EXECUTIVE SUMMARY

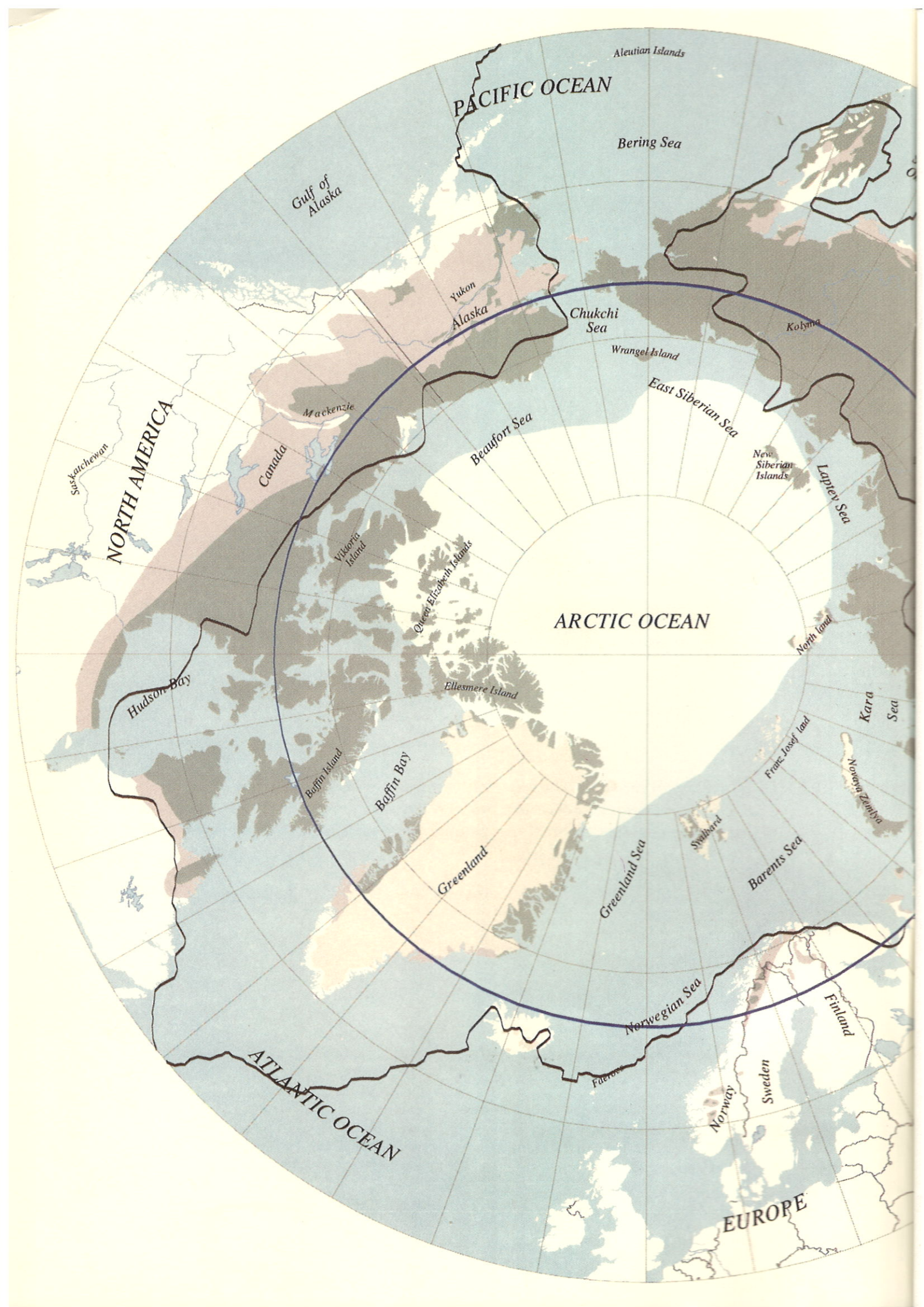
ARCTIC SYSTEMS:

Natural Environments, Human Actions, Nonlinear Processes

International Conference
for
Arctic Research Planning
December 5-9, 1995
Hanover, New Hampshire, USA

