a rule very specialised and highly dependent on specific habitats. Arctic wetlands support habitats for many migrating species, and are often referred to as the 'source of all flyways'. Through migration routes the biodiversity status of the entire world is linked to the status of Arctic habitats.

The typically low rate of productivity of Arctic organisms, populations and ecosystems is responsible for their limited ecological niche capacity, low resistance and restricted restoration potential.

Climate change could seriously affect wetland hydrology, with permafrost melting and disappearance, changes in river flood regime and hydrochemistry, discharge of dissolved and particulate matter that will impact on the permanent ice in the ocean.

Transformations of wetlands by climate change will have a feedback on climate by the release of methane, the volume of which (both modern and relict) is comparable to the current fluxes of industrial origin. This will have global impact.

Land use practice in the Arctic in the recent past has largely been in harmony and integrated with natural ecosystem capacity. New technologies provide ways to overcome the challenges of the harsh Arctic environment and lead to widespread and rapid industrial development, such as the oil and gas industry. Even traditional land uses such as reindeer herding are being industrialised. The growing interest in Arctic resources could cause unsustainable development which ignores environmental constraints.

Recommendations:

- Available information on Arctic wetlands is not sufficient for adequate planning of land use and wetlands conservation. More data is needed on the natural functions of wetlands, and potential threats caused by changes in climate and land use.
- Our experience in regional wetlands conservation proves that good knowledge of wetland ecosystem features, natural processes and mechanisms, combined with precise evaluation of the socio-economic situation, could be background for successful wise-use strategies for wetlands conservation even in the complicated conditions of the Arctic. The activities that still need to be organised are wetlands monitoring, a specific approach to EIA, good geographical analyses aimed combination of protected areas and wise use. There is large field for expert cooperation and exchange.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: BIODIVERSITY AND ECOSYSTEM SERVICES

Gunn-Britt Retter
Arctic & Environmental Unit,
Saami Council,
NORWAY

Biodiversity and ecosystem services

The Saami culture is based on a close relationship to the living resources. The conditions for the living resources are constantly changing. Our realities have never been stable and stability has never been the objective. Thus, we can state that our culture traditionally has depended upon the biological diversity and the ecosystem services, as I understand the concept. Still today our culture depends on continues production in lively Saami communities, still living in a close relationship with nature.

Climate change brings our culture new challenges, but we traditionally, and rooted in our knowledge, have the capacity to face these new challenges; our knowledge should hold the skills and information necessary to adapt to new environmental conditions. "Our search for adaptation strategies is not connected to stability in any form, but in stead instead is focused on constant adaption to changing conditions" (Johan Mattis Turi).

Today's challenge lies mainly in the legal framework and regulations put in place by the authorities, without proper participation by the knowledge holders. The authorities depend on knowledge for their decision making. So far the authorities tend to rely solely on science, and traditional knowledge is not given equal value as a basis for research itself or as basis for developing the legal framework.

Cultural sites can serve as an example for investigating how people have been able to adapt to climate changes previously/historically. Also community-based monitoring has to be further developed/explored to serve the decision-making.

Our knowledge system has always, and continues, to explore adaptive strategies – based in traditional knowledge – that have served Arctic Peoples in the past, in the present, and may do so in the future.

Finally, the ability to adapt to constant changes is rooted in our knowledge that is developed in our regions in the north about living in the north and is embodied in our languages.

Recommendations:

- Seek support for the community based documentation of Traditional Knowledge as a critical source of information to make decisions

- Educate scientists and policy makers about differences and similarities in the knowledge systems and underlying world views
- Traditional Ecological Knowledge must form the basis for regulations, laws and policies and decision-making on the environment and natural resource management;
- Parallel processes must be recognised and encouraged between western scientific methods and the Traditional Knowledge of Arctic Indigenous Peoples in examining the causes and impacts of climate change
- Educate legislators about traditional practices critical to sustainable development (e.g., reindeer castration, whale hunting);

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: CIRCUMPOLAR INDIGENOUS PEOPLES

(In English below)

КОРЕННЫЕ НАРОДЫ СЕВЕРА РОССИИ и ИЗМЕНЕНИЯ СОЦИАЛЬНОЙ И ПРИРОДНО-КЛИМАТИЧЕСКОЙ СРЕДЫ

Л.И. Абрютина

Ассоциация коренных малочисленных народов
Севера, Сибири и Дальнего Востока Российской Федерации
RUSSIAN ASSOCIATION OF INDIGENOUS PEOPLES OF THE NORTH (RAIPON)

К группе аборигенных малочисленных народов Севера России относятся 42 этноса численностью около 200 тыс. человек. В арктической прибрежной зоне Арктики проживает 11 аборигенных народов.

У аборигенных народов Севера разные корни, но есть много сходных особенностей. Техногенная культура изменила мир коренных народов. Негативные и репрессивные воздействия, примененные к аборигенным народам России на советском этапе, сочетались с прогрессивными и гуманными мерами, что привело к двойственным результатам как отрицательным, так и положительным.

Рыночные реформы, начавшиеся в 1990-е годы, перечеркнули достижения советского периода и усугубили скрытые кризисные тенденции. Разрушилась хозяйственная деятельность, возникла массовая безработица, промышленные предприятия разрушают природу и вытесняют аборигенов из традиционных мест.

Итогом кризиса аборигенов Севера является дезадаптация, снижение физического и психического здоровья. Растет смертность, заболеваемость, уменьшается рождаемость. Средний возраст умерших аборигенов Севера составляет 45 лет.

В последние десятилетия реальную угрозу для аборигенных народов Арктики стали представлять стойкие токсические вещества, что показали проекты АМАП Арктического Совета. Очевидно, что потепление климата способствует нарастанию содержания вредных веществ в природной среде и традиционной пище.

Многие аборигены уже ощутили изменения климата на себе и говорят об этом.

Быстро наступающие в Арктике климатические угрозы, опасные для всего

человечества, являются для аборигенов Севера Росси еще и дополнительным фактором кризиса. В прошлом аборигенные народы могли уходить от климатических катаклизмов, меняя территории обитания и формы хозяйствования. В современных условиях многие обстоятельства не дают такой возможности.

Выход, реально поощряемый государством заключается в интеграции, перемещении в населенные пункты, превращение там в безработных или работников «европейского» производства. Это равносильно прекращению существованию аборигенных народов.

Негативным климатическим воздействиям способствуют и другие пробелы: несовершенство метеослужбы, системы здравоохранения, отсутствие эффективных и партнерских отношений с общинами аборигенов, декларативность программ устойчивого развития аборигенных народов, отсутствие сценариев развития событий, моделей адаптации и элементарного информирования населения.

Чтобы защитить наиболее уязвимые группы аборигенных народов от негативных климатических и социальных факторов необходимы разные государственные меры.

Повысить эффективность этих мер можно также путем реализации международного проекта силами научных организаций и нашей Ассоциации (RAIPON) с обширным привлечением аборигенных общин российской Арктики. На основе такого проекта можно будет разработать предложения по смягчению климатических угроз.

Larissa Abryutina
Association of small indigenous peoples of the North,
Siberia and Extreme East of Russian Federation.

Indigenous people of the Russian North and social and climate changes

There are 42 ethnic groups of aboriginal peoples of the Russian North, with a population estimated of around 200.000 peoples. In the Arctic coastal zone there are 11 aboriginal groups.

