

Summary Report on the Sixth Assessment Steering Committee (ASC) Meeting, October 15-18, 2000, Seattle, Washington, USA

Opening

ASC Chairman Bob Corell opened the meeting at 8:30 a.m. on Monday, October 16, 2000. This was the first meeting of the ASC that included the lead authors of the chapters in the assessment.

The draft agenda (Appendix 1) was approved with the following changes:

- discussion of the budget was moved up to Tuesday instead of Wednesday
- there would only be three break-out groups on Tuesday
- there would be an additional plenary session on Tuesday afternoon

Participants introduced themselves. They are listed in Appendix 2.

Since this was the first meeting of the augmented ASC, Bob Corell briefly outlined the background of ACIA and the proposed structure of the assessment.

Pål Prestrud, Vice Chair of the ASC, reported on the Barrow Ministerial meeting of the Arctic Council at which he had made a presentation on ACIA. He reported that the Ministers in the Barrow Declaration:

- endorsed ACIA as a joint AMAP-CAFF-IASC project;
- acknowledged establishment of the Assessment Steering Committee to coordinate ACIA;
- approved the goals and objectives contained in the ACIA Implementation Plan; and
- requested that AMAP and CAFF working groups, in consultation with the Sustainable Development working group, promote the availability of the necessary social and economic expertise to complete the assessment.

The full text of the Barrow Declaration is available on the Arctic Council website at <http://arctic-council.usgs.gov/barrow/barrow2000-info.html>. Pål noted that the Swedish delegation commented on (1) the need for all Arctic countries to participate in a balanced manner, (2) the lack of women on ASC, and (3) the desirability of involving Arctic Council permanent observers on the ASC. In addition, he announced that Terry Fenge of the Inuit Circumpolar Conference had been named as the second indigenous peoples' representative on the ASC.

Bob Corell reported on his meetings with officials in Canada and Sweden and promised to schedule meetings in Russia, UK, and other involved countries. He encouraged all ASC members to help with outreach efforts whenever opportunities arise. He noted that he and Bob Watson are in close contact regarding ACIA and will shortly exchange letters that

specify how IPCC and ACIA will collaborate. This is being done in anticipation of ACIA contributing to the IPCC Fourth Assessment.

Bob Corell defined vulnerability as the difference between cumulative impacts C and adaptation potential A, symbolically $V = C - A$. A small group of scholars have tried using experimental methods as a vulnerability assessment strategy, and Bob thought ACIA might wish to use this methodology in part of its assessment. He said he would come back to the group at a later date with a more substantive proposal on this topic.

Plenary discussion: What is the ACIA?

Executive Director Gunter Weller reviewed the expectations from this meeting:

- a plan for early attention to Arctic climate models and scenarios,
- inclusion of traditional/Native knowledge in the assessment,
- selection and recruitment of contributing authors, and
- reactions to and revisions of the chapter outlines that were developed at the ASC meeting in Copenhagen.

There was a general discussion of how models and scenarios were developed and applied in IPCC and what this group could learn from that experience. John Walsh reported on a recent IPCC modeling meeting at which agreement was reached that Arctic climate studies should (1) make maximum use of models that already exist and (2) build on the best available high-resolution Arctic models. John reported on the Community Arctic Modeling Project (CAMP) being developed at the International Arctic Research Center and that will be proposed to NSF for support. The project includes: (1) intercomparison of existing Arctic models, (2) optimization for Arctic climate simulations, and (3) application of the model for scenario development in ACIA. He acknowledged that timing is a problem, since it seems that ACIA will need the model results before CAMP can produce them. In response to a discussion on how model results and scenarios can sometimes be considered alarmist by the public, John thought IPCC could show the way to present a range of possible model outcomes without being alarmist.

Betsy Weatherhead pointed out that modeling efforts are an exciting area for members of the scientific community who are studying UV and ozone. She said the best models to date are two-dimensional and do not include latitudinal effects. She thought it would be challenging to connect ground level UV levels with stratospheric ozone levels in models and that a lot of work remains to be done in this area. She noted that there is a CAMP-equivalent model for UV that ACIA can use.

The group discussed the role of social science in the ACIA, together with the contention by Native communities that insufficient attention is being paid to their experience and knowledge. David Klein asked that more attention be paid to Native peoples, but he acknowledged that this is against a background of scientists' not paying any attention to Native concerns in earlier times. Jim Berner suggested that attention be paid to Native

peoples throughout the assessment wherever this is appropriate. Bob Corell noted that Native people have their own peer review system, though it differs from the more familiar scientific system. While it was agreed that the assessment should retain a separate chapter on impacts of climate change on Native people, the ASC decided that the lead and contributing authors of that chapter will be asked to provide appropriate material on human dimensions for use in all the other chapters of the study.