The aboriginal peoples of the North have different roots, but they have many similarities too. Anthropogenic impacts on the environment have changed the worlds of indigenous peoples. The negative and repressive impacts on indigenous peoples during the Soviet Period were coupled with progressive and humanitarian measures, which lead to ambiguous results both negative and positive.

The economic reforms of the 90s weakened the achievements of the Soviet Period and worsened a latent crisis. Economic activity collapsed, there was massive unemployment and the remaining industrial enterprises destroyed the environment, poached natural resources, and pushed indigenous peoples from their homelands.

The result of this crisis for aboriginal people of the North is that they are no longer able to lead their traditional ways of life, leading to a deterioration of physical and mental health. The death and sickness rate is growing, while the birth rate decreases. The average lifespan of aboriginal people of the North is 45 years.

In recent decades, the real danger for the aboriginal peoples of the North has become toxic wastes, which was confirmed by AMAP working group of the Arctic Council. It seems that global warming contributes to the accumulation of hazardous wastes in both the environment and traditional food.

Many aboriginal people are already experiencing and discussing climate change. The rapidly occurring climate effects in the Arctic, which are dangerous for the whole of humanity, are for the indigenous peoples of the North an additional crisis factor. In the past, aboriginal people of the North could avoid climate cataclysms, changing their pasture paths and modifying their economic activities. Nowadays, their circumstances do not support such opportunities.

The ’way out’, which is greatly supported by the government, is the integration of aboriginal groups and their migration into inhabited areas; thus transforming them into jobless peoples or into “European”-style employees. This would mean the extinction of aboriginal peoples.

To these negative effects are added other issues: the inefficiency of the meteorological service and health facilities, the absence of effective partnerships between aboriginal societies, the effects of sustainable development programmes for aboriginal peoples, and the lack of future predictions, models of adaptation and basic information systems given to the population.

To protect the most vulnerable groups of aboriginal peoples from negative climate and social impacts, several governmental measures are requested.

To improve the effectiveness of those measures, an international project of scientific organisations and our association (RAIPON) could be set up, with a great deal of participation from aboriginal societies of the Russian North. On the basis of that project we could make further recommendations to lessen the threat of climate change.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: CIRCUMPOLAR INDIGENOUS PEOPLES

Lars-Anders Baer
President of the Sámi Parliament
SWEDEN

Circumpolar indigenous peoples, culture heritage, and development with identity

Indigenous peoples are among the first to face the direct consequences of climate change, owing to their dependence upon, and close relationship with, the environment and its resources. Climate change exacerbates the difficulties already faced by indigenous communities, including political and economic marginalisation, loss of land and resources, human rights violations, discrimination and unemployment. Although they contribute very little to the underlying causes of climate change, indigenous peoples are helping enhance the resilience of ecosystems they inhabit and are interpreting and reacting to the impacts of climate change in creative ways, drawing on traditional knowledge and other technologies to find solutions which may help society at large to cope with impending changes.

Indigenous peoples in the Arctic region depend on hunting for polar bears, walrus, seals and caribou, herding reindeer, fishing and gathering, not only for food to support the local economy, but also as the basis for their cultural and social identity. Some of the concerns facing indigenous peoples there include the change in species and availability of traditional food sources, perceived reduction in weather predictions and the safety of travelling in changing ice and weather conditions, posing serious challenges to human health and food security. In Finland, Norway and Sweden, rain and mild weather during the winter season often prevents reindeer from accessing lichen, which is a vital food source. This has caused massive loss of reindeer, which are vital to the culture, subsistence and economy of Sámi communities. Reindeer herders must, as a result, feed their herds with fodder, which is expensive and not economically viable in the long term.

Reducing vulnerability and implementing adaptation to climate change in the Arctic represents a significant challenge for the region given the predictions in the Arctic Climate Impact Assessment (ACIA, 2005) as well as other work such as the

Intergovernmental Panel on Climate Change (IPCC, 2007). Although ACIA did not specifically assess vulnerability or adaptation needs in the Arctic, it highlighted the climate trends and projected their impacts on Arctic environments and people. ACIA provides basic information that can inform the planning of vulnerability reduction and adaptation measures including at the local level. This Arctic Council project, VACCA (Vulnerability and Adaptation to Climate Change in the Arctic) was approved by the Arctic Council in 2007 and was designed to provide practical, useful knowledge and information sharing at different governance levels and for different sectors so that this learning can be incorporated into policies and decision making.

In the Arctic Council framework it has been undertaking studies, surveys, collected information on the expertise, previous and ongoing projects, and strategies and measures on vulnerability and adaptation to climate change in the Arctic. The greatest strengths of the survey and projects are the large number and the impressive variety of responses, showing that interest and capacity are increasing for, and are being used to deal with, climate change vulnerability and adaptation in the Arctic. The community-based projects are also important in demonstrating the bottom-up approaches that are used. One example is the *Ealát* projects in Norway. The use of local knowledge for dealing with climate change is also highlighted as being particularly important, with projects such as *Inuit Food* exemplifying the necessity and methods of doing so.

Recommendations:

Call upon UNESCO, UNEP, UNFCCC and other UN and intergovernmental organisations active in both climate change and related environments and active in the field of culture, education and research to incorporate in their deliberations and decisions acknowledgement of the importance of indigenous languages in conveying traditional knowledge and concepts which are an essential and significant element in understanding and responding to the impact of climate change in the Arctic. Furthermore, such organisations are asked to continue to recognise indigenous languages and cultures as essential elements of sustainable development in the North, as indicators of community well-being.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: CIRCUMPOLAR INDIGENOUS PEOPLES

Anastassia Lebedeva
Deputy Head,
Center of Nomadic Educational Institutions Development,
RUSSIA

The role of nomadic schools in the revival and preservation of the cultural heritage of indigenous peoples of the North and the Arctic.

The creation of nomadic schools has been provoked by a series of critical social problems: disappearance of traditional ways of life, disturbances to the ecological milieu in which indigenous peoples live, and poor social conditions. Nowadays, there is process of growing self-consciousness and outside recognition of indigenous peoples' cultures. Recently, among scientists, researchers and representatives of indigenous people of the North, worries have arisen about the loss of native language, culture and traditions. The foremost worry is about the process of loss by indigenous people of North of their traditions, valuable forms of national culture, and native languages, with concern for its complete extinction in certain places. All this leads to the destruction of national psychology and culture.

Presently, with connections to the national revival of small indigenous groups of the North, there is a process of renewal in the new form of nomadic schools. This is now recognised as the most suitable form of education within the North, under the influence of deep socio-economic and socio-political transformations. In the North, factors such as the preservation of nomadic or semi-nomadic way of life, the intensive exploitation of virgin and long-fallow lands, and the expansion of living area in boundless tundra and leso-tundra space play a crucial role. This stimulated the development of the mobile settlements which comprise the nomadic school.

At the same time, the nomadic school is seen in some ways as a dilemma, and there are supporters and adversaries of this form of education. Many call it ''golden'', because of the big financial investments and costs involved. Others think that for nomadic reindeer herders, those schools are vital. People who do not know the nomadic

people and their culture may be puzzled. Why have these people decided to restore, what would seem an old form of teaching in modern times, when the schools are equipped with new equipment and teaching aids, and when innovative technologies are utilised everywhere?

The benefit of nomadic schools is access to education. Thanks to nomadic schools, people of the North can now move without constraints along with the reindeer from pasture to pasture, and the children go to the school and receive a basic education in this environment, living with their parents and in family home. Thereby, the reindeer herd grows, children receive full fledged education, and parents maintain this traditional and vital activity.

The specificities and advantage of the nomadic schools are as follows: firstly, under the working conditions of reindeer and fishing brigades (teams) following the migration, the most adaptive form of management is family contact, whereby the children have the opportunity from an early age to experience their parents' skills and knowledge, and spiritual culture of the own people. Secondly, the schooled children are not torn away from the family home. Thirdly, children experience a strong bond to the environment and the sense of being an owner of indigenous lands from early age.

In the process of education it is easy to use the progressive facets of traditional education of indigenous people of the North, where the positive example of the father and mother is valuable. In particular, reindeer breeding and herding is a profession transmitted through generations from father to son, from mother to daughter. Children are constantly in close and contact with the environment, which influences and educates them to treat the vulnerable ecosystems of the North with care.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: CIRCUMPOLAR INDIGENOUS PEOPLES

Sharon McClintock
President/Alaska Native Claims Land Specialist,
McClintock Land Associates Inc.,
ALASKA

Indigenous land claims in Alaska

Alaska Native peoples have used and occupied lands in Alaska since time immemorial. Currently they occupy and utilise land based upon both private ownership rights and the Alaska Native Claims Settlement Act (ANCSA). ANCSA is the largest land claims settlement in US history and was signed into law in 1971. It extinguished long held aboriginal title and compensated the Native Corporations with $962.5 million for the land taken away. ANCSA provided for the formation of over 200 profit-making Village Corporations and 12 Regional Corporations who were vested with 44 million acres of land. Village Corporations received the surface estate while the Regional Corporations receive the subsurface estate. ANCSA had another purpose; to create a mechanism for economic development in Alaska, particularly in rural areas. The need for a land settlement was brought to the forefront by the desire by industry to develop the huge oil fields on Alaska's North Slope and the need to clear title to a corridor for an 800 mile oil pipeline to bring the product to market. Selection of ANCSA lands by the Native Corporations was based on several main values; First - for protection/control of culturally important areas, primarily for Subsistence use; Second - for control of coastal and transportation routes and areas; and Third – to control of areas of likely future development, primarily for subsurface mineral resources.

ANCSA lands located along Alaska's coastline realize serious threats to loss of their land base and subsistence activities due to erosion and flooding. Unseasonably warm weather, severe sea storms, and melting permafrost and the Polar ice cap is raising the sea water level, causing subsistence camps and some entire villages along the coast to be threatened by the sea. The sea-coastal villages of Shishmaref and Kivalina are built on sandy barrier islands or spits and are immediately dangerously affected. Attempts by the US Army Corps of Engineers to stabilise the erosion is a temporary fix bringing very stark revelation of

man's inability to control the results of this climate change. Gabions and seawalls designed to last 25 years may last 5 to 10 years or even be destroyed by the next storm. When a village decides to move their entire community, funds promised for the community improvement projects by the State and Federal government cease, leaving community to deal with social problems stemming from the lack of basic amenities such as sewerage, water and housing.

Relocation of villages requires coordinated efforts and tremendous amounts of money. It is difficult to find suitable sites that meet the minimal requirements of providing for subsistence activities while providing an area suitable for the development of modern "necessities" such as modern homes, water/wastewater facilities, schools, and airports. Obviously serious planning must be accomplished prior to a village relocation to make sure the society is sustainable. There is a general lack of understanding of how dramatically climate change is affecting Alaska villages and that third world conditions exist there. There is a crisis and a need to act quickly before the villages are wiped off the map, but there must also be adequate planning to make sure the new communities are sustainable. Land in Native control and ownership is the last hope for the survival of our peoples' identity, culture and economic viability.

Recommendations:

- The US Federal Government must enact special measures to ensure Alaska villages qualify for and receive federal assistance for erosion protection and relocation. Congress should also appropriate funding for villages to acquire lands from ANCSA Corporations or Native allotments for relocated village sites, since the most suitable lands are located on these sites.
- State and Federal Government agencies must fully coordinate efforts to plan and help Alaska villages establish a comprehensive relocation strategy and educate them on all of the necessary requirements. Planning should include the theme of "Sustainability" as a primary theme in all disciplines.
- Archeological studies of coastal historical sites and village sites must be performed to help document the past land use and culture of Inupiat people before they too disappear into the ocean.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: CIRCUMPOLAR INDIGENOUS PEOPLES

Jonathan Motzfeldt
Former Prime Minister, Greenland
MP, Greenland Parliament

Sustainable Development of the Arctic in the face of Global Climate Change seen from a Greenlandic viewpoint

Due to global climate change the Arctic, including Greenland, has experienced an enormous change in attention from the rest of the world, from being almost non-existent on the international political arena to being the focus of political fora and medias all over the world.

Greenland can only welcome this attention. It gives us new opportunities to explain to the world what life in the Arctic means and thereby attrack foreign expertise and finance to help us develop our part of the Globe.

Greenland has for thousands of years lived of and on the Sea. Hunting marine mammals and fishing has been the only way to survive in the harsh climate. It's less than three hundred years since the Europeans (Scandinavians) came to our shores and brought with them what is today known as urbanisation. Today about 60.000 people live in towns and settlements – but we see a very clear trend – the young people wants to live in bigger communities than before. Today our capital Nuuk houses about 25 % of the whole population

So the traditional hunters' and fishermen's community will disappear in the foreseeable future especially because climate change will speed up this development. It is very simple – no sea-ice, no seals, walruses, polar bears etc. In this respect the traditional hunters are part of the food chain.

But also international focus on marine mammals in respect of misunderstood protection plays a serious role. Wealthy animal welfare organisations have over the last 25 years focused on seal and whales and created a media hysteria which eventually will force the EU to pass legislation banning the use of seal products in the European Market and also bring a stop to our traditional whaling.

Not only does this mean that about 20 % of our population will have to find

new occupations, but also that the basis for our culture will vanish – and again the world becomes more uniform and culturally poorer.

We may still have a fishery in the future. Right now we depend on shrimp and Greenland halibut, but both stocks are fragile. We still wait for the cod to return in sufficient amounts for industrial fishery, but also here Climate Change plays a major role. Even small changes in water temperature can be of significant importance for the fish stocks.

My conclusion is therefore that we must find new alternative ways to create a basis for human existence in the Arctic. This –of course – is easier said than done, but it is not impossible. Let me give some examples:

It has been known for decades that Greenland has a very big mineral potential, and so far we have only knowledge about less than 5 % of the ice-free land. The present melting of the Ice Cap opens up new areas and mining companies from abroad show a still growing interest. We may face a temporary hold or even set back because of the international financial crisis but I am sure that we will see a number of operating mines within the next ten years.

Both mines and industries related to minerals need lots of energy. In Greenland we have invested heavily in hydro power. The capital Nuuk's need for electric power is today fully covered by hydro power and two more hydro power plants will be in operation shortly. This will give basis for new industries that can utilize among other things our enormous resources of freshwater.

It is also known that the Arctic holds hydrocarbon resources in a very big scale: This also is the case for Greenland. Climate change make access to these resources easier, so it is just a question of time before exploitation starts.