Outline of the assessment report

Participants focused their attention on the outline of the assessment report that had been developed at the ASC meeting in Copenhagen.

It was agreed that the impacts on humans of climate change and increased UV radiation should be discussed in the introduction of the study. It was also agreed that the report will have three main sections, with each section containing an introduction or chapeau that shows the linkages among physical, biological, economic, social and cultural systems. Each of these introductory sections should be fairly complete, not just a simple statement that "This section has chapters on the following topics...." Synthesis can and should be done at multiple places throughout the study.

Lars-Otto Reiersen suggested that ACIA sponsor a workshop in Russia within the next year to gain access to and summarize the climate-related research that is being done there. The ASC accepted this suggestion.

Contributing authors

Next the participants turned their attention to the topic of selecting and recruiting contributing authors.

Bob Corell emphasized that the contributing authors of each chapter in the assessment will serve as members of a team that is assembled by the lead author of that chapter. Consulting authors can also help. The Secretariat was instructed to keep a very accurate list of all the people who contribute to the assessment in order that their contributions may be acknowledged. The scientific capability of the individuals involved is the primary consideration to be used in recruiting both contributing and consulting authors. While lead authors may ask individuals about their availability to serve as contributing authors, lead authors should not issue an invitation to serve. This may only be done after approval by the ASC.

Gunter Weller reminded the committee that the Secretariat had earlier solicited the names of qualified individuals from a variety of sources: IASC, AMAP, CAFF, Arctic Council representatives, ARCUS, Indigenous Peoples Secretariat, Northern Forum, IABP, etc. He provided lists of names that had resulted from this solicitation, while noting that these lists

were not binding in any way. He urged lead authors to keep redundancy in mind as they considered potential contributing authors, since some would not be able or willing to participate.

Bob Corell remarked that recruitment of contributing and consulting authors is not restricted to the eight Arctic nations. He thought it likely that the assessment would include participants from Germany, UK, etc.

Revised assessment outline

At 8:30 on Tuesday, October 17, Pål Prestrud presented a revised outline of the assessment that had been developed by a small committee during the previous evening. This outline was accepted by the ASC as a working document for the remainder of the meeting. Because it was subsequently superseded by the "First Order Outline" given in Appendix 3 of this report, all references to chapters in the assessment are based on the First Order Outline in Appendix 3.

ACIA budget

Gunter Weller described the items in the ACIA budget as they are known at this time. Fundamental to this description was the understanding that the U.S. National Science Foundation (NSF) and National Oceanic and Atmospheric Administration (NOAA) will support ACIA Secretariat costs, including US \$20,000 for use by the lead author(s) of each chapter in the assessment and some limited funds to support Russian participation. It is expected that each of the other Arctic countries will support participation by its lead and contributing authors.

Gordon McBean stated that the Canadian government is prepared to support the costs of its participants, including meetings, etc.

Erland Källén suggested that it would be useful to have statements concerning financial support from all participating countries, and the ASC agreed that it should seek such statements from all Arctic governments. There was general agreement that all countries will be in better shape to respond to this kind of request once they know how many lead and contributing authors they are expected to support.

Pål Prestrud said that the government of Norway is considering a budget item of about US \$350,000 for support of ACIA-related activities.

The ASC instructed the Secretariat to put together a spreadsheet that would show what each country is contributing to ACIA.

Bob Corell noted that this highlighted the question of how the ASC is to interact with national governments. He thought that the ASC needs a point of contact with each Arctic national government.

The ASC instructed the Secretariat to assemble a list of points of contact to national governments. It also noted that ACIA-related information should go to governments through AMAP and CAFF representatives in addition to these designated points of contact.

In answer to questions about the role of environmental groups and industry, it was agreed by the ASC that it should put more effort into looking for non-governmental organizations that can serve as financial partners and also contribute intellectually.