For Greenland it is a must – it is beyond discussion – that all these different kinds of operations are carried out in balance with the nature. Protecting the environment and ensuring sustainability are priority goals for Greenland. We know better than anyone else how fragile our nature is and we want to keep it.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: CIRCUMPOLAR INDIGENOUS PEOPLES

Klemetti Näkkäläjärvi
President, Finnish Saami Parliament,
FINLAND

The effects of climate change and international politics on indigenous cultures

The cultures and languages of the indigenous peoples of the Arctic have adapted to the arctic ecosystem. Arctic indigenous peoples live in nation states and have but limited influence on policies aimed at deterring climatic change. Indigenous peoples have always lived in accord with the principle of sustainable development. Over the last century, nation states through their actions have increasingly forced indigenous peoples to adopt more polluting forms of activity while simultaneously encroaching on the traditional forms of livelihood of indigenous cultures. Approaches to mitigate climatic change are being discussed in the Arctic Council, the Intergovernmental Panel on Climate Change, the UN, the Barents Cooperation organisations, and in the domestic politics of nation states. On all of these forums indigenous peoples are only spectators, their rights limited to observation or speech, depending on the organisation. It has been recognised on an international political level that the arctic indigenous peoples will suffer the most from climate change. Nevertheless we, who will be most affected by climate change, are sidelined from the policy-making process and largely also from the administration of our own territories. Climate change, the right of indigenous nations to self-government, and the UN Declaration on the Rights of Indigenous Peoples obligate nation states and international political organizations to include indigenous peoples as equal political partners in the struggle against climate change.

Article 8(j) of the UN Convention on Biological Diversity stipulates that countries shall "…subject to national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity…" International political institutions such as the Arctic Council are shouldering an increasing share of the responsibility in the struggle against climate change. Article 8(j) should be applied also to the functioning of the Arctic Council and other multinational organisations

that deal with matters pertaining to indigenous peoples.

Indigenous languages have developed under the combined influence of cultural resources, subsistence methods, geographical location, and climate. Indigenous languages contain information on natural phenomena, an exact and scientific method of classification, a record of how the culture has reacted and adapted to changes in the resource base, and information on how the culture's methods of subsistence have evolved. Due to climatic change and the actions of nation states, this linguistic information is threatened with extinction. Indigenous languages are not taught, and the transferring of the language to the next generation is not sufficiently encouraged. The connection of the language with subsistence practices and with the environment is disappearing with the appropriation of indigenous territories for the use of the industries of the dominant culture, the dwindling of possibilities for practicing traditional subsistence methods, and the spread of the social structures of the dominant culture.

The capability of indigenous peoples to utilise their linguistic knowledge in the struggle against climate change as well as in adapting to its consequences will decrease unless indigenous peoples are allowed to retain their aboriginal culture and language. Indigenous languages offer a facility for classifying, studying, and explicating the effects of climate change. The deployment of indigenous knowledge in adapting to and studying climate change requires a strong contribution from indigenous researchers and the development of a system of academic education suited to the culture of indigenous peoples.

Recommendations:

1. The application of Article 8(j) of the Convention on Biological Diversity to national and international political organizations, in cooperation with indigenous peoples
2. The development of systems of academic education and researcher training suited to the requirements of indigenous cultures, and the development of climatic research carried out by indigenous peoples
3. The founding of a climate panel of arctic indigenous nations
4. Revitalisation of indigenous languages as domestic, official, and scientific media

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: CIRCUMPOLAR INDIGENOUS PEOPLES

Alan J. Parkinson
Arctic Investigations Program
Centers for Disease Prevention and Control
Anchorage Alaska US

Climate Change, Human Health and Sustainable Development in the Arctic

The Arctic, like most other parts of the world, has warmed substantially over the last few decades. The warming trend is projected to continue, and may lead to significant economic and cultural upheaval particularly for the indigenous peoples of the Arctic.

Resident indigenous populations of the Arctic are uniquely vulnerable to climate change because of their close relationship with, and dependence on, the land, sea and natural resources for their cultural, social, economic and physical well being. Direct health threats from climate change 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 from increasing illness due to failing sanitation infrastructure resulting from changes in permafrost and storm surge. 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. Projected warming will affect the transport, distribution and behavior of contaminants, and human exposure in northern regions, further threatening the safety of the traditional food supply. 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. The potential impact

on human health will differ from place to place depending on regional differences in climate change was well as variations in health status and adaptive capacity of different populations.

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, organise and understand information that indicates changes taking place and emerging threats, as well as their potential impacts.

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.

"*Without health there is no sustainable development-without sustainable development there is no health*"

Recommendations:

1. Encourage action on the Arctic Council's Climate Impact Assessment recommendations in human health and climate change in the Arctic
2. Explore linkages within the Arctic Council's Sustaining Arctic Observing Networks process to establish an arctic observing network for human health.
3. Use the Arctic Council and other circumpolar partnerships to identify communities and segments of the population at greatest risk and to facilitate the design of community based monitoring and formulation of intervention and adaptation strategies.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: CIRCUMPOLAR INDIGENOUS PEOPLES

Duane Smith
Inuit Circumpolar Council (Canada) President,

The Sea Ice is Our Highway: The Importance of Sea Ice to the Inuit Way of Life

Based on an ICC Canada report that examines the historical and contemporary use of sea ice by Inuit, Duane Smith's presentation will describe the importance of sea ice in the lives of circumpolar Inuit in order to explain the challenges caused by climate change and melting sea ice.

With few exceptions, Inuit settlements are located on sea coasts or on major waterways with easy access to the sea. The usually ice-covered sea is their highway, the only physical connection between many Inuit communities and the only way to access many of the animals they depend on for food.

Interviews conducted by ICC Canada in March 2008 indicate that despite the increased difficulty in finding and harvesting big game and sea mammals due to thinning and less predictable sea ice, Inuit communities are persistent in maintaining their traditional diets. When asked whether changes in ice conditions were affecting their traditional diets, respondents spoke of having to travel further or in a different month than usual; they spoke of dietary substitutions such as hunting more musk-oxen when the caribou migration shifted away from their area, or they explained how melting permafrost has made the natural ice cellars used to age and store meat less effective. Not one of them said anything to suggest they were giving up on hunting despite the considerable challenges some were facing in getting out on the ice and land.

Inuit hunters have reported many changes in the locations and times that their traditional animals can be found. In some communities this is reducing the territory that hunters need to cover, while in others they have to travel much further onto the sea ice than before in order to harvest enough food for the communities. This is why Inuit are very concerned that sea ice routes remain passable for hunters as well as the migratory game they follow, and that the entire Arctic environment be kept free from contamination – both in the areas they are now using regularly and in those areas where they may need to hunt in the future.

Duane Smith's presentation will expand on these points and provide more detail on the interviews held with Inuit hunters and elders regarding the importance of sea ice to their way of life.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT: CIRCUMPOLAR INDIGENOUS PEOPLES

Chris Southcott
Professor, Lakehead University,
Research Associate, Yukon College, and
Chair, Research Outreach Program Team, University of the Arctic

Climate Change and Sustainable Development in Canada's Northern Communities

This presentation will discuss the impact of climate change in light of the challenges currently facing sustainable development in Canada's Northern communities. The first part will outline current research on the social and economic impacts of climate change on the region. The second part will attempt to answer the question of what needs to be done to ensure a comprehensive, interdisciplinary and multi-actor approach to achieving sustainable development in the Arctic. The final part of the presentation will deal with the modalities required for a long-term and sustained approach to addressing sustainable development in the Arctic and the need for a concerted effort at the increasing involvement of communities in the generation, transfer, and utilisation of knowledge relating to sustainable futures.

Few societies have undergone economic transformations with the rapidity that communities in Canada's north have over the past 100 years. These communities have moved from an economy based almost entirely on subsistence hunting and fishing, to an economy dominated by the industrial exploitation of natural resources, to an uncertain future in a world increasingly dominated by a knowledge-based post-industrial culture. These changes have introduced a great deal of stress accompanied by social and economic problems. Recent trends have increased the likelihood of challenges to a sustainable future but some have also offered promise for these communities to become increasingly involved in finding solutions to these challenges. Climate change is proving to add to these challenges. The central problem concerning climate change is that it is extremely difficult to determine its social and economic impacts.

There is good research being done on the impacts of climate change on health and food security. A changing climate is seen to have a possible negative affect on access to country foods. This would lead to less healthy diets and economic and cultural

problems. There is very little direct research looking at the economic or social impacts of climate change from the perspective of sustainable development. Recent studies examining the impacts of climate change on the vulnerability, adaptability, and the resilience of these communities is providing some information but much needs to be done.

Part of the problem stems from the fact that for many of these communities there are issues that are seen as more important than climate change. These communities suffer from many social pathologies that are difficult to attribute to climate change. Indeed, considering the past, it is not inconceivable that climate change might offer positive options. Additional evidence suggests that there is a great deal of variation between communities as far as climate change and its impacts is concerned.

The one issue around which a consensus seems to be developing is that greater community involvement and empowerment is the most sensible long term solution. Any strategy regarding the sustainability of communities in the Canadian Arctic needs to discuss ways of increasing human, social, and physical capital.

Recommendations:

- Very little research exists on the social and economic impacts of climate change on sustainability. A new research initiative looking at the issue in relation to the other challenges to sustainability would be welcome.
- Climate change is often seen as a less important problem than other issues facing their community. Climate change has to be understood as one of many challenges these communities are facing.
- Greater community involvement and empowerment through increasing human, social, and physical capital is the most sensible long term solution. Researchers, governments, and communities themselves must increase efforts to improve community empowerment through local knowledge generation, transfer, and utilisation.
- A new international initiative building on the work of the ACIA and other previous initiatives would greatly assist in bringing attention to the challenges facing the sustainability of communities in the Arctic.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT:
ECONOMIC DEVELOPMENT AND SOCIAL TRANSFORMATIONS

Ann Andreasen
Leader of the Children's home in Uummannaq
Director of UPI – Uummannaq Polar Institute (Art, Culture, Nature and People)
Greenland Home Rule Government
GREENLAND

On Thin Ice

My field of work is dealing with children and young people with difficult social backgrounds. These kids and their families are mainly a product of the rapid changes in the Arctic during the last 50 years. I work very closely together with local hunters and fishermen in the treatment of these children and young people. Through UPI, I also have had close contact with foreign scientists and research teams working with pollution and climate changes.

In the beginning the problems related to our work were caused by changes in culture and technology, but within the last 10 - 15 years the changes have also included climate changes, which is more of a problem today than the cultural and technological changes. Also the increase of pollution in the traditional Greenlandic food sources, such as seal and whale has become a major problem. People must earn more money to buy foreign food or risk getting sick if they continue to eat only traditional food.

As it is right now, for many people in Greenland, especially in the small villages and settlements in the outer regions, the only way to earn a living and support a family is fishing and hunting. Due to climate change this way of living has become more and more difficult. The lack of sea ice in winter and spring, and a generally more unstable weather with heavy unpredictable storms that often last for days have made the work as a hunter and fisherman very hard and dangerous, and make it difficult to live and even survive in the arctic.

If the families stay in the small villages or settlements they must endure periods of unemployment, which means very little money or even starvation. Because of this some start to abuse alcohol when times get tough and over time they get addicted.

This leads to social and personal disasters, with the children as the big losers.

Due to the generally low level of school education is it hard for these families to get jobs in the bigger cities further south on the coast. If they choose to move or get deported as a result of their settlements closing down, they often end up in ghettos abusing alcohol and then fail to raise their children well.

The dilemma for these people is easy to spot but not so easy to deal with. Their pride and traditionally culture keeps many alive but it is a struggle and if it lasts for many years, even some of the most stubborn will break.

My tribute to the conference will be a movie called “Silent Snow”. It shows the situation and worries of today’s people living in the arctic area, with climate changes and pollution as the main themes. The movie lasts about 13 minutes; it is in Greenlandic with English subtitles.

Recommendations:

- Stopping climate change and pollution is not something that is possible to do overnight. It will take many years of hard work, if it is even possible in our lifetime. With this in mind I think that it is important not to just sit back and wait for these changes to come. We need action to be taken as soon as possible to make life more feasible in the arctic. We need to help arctic people to a better life under the influence of climate change, which is already a reality.
- For arctic people this task is out of their own hands. They are the victims of a global problem and need help to overcome the devastating conditions of their daily life.
- One way to help these people is education. If they were better educated they could get access to jobs that are not dependent on weather and climate conditions or they could get jobs in the bigger cities. Furthermore education makes people feel more important, and more valued, which gives strength for them to endure some of the harsh times.
- While being educated it can be difficult to support a family because of the low fee you get from the Government. This makes some people to choose not to have an education, which leaves them with only one choice; to live a life where they are dependent on the weather and rapidly changing climate conditions. Therefore there is a need for some better conditions during the period of education.
- One of the options for Greenland could be an IT based industry, with programming, graphic design, animation and so on. For this to work there is a need for computers, education and knowledge in this field. This work could be performed even if you live in a small town or settlement, but will require education and proper internet connections.
- For a better educational level an improvement of language skills is also needed, primary Danish and English. But also other languages such as French and German can provide jobs in the tourist industry which is growing at present in Greenland and the arctic region in general.
- Last but not least, I believe that the knowledge gathered by scientists and researchers, should be more available to the public worldwide. If we do not implement this knowledge into the life of ordinary people then what good does it do? We need to make the general public more aware of the catastrophic and rapid changes in order for them to choose a more appropriate lifestyle, with less pollution.

My keywords to changes are better <u>education</u> for the arctic people, and more <u>information</u> to the public worldwide.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT:
ECONOMIC DEVELOPMENT AND SOCIAL TRANSFORMATIONS

Susan Barr
Directorate for Cultural Heritage,
Oslo,
NORWAY

Protecting cultural heritage and community roots

It is now a generally accepted fact that climate change is happening faster in the Arctic than in other regions of the world. The changes we see are milder temperatures, more, and wetter, precipitation, more stormy weather and less sea ice. All these changes have great effects on the cultural heritage of the Arctic, both directly and through the more indirect effect of greater accessibility to areas previously protected by sea ice hindrance. International history can loose its concrete manifestations and local communities can lose their tangible roots.