Break-out groups

Participants broke into three break-out groups:

- Gordon McBean assembled a break-out group representing (new) chapters 2, 3, 4, 5, and 15
- Harald Loeng assembled a break-out group representing (new) chapters 6, 7, 8, 12, and 13
- Henry Huntington assembled a break-out group representing (new) chapters 9, 10, 11 and 14

The Executive Director charged these break-out groups to consider and report back on:

- An outline for each chapter
- A strategy for creating writing teams, suggesting names of potential contributing authors, and a first order cut at steps that will move each chapter forward
- Special needs of each theme or chapter
- Things the ASC should do to help get the job done
- Attention to scenarios and models

At a brief plenary session after lunch, the break-out groups reported on their progress. Participants saw numerous opportunities for cross-referencing material in the various chapters of the assessment. It was agreed that authors should not wait for the Secretariat to identify areas of overlap and potential duplication; they should take the initiative to communicate with authors who are working on similar or related topics. It was also agreed that the Secretariat should circulate the schedule of workshops so that authors could attend one another's workshops.

The ASC decided that it should see the lead authors' lists of recommended contributing authors so it can approve the final list. This will be handled by e-mail.

Glenn Juday asked whether standard databases could be made available so all authors can have access to them. Gunter Weller replied that the Secretariat can make them available, and this is provided for in the Secretariat budget.

The break-out groups returned to their deliberations for the remainder of the day.

Final plenary session

On Wednesday, October 18, the three break-out groups of the previous day reported on their progress. Their revised chapter outlines are included in the First Order Outline in Appendix 3.

A few noteworthy items:

- The lead authors of chapters 2, 3, and 4 intend to act as a single team.
- Betsy Weatherhead has agreed to be a co-lead author for chapters 2, 3 and 4
- The scenario development workshop is proposed for 29-31 January 2001 in Stockholm for about 30 people
- The assessment should include definitions of climate change and climate variability
- The titles of some chapters were changed
- Treatments of terrestrial and freshwater ecosystems were separated, though they may later be combined
- An indigenous group will be assembled to help provide Native perspectives for all chapters in the assessment that need that kind of assistance
- Contributing authors for chapter 14 on human health had already been recruited at an international meeting held a couple weeks previously
- Nobody was present to speak to chapter 12 on fisheries and aquaculture

Bob Corell instructed the Secretariat to create a First Order Outline of the study and circulate it to the ASC for comment. This will lead to a subsequent "Operative Outline."

Gunter Weller asked that lead authors look into the availability of qualified people to serve as contributing authors and notify the Secretariat about their availability as soon as possible.

It was asked if the ASC needs a lead person for data and graphic support. The ASC decided that a committee of Gunter Weller, Pål Prestrud, Erland Källén and Bob Corell will look into this matter.

The ASC decided that the Operative Outline of the assessment will be shared with AMAP, CAFF, IASC, and the Senior Arctic Officials. It is considered important that they understand and approve its content.

It was agreed that, for handling issues that develop between ASC meetings, a person from each of the break-out groups will be added to the ASC Executive Committee.

The Secretariat was instructed to create a detailed schedule for the next two years, followed by a less detailed schedule for the succeeding two years.

The ASC accepted the invitation of the Government of Iceland to hold its next meeting in Iceland in April 2001. The Secretariat will handle detailed planning for that meeting. The following meeting will be in October 2001.

The ASC asked Bob Corell to consult about a lead author for the chapter on fisheries and aquaculture and then seek ASC approval via e-mail.

The meeting of the ASC was adjourned at 12:25 on Wednesday, October 18, 2000.

Respectfully submitted,

Tom Murray

Appendix 1

ASC Meeting, Seattle, 15-18 October University Inn, 4140 Roosevelt Way NE

AGENDA

Sunday, 15 October

19:00 Informal get-together and dinner

Monday, 16 October

8:00 Continental breakfast

8:30 Opening remarks by Chairman Corell

9:00 - 12:30 Plenary discussion: What is the ACIA?

- ACIA Version 3.7 including timetable
- Need for modeling and scenarios
- Inclusion of traditional/Native knowledge
- "Vulnerability assessment"

14:00 Plenary discussion: What is the ACIA?