Direct effects of climate change on cultural heritage

The fixed (i.e. objects that cannot be removed to museums) cultural heritage of the Arctic consists of many types of remains of earlier human activities, both from the indigenous populations and from other visiting cultures. Examples include various types of early Inuit dwellings, explorers' campsites, graves and memorials, wooden huts, early mining installations, shipwrecks. While previously often described as "frozen in time", we now see that the milder, wetter climate is accelerating rotting, mould growth, rusting and disintegration of heritage sites.

The majority of sites in the Arctic are to be found along the coasts and the lack of sea ice – in particular the ice foot attached to the shoreline – together with more wind and wave effect, is seriously accelerating the erosion of shorelines with resulting loss of heritage sites. This can be seen all around the Arctic and affects heritage from 1200 year old native cemeteries (Nuvuk, Barrow, Alaska) to late 19th century whaling stations (Herschel Island, Yukon) and early 20th century explorers' sites in the Russian Arctic (Mys Flora, Franz Josef Land).

Knowledge gaps and action needs
In both the Arctic and Antarctic scientists are working to address the challenges mentioned above, which involve multi-disciplinary research from both science and the humanities. Methods to save sites from destruction by erosion are sorely needed.

Indirect effects of climate change on cultural heritage
The Arctic has received much publicity in recent years, and together with the fact of retreating sea ice, this has led to an extremely rapid increase in the tourist industry. Heritage sites which were previously preserved by their inaccessibility are now being exploited, for better and for worse. Considering the attraction of heritage sites, local communities can and do use them as a source of new income. While this can greatly benefit a community, it can also compromise both the community and the heritage sites. Heritage sites lying far from any settlements can be seriously damaged by increased visitation.
Knowledge gaps and action needs
The effects on and mitigation of increased visitation on sites, including general wear and tear and the disturbance or removal of objects needs to be better researched. Information concerning positive and negative effects of the exploitation of community heritage should be spread to potential new tourism areas.

Sustainable heritage?
Management plans for particularly valuable sites must be developed and enforced. Tourist guides and communities must cooperate to the advantage of both tourists and communities. Methods to stagger erosion and climate degradation of heritage sites must be developed and applied. Heritage sites generally should be well documented in case of unavoidable loss.

Recommendations:

- The preparation of an international assessment of significant heritage sites around the Arctic to present an overview to UNESCO and the Arctic Council of sites of particular international value that need special attention paid in the future to management and protection. cf: CAFF's (Conservation of Arctic Flora and Fauna) Arctic Biodiversity Assessment project.
- The development of a concentrated, international and multi-disciplinary programme to address the challenge of the increasing erosion of coastal cultural heritage sites should be initiated.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT:
ECONOMIC DEVELOPMENT AND SOCIAL TRANSFORMATIONS

Bernard Funston
Executive Secretary,
Arctic Council Sustainable Development Working Group
and President, Northern Canada Consulting

Sustainable Development of the Arctic: the Challenges of Reconciling Homeland, Laboratory, Frontier and Wilderness

This presentation will examine relationships among Arctic and non-Arctic interests. It will argue that it is not enough to simply advance scientific knowledge of the Arctic. The translation of Arctic knowledge (scientific and indigenous/local) into policy development and policy implementation is slow and poorly executed in some Arctic states and in most non-Arctic states. Arctic state and non-state actors can no longer simply talk among themselves. Non-Arctic state and non-state actors can no longer ignore their connection to changes in the Arctic. Both Arctic and non-Arctic interests must accelerate their efforts to find processes and mechanisms to improve dialogue and take actions. Even with immediate reductions in greenhouse gas emissions, the impacts of climate change on the Arctic, and on global systems generally, will continue. The primary search for mitigative solutions needs to be outside the Arctic. The search for solutions in the Arctic needs to be directed primarily at adaptation. A coordinated global approach is needed.

The Arctic can be analysed under four broad and often competing conceptualisations: homeland, laboratory, frontier and wilderness. Depending on how it is delimited, the Arctic is home to between 4 and 9 million people, including indigenous peoples. Hunting, herding, fishing, trapping, gathering and other renewable resource activities remain important components of indigenous cultures and economies. For the past few decades the Arctic has been a laboratory for increasing scientific research and cooperation, particularly during the current *International Polar Year*. For many nation-state governments and multinational corporations the Arctic is a "frontier" with potential for exploitation of important natural resources to feed global demands for energy, fresh

water and other minerals. Alternatively, many environmental and conservation organisations rooted in towns and cities outside the Arctic see this region and its flora and fauna as “wilderness” to be preserved in parks and protected areas.

While this way of characterizing Arctic affairs is an over-simplication, juxtaposing homeland, laboratory, frontier and wilderness helps clarify some of the values and goals of various stakeholders. The future of the Arctic will be determined by how these various values and goals are reconciled in regional, national and international law and policy. This reconciliation may well hinge on the ability of state and non-state actors to achieve sustainability and balance. In the Arctic, sustainability is often characterized as a blend of the best of the old with the best of the new. Balance is important because the values expressed through each of the conceptualisations of the Arctic (homeland, laboratory, frontier and wilderness) are politically legitimate and have to be taken into account in policy-making processes.

The Arctic is not a closed system. The presence of some sort of ‘Arctic Circle’ demarcating the southern-most limit of the Arctic has tended to “ghetto-ize” the region even within the Arctic states, setting it aside as a boutique issue that is often viewed in isolation, apart from mainstream national and international affairs.

Many of the drivers of Arctic change have origins outside the region. Quite simply, the solutions to many Arctic problems cannot be implemented by actions in the Arctic alone. While climate change and developmental pressures have potentially profound impacts on the ecosystems and peoples of the Arctic, changes in the Arctic also have significant implications for non-Arctic regions which are poorly understood and often overlooked by non-Arctic states. Non-Arctic regions may be unable to address some of their pressing local and regional problems without giving due attention to Arctic factors.

Therefore, the Arctic should be viewed as a barometer that is highly responsive to global processes. It may also be a trigger for a cascade of globally-important processes relating to ocean circulation and weather systems. In other words, the Arctic today is a tightly-coupled component of highly dynamic global biophysical, geopolitical and socio-economic systems. Such systems can involve shifts that may be both non-linear and abrupt. Even under normal conditions it is difficult to forecast or project their trajectories beyond the immediate future. We cannot say when dramatic changes will occur or what particular form they will take. Climate change could produce impacts in the Arctic that overwhelm existing adaptive capacity, not only in the Arctic, but in other regions of the globe.

Devising governance systems and management practices that are both resilient in the face of change and nimble in their ability to adapt quickly and effectively to new challenges is essential in situations of this kind. Soft and hard law tools will be required to deepen and broaden co-operation among Arctic states, but also to provide meaningful roles for non-Arctic states and non-state actors.

Recommendations:

- Greater attention could be given to expanding the dialogue among Arctic and non-Arctic interests in relation to the non-Arctic drivers of Arctic change and the significance of Arctic change for non-Arctic populations and economies. Arctic states in particular could accelerate efforts to expand the discourse with non-Arctic states though bodies like the Arctic Council.