- The ACIA themes and outline of each chapter
- Compiling a list of contributing authors for each chapter

19:00 Dinner hosted by the ACIA Secretariat

Tuesday, 17 October

8:00 Continental breakfast

8:30 Brief plenary session to discuss breaking into smaller groups

9:00 - 12:30 Convene in smaller groups to work on ACIA implementation plan

- Chapters 1, 2, 3, 4, 13: climate, modeling, physical environment
- Chapters 5, 6, 10, 11: terrestrial and marine, fisheries, forestry and agriculture
- Chapters 7, 8, 9, 12: Natives, subsistence, conservation, health

14:00 - 18:00 Continue to re-write chapter outlines and compile lists of contributing authors

Dinner on your own

Wednesday, 18 October

8:00 Continental breakfast

8:30 - 12:30 Plenary discussions of any remaining issues

- ACIA budget, including funding of lead authors
- ACIA Brochure and website

12:30 End of meeting

Appendix 2

Participant List Assessment Steering Committee Meeting University Inn, Seattle, WA, 15-18 October 2000

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**ARCTIC CLIMATE IMPACT ASSESSMENT
FIRST ORDER OUTLINE**

THE ARCTIC REGION

Preface: Purpose of ACIA—structure (sectoral vs. regional, etc.), philosophy, connections

Chapter 1: The Arctic System

1. Arctic overview—definition, characteristics, etc.
2. Humans in the Arctic: who, indigenous, demographics, activities, etc.

THE ARCTIC AS PART OF THE GLOBAL CLIMATE SYSTEM

Chapeau

Chapter 2: Climate System and the Roles of Ozone and UV Processes on the Planet and the Arctic (Lead authors: Gordon McBean, Petteri Taalas, Betsy Weatherhead)

1. Description of the global climate and ozone systems
2. How does the Arctic system interact with the global system?
3. Importance of oceans, sea ice, clouds, dynamics, aerosols, etc.
4. What are the extra-arctic influences, e.g., El Niño, North Atlantic Oscillation, etc.
5. How do the climate and ozone systems interact?
6. Global balances of GHG and ODS and the role of the Arctic as a source or sink
 - Reference IPCC conclusions, TAR Working Group 1, Chapter 1, global
 - Reference IPCC conclusions, TAR Working Group 2, Chapter 16, Polar (Arctic subset)
 - Reference AMAP (Table of Contents, Chapter 11, items 1-6)
 - Reference UV: AMAP Chapter 11, IASC UV report, WMO Ozone Assessment, Solomon's Nature paper
 - Feedbacks

Chapter 3. Past and Present Changes of Climate and UV: Climate Variability and Change, Ozone Processes and UV Increases in the Arctic Region (Lead authors: Gordon McBean, Petteri Taalas, Betsy Weatherhead)

1. Arctic paleoclimate and historic record
2. Arctic observational (climate, ozone, UV)

3. Emphasis on the long-term (back to last glaciation, with earlier information with respect to variability and possibility of rapid changes) - deal with last few decades in chapters 5,6,7
4. Understanding and quantifying natural variability
5. Information on extremes and rapid changes
6. Include precipitation minus evaporation (input to chapter 5)
7. Information on the quality and quantity of observing systems (climate and ozone/UV) in arctic region
8. Indigenous/local knowledge (as a distinct source of data)
9. Sub-regional variability (present vs. paleo)

Chapter 4. Future Changes of Climate and UV: Modeling and Scenarios for the Arctic Region (Lead authors: Vladimir Kattsov, Erland Källén, Betsy Weatherhead)

1. To what extent do (can) the global models describe physical climate and ozone/UV processes in the arctic region?
2. Arctic regional modeling - ocean, ice, atmosphere - resolution?
3. Build upon IPCC, use scenarios A2, B2, CMIP information - focus on 2020, 2050, 2080(2100) for time slices
4. A set of scenarios and their interpretation, uncertainty and limits of predictability (with or without stabilization)
5. What variables are needed for impact studies?
6. Changes in frequency and extent of extreme events
7. What can be said about future changes for the sub-regions and sub-annual times scales (seasons)?

PHYSICAL AND BIOLOGICAL SYSTEMS AND RESPONSE TO CLIMATE CHANGE

Chapeau: Current knowledge of components, including humans and how climate change is propagated through the system.

Chapter 5. The Cryosphere and Hydrologic Variability (Lead author: John Walsh)

1. Precipitation minus evaporation (primarily in Chapters 2-3)
 - uncertainties in observational estimates
 - recent variations in P-E
 - river discharge – recent variations
 - projected changes
2. Sea ice
 - influences on global circulation
 - growth and melt – climatological distribution
 - ice thickness – recent variations

- horizontal transport (esp. to North Atlantic)
 - extent and concentration – recent variations
 - projected changes
3. Snow cover
 - albedo variations and parameterizations
 - albedo-temperature feedback
 - influence on global circulation
 - recent variations in snow coverage
 - projected changes
 4. Glaciers, ice sheets
 - factors affecting mass balance
 - recent variations
 - freshwater fluxes to oceans
 - projected changes
 5. Permafrost
 - factors affecting extent, thickness
 - recent variations
 - projected changes