- Political cycles in many western nations tend to be too short to foster implementation of long-term strategies directed at the social transformations which must underlie new approaches to sustainable economic development and global stewardship. Some practical and effective mechanisms (governmental and non-governmental) for continuity in policy development and policy implementation are required within states and among states.
- Addressing Arctic issues will require lateral thinking. While multilateral environmental agreements are one component, international trade agreements, research and development efforts and energy policies (to name only a few) must take into account the Arctic as a barometer of planetary change.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT:
ECONOMIC DEVELOPMENT AND SOCIAL TRANSFORMATIONS

Ilan Kelman
Senior Research Fellow,
CICERO, Oslo,
NORWAY

Ethical Livelihoods

Livelihoods refer to ways of living and working for acquiring the necessities of life such as food and water and for generating further cash and non-cash income. Examples of Arctic livelihoods are reindeer herding and extracting oil and gas. Desire for certain livelihoods forms and styles is the root of seeking economic development, leading to deliberate and inadvertent social transformations.

As industrial development for livelihoods continues and expands around the Arctic, such as for transportation facilities or mining, land use patterns change. That could be vehicles driving across tundra or settlements encroaching onto previously unsettled land. Industrial development also brings socio-economic change which is frequently increased reliance on cash-based purchases for goods and services; less reliance on one's own skills for food and shelter; immigration into the Arctic to pursue new, often opportunistic and short-term livelihoods; and emigration from the Arctic due to declining livelihoods opportunities of one's main interests or seeking new options.

Conflicts and trade-offs can occur amongst different livelihoods. Oil or diamonds might be sought or found on prime hunting and herding land. Increased use of shipping lanes for commercial products might interfere with nature-based or culture-based tourist cruises. Tourism also illustrates the challenge of livelihoods scales. Increasing tourism can increase income, but can then harm the solitude, wildlife, and landscapes that many tourists seek in the Arctic.

Consequently, ethical approaches can assist in developing and maintaining long-term livelihoods. Different ethical approaches might yield different decisions. "Do no harm" refers to assessing possible outcomes from livelihoods choices and avoiding as much social and environmental harm as feasible. Risk/benefit analyses balance risks

and benefits from livelihoods, while trying to manage and mitigate the risks. Utilitarianism seeks the greatest happiness or greatest good for the greatest number through livelihoods activities. Different cultures have different base ethics, while all ethical approaches have been critiqued and the limitations evaluated. No ethical panacea exists.

Nonetheless, asking ethical questions about livelihoods from varying perspectives helps to develop and maintain livelihoods that meet a large set of ethical criteria. Even without explicitly selecting a culture or approach for an ethics base, guidelines can be developed for making "ethical livelihoods" practical in reality and for assisting the analysis of livelihoods choices. Examples of operational guidelines are provided as the recommendations for discussion that accompany this summary.

With that starting point for ethical livelihoods guidelines to support Arctic sustainable development:

1. Where are the most severe gaps in knowledge and action?
    - How flexible are Arctic subsistence livelihoods given the expected social and environmental changes? Plenty is known about livelihoods vulnerability, but not enough is known about actions to take to adjust to these changes without excessive detrimental consequences.
2. What needs to be done to ensure a holistic, interdisciplinary and multi-actor approach?
    - Instill a better balance of Arctic livelihoods needs over different time scales, especially including subsistence living, rather than focusing on short-termism. Think beyond, without ignoring, political boundaries to seek livelihoods choices that support the Arctic and the world rather than supporting the most powerful interests of Arctic states.
3. What modalities are required for a long-term and sustained approach?
    - Adopt a sustainable livelihoods approach as a basis http://www.eldis.org/go/livelihoods.
    - Seek a better balance of criteria for livelihoods-related decision-making, not relying on macro-economic indicators and not seeking continual or maximal economic growth.

Recommendations:

These recommendations further represent sample, general guidelines for ethical livelihoods, as a starting point for discussion:

- Livelihoods choices should be selected on the basis of criteria from the sustainable livelihoods approach http://www.eldis.org/go/livelihoods rather than relying on macro-economic indicators or economic growth rates.
- Cultures and natural environments have non-quantifiable, non-financial, non-monetary values that must be considered when making livelihoods decisions.
- Indigenous land rights and subsistence livelihoods deserve full consideration, potentially even priority, when balancing conflicting Arctic livelihoods.
- When making livelihoods choices, all time scales must be considered, including many generations into the future, not just short-term gains.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT:
ECONOMIC DEVELOPMENT AND SOCIAL TRANSFORMATIONS

Alexander Pelyasov
Director of the Center for Arctic and Northern economies,
Council for Research for Productive Forces, Moscow,
RUSSIA

Arctic in the New Creative age (Arctic dimension of the knowledge economy)

1. The Arctic's major peculiarity – the route to the knowledge economy is undertaken under the condition of a very narrow or even absent industrial layer. There were no Fordism combines in the Arctic. The Russian Arctic was the one only exception. But even there in many territories post-industrial transformation is beginning only from the agricultural layer. In the Arctic we do not see division into labor and creative class, but mostly service and creative class.

2. We can distinguish four major models of the Arctic economy and correspondingly four specific routes to the knowledge economy: American, Canadian, European and Russian. In each of these models new post-industrial integration of the natural and economic systems, transformation from the industrial territories to the venture territories is undertaken under the conditions of global warming.

3. If we compare Arctic countries with non-arctic countries and regions we can reveal Arctic success in the general index of creativity. One of the reasons is that in the Arctic territories there are no brakes for innovations from the public institutions. We can postulate the existence of the Arctic (zone) model of creativity based on the internal unique characteristics of the Arctic communities.

4. Climate change will make the Arctic region more attractive for a skilled workforce. The goal to fight more energetically to attract a skilled workforce is a must for every Arctic region. Arctic labor contracts should be adjusted to better correspond to the needs and values of the skilled people from outside.

5. The key features of the Arctic communities are tolerance, and an open character. These are essential strengths for the knowledge economy.

We do not have anti-global movements throughout the Arctic zone. This is very

interesting and encouraging phenomenon. Its reason should be clarified.
Policentric world for the Arctic means that we should be ready for very pluralistic, multi-ethnic Arctic communities and activities including actors from the BRIC countries (Brazil, Russia, India, and China). Arctic identity is very specific as it has a network, not a compact, character. It is dispersed throughout the Arctic communities. We should think about how to construct and strengthen global Arctic identity.

6. Making cooperation work in the Arctic communities means network-building between Arctic and non-arctic communities, inside Arctic settlements globally. The strength of the network's economic effects is one of the useful examples of the Arctic for the rest of the world.

We should use network solutions to attract a skilled workforce to the Arctic (case from Finland - South Ostrobothnian University Network). Climate change will influence network-building in the Arctic and we should use new possibilities to enrich and enlarge contemporary Arctic networks.

7. Indigenous peoples are Arctic 'hackers' in the sense that they are accustomed to sharing information and food free of charge. These features are intangible assets for the knowledge economy. Native villages are laboratories of tacit knowledge. One needs to learn how to divide tacit knowledge into pieces and standardise it to make it useful for everybody in the Arctic.

8. Arctic tourism can be seen as the materialisation of the intangible assets of the Arctic zone. One need is to transform common eco-tourism into spiritual tourism (experience tourism) to better adjust it to the challenges of the creative age.