Chapter 6: Terrestrial Ecosystems (Lead author: Terry Callaghan)

Pre-Section Chapeau: Rationale for approaches within the section

- Distribution, extent, characteristics and human dimensions of Arctic terrestrial ecosystems and organisms. *Will adaptation to cold and historically low UV-B environments constrain responses to warming and increased UV-B?*
- Past and current dynamics of Arctic terrestrial and freshwater ecosystems. *How are dynamics related to climate? (includes indigenous knowledge)*
- Effects of changes in climate and UV on Arctic organisms. *What changes have been seen? Are these caused by climatic changes? What changes do we expect to see? When do we expect to see changes? (includes indigenous knowledge)*
 - Plants
 - Animals
 - Micro-organisms
- Effects of changes in climate and UV on Arctic ecosystems. *What changes have been seen? Are these caused by climatic changes? What changes do we expect to see? When do we expect to see changes? Will climate and UV-induced changes at the ecosystem level be identified before or after those at organism level? (includes indigenous knowledge)*
 - Ecosystem structure, in terms of
 - trophic interactions and

- biodiversity
 - Ecosystem function in terms of
 - Carbon and nutrient cycling and other soil processes
 - Primary and secondary productivity
- Effects of changes in climate and UV on arctic ecosystems at the landscape level.

How will the various positive and negative feedbacks to climate and UV balance? How strong or weak is their signal compared to noise? How will the patchiness of landscapes change? How will distributions of biota change?

 - Carbon emissions
 - Albedo
 - Disturbance
 - Vegetation and animal redistribution, e.g., treeline movement
 - Interactions between terrestrial and freshwater ecosystems
 - Interactions between terrestrial and marine ecosystems
- Uncertainties: comments on constraints of methodologies and requirements for new data bases
 - Methodologies
 - Scaling up and down
 - Observation *versus* experimentation and inter-comparison of different methodologies
 - Need to fill in gaps in geographical coverage
- Synthesis: sub-regional scenarios – vulnerability, sensitivity, “adaptation”

Post section pre-synthesis: scenarios of linkages between sections

Chapter 7: Arctic Freshwater Ecosystems (Lead author: Jim Reist)

- Types, structure and function of arctic freshwater ecosystems:
 - Types: large, deep lakes; small, shallow lakes; tundra standing water and ponds; small-medium, local rivers; large northward flowing rivers; simple systems (high arctic) vs. complex systems.
 - Organisms/trophic components: nutrients; microbes/microplankton; autotrophs; heterotrophs; fish – freshwater and anadromous (temperature guilds); plankton and benthic issues.
 - What they are (components); how they function (processes and linkages); seasonality and structure of ecosystems (e.g., thermoclines and lake types).
- How environmental variables are mediated into aquatic ecosystem processes and components:
 - Temperature, precipitation, wind – degree days, amounts and form of precipitation and how these translate to productivity.

- Seasonal variability and limits, timing of events (e.g., fall rain).
 - Gaps in understanding.
 - Lag times between abiotic input and biotic response.
- Past changes in arctic aquatic ecosystems:
 - Long-term (development since deglaciation); unglaciated areas; paleorecords (e.g., diatom profiles)??
 - Short-term historical record; knowledge base (quantitative, qualitative, scenario?)
 - Potential adaptability to change and relationship to system complexity.
- Effects of change in climate and UV on aquatic organisms:
 - Internal physiological processes and individuals.
 - UV damage to fish eggs/larvae, algae, plankton.
 - Interaction of climate change and UV change (enhancement of effects?).
 - Short-term changes at population level (e.g., dynamic parameters shift); potential for increased productivity in some situations.
 - Emphasis on key nodal taxa/processes/trophic groups –indicator species/groups.
 - Vulnerabilities: population/species – adaptive capacity of organisms.
- Effects of change in climate and UV on aquatic ecosystems:
 - Ecosystem structure:
 - Composition – biodiversity; invasions/extirpations; range expansion/contraction.
 - Trophic shifts – increase/decrease productivity; changes in complexity.
 - Habitat changes – flow regimes, slumping; loss/shift in critical thermal habitat
 - Ecosystem function:
 - Nutrient inputs/fluxes and cycling, carbon flow, sequestration/release.
 - Productivity flows.
 - Sediment transport (from land to aquatic system; from large rivers to sea).
 - Source/sink issues for greenhouse gases
 - Vulnerabilities - Key nodes, forcing functions, adaptive capacities of systems.
 - Permafrost issues/hydrology cross-linkages.
- Effects of change in climate at the ‘landscape’/regional level:
 - Ice formation/loss: ice-free seasons and change in duration.
 - Species distribution shifts
 - Photochemical effects associated with contaminants (e.g., UV and mercury, enhanced potential input to biota).
 - Linkages: terrestrial to/from freshwater; freshwater to/from marine (anadromous fish); large rivers as conduits to accelerate/amplify local change.
- Humans and arctic freshwaters:
 - Human use of freshwater ecosystems (transportation – soft and hard water); human footprint on ecosystems; cross-reference to AMAP contaminants and increased re-volatilization of current sinks; waste deposition (e.g., Kola Peninsula

- sulphur dioxide) and nutrient input; recreation; fishing (cross reference to Fisheries chapter).
 - Levels of impacts – catastrophes (pulses); inputs and effects.
 - Cumulative effects with climate change.
- Gaps in knowledge and understanding which prevent/impede forecasting of climate change effects:
 - Type of freshwater system; geographical/regional coverage.
 - Understanding components or processes in ecosystems.
 - Understanding/quantifying linkages of environmental parameters to ecosystem components or processes.
 - Methods/approaches.
 - Data bases.
 - Monitoring programs, indicator species, developing new hypotheses, accumulating data and testing hypotheses.
- Summary/Conclusions:
 - Potential for surprises (e.g., 2nd or 3rd order linkages).
 - Precision vs. accuracy of ‘forecasts’ or scenarios – can we bound things (best vs. worst case scenario).
 - Scenario development – word models of plausible futures for particular sub-regions.
 - Time frame for change vs. response in the systems.
 - Potential dis-connect between climate change time horizons and ecosystem/component adaptability.
 - Temporal (seasonal) dis-connect between climate change effects in south and organisms in north (e.g., critical cues for migration/spawning of anadromous fish come at inappropriate times).
 - Risk analysis – can we assign probabilistic risks to particular changes/impacts.
 - Parallels/contrasts with Antarctic aquatic systems – can we learn by proxy?

Chapter 8: Oceanic and Marine Systems (Lead author: Harald Loeng)

- Introduction
 - General physical characteristics
 - Brief description of the marine ecosystem
- Paleorecords (brief description of historical ocean climate/knowledge) (ref. Ch.3)
- Climate variability in the ocean
 - Temperature observations
 - Sea ice
 - distribution
 - thickness

- Changes in water mass distribution
 - Arctic Ocean
 - Greenland Sea
 - Others
- Processes influencing climate variability
 - Thermohaline circulation (THC) [Box: Ramstorf]
 - deep water formation
 - overflow processes
 - Atmospheric forcing (NAO/AO)
 - Carbon cycle
- UV in the ocean
- Climate/UV effects on the marine ecosystem
 - Plankton production
 - phytoplankton/ice algae
 - zooplankton
 - Fish stock population parameters
 - recruitment
 - growth
 - migration/distribution
 - Biodiversity
 - Marine mammals (move to wildlife?)
 - Sea birds (move to wildlife?)
- Future changes in marine climate and UV
 - Consequences for the physical environment
 - Consequences for the marine ecosystem
- Lack of knowledge / Need for research
- Conclusions and recommendations

IMPACTS ON HUMANS AND THEIR ACTIVITIES

Chapeau

Chapter 9: Indigenous Perspectives on Climate Change (Lead author: Henry Huntington)

1. Will include indigenous perspectives, in their own words as much as possible, without trying to adapt them to “western” ideas of the implications of climate change and its connections to other matters.

2. Will not be comprehensive in that we cannot travel to all Arctic communities to gather information.
3. Will not be “scientific” in that we will not be able to follow a sampling method or protocol, but will be relying on materials that are available or can be gathered opportunistically during the course of preparing the chapter.
4. Will provide a way to make indigenous concerns, observations, and ideas prominent and accessible in the ACIA, to give their perspective on why climate change matters, what types of changes they are seeing, what the implications of those changes are, and what might be done in response.