Recommendations:

- It is important to elaborate common Arctic standards in the various branches of the economy, environment, NMR transportation, education, finance, e-commerce, insurance, trade and tourism, and labor market. These standards will be internationally recognised. They will simplify economic, social, cultural cooperation between Arctic regions and countries. The nearest example is EU experience. Arctic territories should elaborate quasi-EU standards for their own purposes.
- Under the pressure of climate changes Arctic territories should elaborate internationally recognised new institutions (norms, rules of behavior) for the economic agents in the Arctic, for Arctic communities.
- New PR initiative "United Arctic"/relay race: from Russian Chukotka in the coastal settlement of Uelen (or Lavrentiya) production begins of an Arctic souvenir, which is then transmitted further to the next settlement where new details to this souvenir will be added and so on until it reaches the last coastal settlement in the State of Alaska.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT:
ECONOMIC DEVELOPMENT AND SOCIAL TRANSFORMATIONS

Odd Rogne
Senior Advisor,
AMAP & IPY IPO
NORWAY

The Need for Arctic Data (Sustaining Arctic Observing Networks - SAON)

The Arctic is undergoing considerable changes due to climate change, contamination, biodiversity loss and changes to the physical environment, which have serious impacts both inside and outside the Arctic. Trends indicate that the severity of the impacts is projected to increase in the near future. Natural capital and prospects for human development may be undermined.

Arctic countries and their people are faced with new environmental, economic and social challenges. Global activities affect the Arctic environment while changes in the Arctic environment have global consequences. Hence, the broader global community must be engaged in improved monitoring of the Arctic to better understand the changes and their affects, and must address the social and human dimension in Arctic observations.

The need for comprehensive, sustained and interdisciplinary Arctic observations and data management has been identified previously in several international reports (ACIA, ICARP II etc.) The International Polar Year 2007-2008 (IPY) provided an opportunity to initiate new observing activities in the Arctic. However, we do not know which of these programmes will survive in the long-term.

The present status of Arctic data is that they are mostly fragmentary, hard to find or access, lacking pan-Arctic coverage etc. This distressing state of affairs has been realised by many user groups, and prompted the Arctic Council (a high level intergovernmental body with all Arctic states and Arctic indigenous peoples as regular members) to agree in their Salekhard Declaration (November 2006) to:

"Urge all Member countries to maintain and extend long term monitoring of change in all parts of the Arctic, and request the Arctic Monitoring and Assessment Program to

cooperate with other Arctic Council Working Groups, the International Arctic Science Committee and other partners in efforts to create a coordinated Arctic observing network, that meets identified societal needs"

This initiative has become known as the 'SAON process' in which the Arctic Council and 12 other international organisations have made a joint effort to identify a strategy for 'Sustained Arctic Observing Networks' (SAON), as well as identifying actions to be taken.

The SAON process has so far consisted of 3 major international workshops, 2 regional meetings and numerous consultations. A special effort has been made to have all observing communities (governmental agencies, scientists, and local/indigenous communities) well represented, as well as participation of all sorts of users and stakeholders.

The SAON Report ('Observing the Arctic') was finalised in December 2008, and is now under consideration by the Arctic Council and the other organisations involved. The final discussion of the SAON Report, including actions to be taken, is expected at the Arctic Council Ministerial meeting in April 2009.

The SAON recommendations include advice to national governments on actions to be taken on sustaining and increasing current level of observing activities; creating a data dissemination protocol to make data and information freely, openly and easily accessible; establish national inter-agency group to coordinate and integrate their Arctic observing activities; and finally to welcome non-Arctic states and international organisations as partners.

The basic SAON strategy is to:

- Build on existing (or developing) networks (governmental agencies, research, community-based), aiming at covering all the Arctic, meeting all societal needs, and collecting data long-term;
- Focus on making networks meeting societal needs sustained (funded long-term); and
- Address a number of key issues that transcend individual networks or national capabilities.

Recommendations:

All observing and data networks being presented at the UNESCO Monaco meeting are or will fit under the SAON umbrella, and will benefit from this initiative. Consequently, the UNESCO Monaco meeting (like Arctic Parliamentarians, the EU Arctic Monaco meeting etc.) is strongly encouraged to:

- Support and encourage the Arctic Council and their partners to sustain and increase Arctic observations, and related data and information management services.
- Take concrete actions for ensuring long-term national as well as trans-national funding for observing platforms, data archives, and information management services.
- Assist in filling current gaps (temporal, spatial, and disciplinary) in Arctic observing and data services.

United Nations
Educational, Scientific and
Cultural Organization

Organisation
des Nations Unies
pour l'éducation,
la science et la culture

International Experts Meeting

Climate Change
and Arctic Sustainable Development :
scientific, social, cultural and educational challenges

3-6 March 2009, Monaco

ABSTRACT:
ECONOMIC DEVELOPMENT AND SOCIAL TRANSFORMATIONS

Marianne Lykke Thomsen
Senior Policy Advisor
Dept. of Foreign Affairs
Greenland Home Rule Government

Sustainable Development of the Arctic in the face of Global Climate Change:
Challenges and Opportunities in the case of Greenland.

Climate change and its potential impact on the society is considered important, but has not yet reached the very top of the political agenda in Greenland. This is despite the fact that Greenland tends to be at the centre of the international climate change debate.

Over the past 30 years, the overall political goal of the Greenland Home Rule Government has been to establish an economic sustainable society. This effort continues today and has been one of the most important drivers towards greater political self-determination.

As a result, the Greenland Home Rule Government will, this year on June 21 - with the clear consent and approval of the Greenland people - transform into Greenland Self-Government, whereby its powers will be extended even further.

This major and historic achievement, combined with the attention and many activities generated by the process to renew the Kyoto protocol, gives new momentum to climate change issues as they clearly impact on political and economic developments in Greenland.

In this context, it is important to note that there are many challenges ahead but also some potentially rewarding opportunities. This presentation attempts to highlight some of these challenges and opportunities as they relate to both sustainable development and climate change and to the responsibilities following Greenland's assumption of additional political decision-making power.

A couple of observations include the fact that increasing sea temperatures may have dramatic consequences for traditional occupations such as small scale hunting and fishing in which stable sea ice is essential for the hunters and fishermen to be able to get

to the hunting and fishing grounds.

It is date impossible to predict exactly how changes in sea currents will impact on the biodiversity and thereby on both small scale hunting and fishing and industrial fisheries. Fisheries currently constitute 86 % of Greenland's export revenues.

To potential benefits may be counted the increased access to previously ice covered areas with oil and gas deposits, which may be extracted more easily.

Warmer temperatures in South Greenland may indeed aid the farmers in their attempt to increase agricultural production and the breeding of livestock. The overall dominating sheep farming has, over the past few years, been supplemented by cattle, and the variety and distribution of local agricultural products have been on the increase.

These and other factors put pressure on Greenland to continuously adjusting its economic development strategies in order to maximize benefits and minimize disadvantages.

Recent developments, which will culminate with the introduction of the new Self-Government seems to boost the political and industrial self-esteem. Greenland may, after all, be able to make significant contributions sustainability of the Arctic – in the face of climate change.

Recommendations:

- Promote the implementation of the United Nations Declaration on the Rights of Indigenous Peoples, in particular the right to self-determination including ownership and control of lands, territories and natural resources.
- Promote and support the participation by indigenous peoples and Arctic communities in all processes and negotiations concerning climate change mitigation goals and measures, as these will have a major impact on the opportunities for sustainable economic, social and cultural development in the Arctic.
- Ensure local ownership to climate change adaptation strategies by basing capacity building efforts on local knowledge and practices as well as cultural values.
- Ensure that communication, outreach and education strategies on climate change mitigation and adaptation are involving and targeting relevant stakeholders.