Chapter 10: Wildlife and Associated Conservation Issues (Lead author: David Klein)

- Climate change effects on focal animal groups and species
 - Endangered, threatened and rare species
 - Marine systems (e.g., black-legged kittiwake, polar bears, whales, etc.)
 - Terrestrial systems (e.g., Peary caribou, spectacled eider, etc.)
 - Risk analysis
 - Wildlife species of societal interest
 - Subsistence resource species (e.g., marine mammals, marine birds, caribou, waterfowl, ptarmigan, etc.)
 - Commercially harvested species [e.g., marine mammals, muskox, caribou, (reindeer)]
 - Migratory birds (e.g., waterfowl, shore birds, marine birds, etc.)
 - Estuarian/delta nesters – sea level rise effects.
 - Multiple ecosystem relationships – threats in Arctic and in wintering grounds
 - Pollution effects – oil spills/open sea lanes, contaminants
 - Other focus of interest species
 - Wildlife watching/tourism (e.g., whales, muskoxen, sea birds, etc.)
 - Charismatic species (e.g., polar bears, arctic foxes, wolves, caribou, raptorial birds)
 - Keystone species for ecosystem function & integrity – (e.g., caribou, cyclic species, etc.)
- Threats from new species
 - Alien species
 - Accidental – (e.g., rats on Pribilof Islands)
 - Deliberate – (e.g., wood bison to AK and Sakha Rep., muskox introductions)
 - Reindeer – competition with caribou/muskoxen
 - Natural invasions
 - Northward moving species and competition with indigenous species (e.g., moose, muskoxen, red fox, roe deer)
 - Associated parasites, disease, and predators

- Importance of protected areas
 - Assessment of existing protected areas
 - Need for additional protected areas
 - Inventory and assessment of critical habitats
 - Threats to protected areas: maps/overlays of protected and other critical habitats and areas of present and likely resource development
- Management Strategies
 - Completion of inventory of critical habitats and threatened populations
 - Coordinate with national/regional management agencies and NGOs re above threats in development of management strategies
 - Matrix of above threats and effects of climate change on them.
 - Increase societal awareness of issues via government agencies, NGOs, related industries (tourism, oil, mining, etc.), public education and outreach (news media, schools, NGOs, nature publications, etc.)
 - Bi-national/international agreements for protection of endangered/threatened rare species and set harvest quotas

ACIA Chapter 11: Hunting, Fishing, Herding, Gathering (formerly “Subsistence”)

(Lead author: Mark Nuttall)

[NB: This outline is a placeholder prepared at the ASC meeting in Seattle, Oct. 2000. Mark Nuttall will review it and prepare the real working outline.]

- Background and Current Status
 - Archeological record and developments, e.g., Thule culture, reindeer husbandry
 - Current patterns and uses: To include: species/resources used, harvest methods, seasonal patterns, interannual variability, trends over time, production levels, sharing and distribution, . . .
 - Cultural and social significance, i.e., going beyond economic aspects—tie in with Human Health chapter through nutritional values, community well-being, etc.
 - Management context: To include: land status, land claims/sovereignty, regulatory system, co-management, indigenous rights, . . . —tie in with Wildlife and Conservation Issues chapter through conservation regimes, indigenous involvement in management, etc.
- Climate Impacts
 - Through ecosystem changes, e.g., species distribution and abundance, timing of migrations, availability of alternative resources—*tie in with Terrestrial, Freshwater, and Marine chapters*
 - Through physical changes, e.g., mobility across sea ice, timing of break-up, loss of ice cellars for food storage—*tie in with Hydrology & Ice chapter*

- Through combined effects, e.g., changes to local economies, infrastructure, etc., and their repercussions for hunting, fishing, herding, gathering—*tie in with other Human Impacts chapters*
- Contribution to combined effects, e.g., implications for health and social services, economic impacts of loss of local food production, etc.
- Adaptive capacity – flexibility of the system, acceptability of alternative resources, etc.

Chapter 12: Fisheries and Aquaculture (To Be Provided)

Chapter 13: Forests, Land Management, and Agriculture (Lead author: Glenn Juday)

- Extent and characteristics of forests and agriculture in the (AMAP) area. (*What kind of forests and agriculture occur in the area and what are the main approaches to management systems?*)
 - (Extensions of) boreal forests in the far north (closed canopy, woodland, treeline)
 - Values and products of the northern boreal forest
 - Three models of far northern agriculture - tradition, local need, market opportunity (*harvest of native plant foods?*)
 - Land ownership/tenure and management systems; management goals
 - Reindeer production systems
- Sensitivity of forests and agriculture to UVb impacts in the far north. (*What are the key impacts/controls of UVb, and how adaptable are northern boreal forests and food production systems?*)
 - Direct impacts of UVb to crops
 - Direct impacts of UVb to forest vegetation
 - Potential indirect effects of UVb
- Sensitivity of forest and agricultural plants and animals to climate impacts in the far north. (*What are the key climate controls, and how adaptable are organisms in northern boreal forests and food production systems?*)
 - Climate warming and direct effects in agriculture (growing seasons, warmth limits, soil moisture, snow cover)
 - Direct effects of climate variability on forest growth (direct controls of temperature and precipitation on tree growth, tree stress/health, tree reproduction)
- Sensitivity of forest ecosystems and agricultural/food production systems to climate impacts in the far north. (*What are the key climate controls, and how adaptable are ecosystems and production systems in the north?*)
 - Climate warming and agricultural inputs (adaptability of production systems, relative cost advantage/disadvantage in the north, transportation issues, local demand, new crop opportunities)

- Indirect effects of climate variability on forest growth (indirect controls of climate change on northern forest ecosystems)
 - Insect outbreaks and tree mortality
 - Wildland (forest and tundra) fire
 - Mechanical damage (snow and ice breakage, wind)
- The forest-tundra environment. *What*
 - Values and management of treeline forests
 - Treeline movement history
- “Plausible futures” of climate change and forest/forest management response. *What are the plausible expressions of climate change in the northern boreal region, and what range of ecosystem responses are*
 - To be developed from climate scenarios

Chapter 14: Human Health (Lead author: Jim Berner)

- Background
 - Description of current causes of morbidity and mortality in Arctic populations, and historical trends.
 - Description of technologic and medical advances which have modified traditional sources of morbidity and mortality.
 - Description of known social/economic/cultural factors that impact communities as stressors, as well as those that may enhance adaptability and resilience.
- Climate-induced ecosystem change and potential influence on human health
 - Discuss two currently documented climate change trends, warming, and cooling.
 - Past responses to climate change by Arctic populations
 - Current structure of remote communities
 - Less ability to adapt to climate change, can no longer migrate intact
 - Families fragment, and move to other communities, without their support systems.
 - Receiving communities rarely have resources to accommodate in-migration.
 - Decreases in key species, central to traditional life, can cause a variety of adverse impacts.
 - Community grief response with associated depression
 - Changes from traditional diet, with loss of nutrient benefits, and an increase in certain diseases, such as diabetes, certain cancers, and heart disease.
 - Development of potentially adversarial relationship with wildlife agencies and advocacy groups
 - Increase in UV exposure, with potential effects on ocular and dermatologic conditions, and immune suppression.
 - Changes in organisms at the bottom of the food web, with potential changes in the range of human and zoonotic disease vectors

- Heating or cooling will affect the volatilization of organic contaminants, and thus their distribution
- Detection of climate change impact on human health
 - Duration of climate change is slow compared to human life span
 - Effects of climate change on health are non-specific
 - Impact assessment will require systematic monitoring over many years
 - Description of possible monitoring system

Chapter 15. Infrastructure, including business/industry (Lead author: Arne Instanes)

- Physical environment
 - Seasonal frost
 - Permafrost
 - Coastal zone
 - Offshore
- Hazards
 - Freezing/thawing
 - Sea ice changes,
 - Floods, erosion, avalanches (geohazards)
 - Wind/snow/ice storms
 - UV
- Infrastructure
 - Natural resources (oil, gas, mining, ...)
 - Military activity, communities (waste disposal, water supply, settlement relocation)
 - Transportation systems, -land/air/sea - roads, ports, airports, railroads
 - Military activity
- Engineering design - government responses - building codes

SYNTHESIS

Chapter 16. A Synthesis: Implications of Climate Variability and Change and UV Increases for the People and Institutions of the Arctic Region

1. Major patterns and variabilities of the change and impacts for the arctic region
2. Implications of such changes for ecosystems and their services across the arctic region
3. Main consequences of socio-cultural change, impacts and vulnerabilities across the Arctic
4. Economic and infrastructural consequences of these changes for the people and institutions of the arctic region
5. Adaptive capacity

6. Mitigative response options (what are the ways we could address the impacts? Not recommendations, but presenting the options that are available)

Each of these impact areas in the assessment (ACIA) will be analyzed in a hierarchical manner. Impacts will be considered on a sub-regional basis. Within each sub-region, the assessment will focus on three areas (the physical environment, ecosystems, and people).

APPENDICES