IASC

INTERNATIONAL ARCTIC SCIENCE COMMITTEE


Aleutian Islands
PACIFIC OCEAN
Bering Sea
Gulf of Alaska
Yukon
Alaska
Chukchi Sea
Kolyma
Wrangel Island
East Siberian Sea
NORTH AMERICA
Mackenzie
Beaufort Sea
Saskatchewan
Canada
New Siberian Islands
Laptev Sea
Victoria Island
Queen Elizabeth Islands
ARCTIC OCEAN
North land
Hudson Bay
Ellesmere Island
Kara Sea
Franz Josef land
Baffin Island
Baffin Bay
Novaya Zemlya
Greenland
Svalbard
Greenland Sea
Barents Sea
Norwegian Sea
Finland
ATLANTIC OCEAN
Norway
Sweden
EUROPE

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This document is an executive summary of the report of the International Conference for Arctic Research Planning, organized by the International Arctic Science Committee, sponsored in the United States by the National Academy of Sciences and the National Science Foundation, and hosted in Hanover, New Hampshire from 5 to 9 December 1995, by Dartmouth College and the U.S. Army's Cold Regions Research and Engineering Laboratory

IASC Report No. 3
Available from IASC Secretariat, Middlethuns Gate 29
P.O. Box 5072, Majorstua, 0301 Oslo, Norway

IASC - The International Arctic Science Committee is a non-governmental international organization to encourage and facilitate cooperation in all aspects of arctic research, in all countries engaged in arctic research and in all areas of the arctic region. The IASC member organizations are national science organizations covering all fields of arctic research. Each national member organization has a mechanism to provide ongoing contact between its Council member and its arctic science community. IASC draws on this structure to identify scientific priorities, members of working groups, etc. An international science programme planned or recommended by IASC should be of high priority to arctic or global science.

THE MISSION of IASC is to encourage, facilitate and promote basic and applied interdisciplinary research in or concerned with the Arctic at a circumarctic or international level; and to provide scientific advice on arctic issues.

IASC will give priority to interdisciplinary projects relevant to Arctic science issues which require international cooperation.

More precisely, this should be achieved by

- framing issues in **thematic** rather than disciplinary terms;
- bringing together the **physical, biological and social sciences** to address substantive themes;
- strengthening the **dialogue between the science community and the policy community**;
- addressing the **concerns of those who live in and near the Arctic;** and
- basing the science initiatives of IASC as much as possible on **the priorities of the arctic science community in each member country,** and in the context of internationally agreed programmes.

While maintaining an interest in facilitating the effectiveness of arctic science in all fields, IASC will select a few programmes for immediate and direct action. Priority will be given to achieving research output from these programmes within an agreed period of time.

In addition to science planning, IASC has taken on a number of other tasks as mentioned in the strategy document. One of these tasks is scientific advice on arctic issues. The strength of IASC in this respect lies in its access to the scientific expertise represented by members of the Council and other bodies, and a large number of scientists and science administrators through the national committees of its member countries.

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Full texts of Science and Implementation Plans will be published in a separate document

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Part 1

CONFERENCE CHAIR'S REPORT

1. Introduction

Meeting from 5 to 9 December at Dartmouth College in Hanover, New Hampshire, the International Conference for Arctic Research Planning (ICARP) brought together approximately 300 participants for five days of intensive science planning. The goal of ICARP was to reach agreement among members of the community of working scientists and representatives of the community of funders, managers and users of Arctic science on the terms of science and implementation plans intended to guide international cooperation over the next 5-10 years in the conduct of research dealing with a set of priority topics identified by the International Arctic Science Committee (IASC) and included in the current version of the IASC Science Agenda. Because this Science Agenda is a living document, ICARP provided an opportunity as well for the development of new ideas that may find their way onto this agenda in the future.

Three salient features of the December 1995 gathering deserve emphasis at the outset. ICARP was a thoroughly international gathering rather than an American event with a sprinkling of participants from other countries. Accordingly, the presence and active participation of a sizable group of representatives of the community of funders, managers, and users. The preparatory work for ICARP was carried out for the most part by members of the community of working scientists. But the dialogue that took place at the conference itself involved an extensive sharing of views between the two communities. Above all, ICARP emerged as a defining moment for IASC. Founded in 1990, IASC has been working to clarify its identity and its role during the intervening years. In the aftermath of ICARP, it seems fair to say, IASC has developed a clear sense both of the range of issues that are appropriate for it to concentrate on and of the role of the organization in science planning relating to those issues.

2. The IASC Science Agenda

From the beginning, IASC treated science planning as a major part of its mission, placing particular emphasis on the need "to address multidisciplinary problems and to tackle scientific problems of various scales, over time and space." Initial emphasis in this realm fell on "long-range international programs of regional or global significance which ... require several years of planning" and on projects on the drawing boards that would benefit from "international consensus or from linkages with other organizations." Beginning in 1993-1994, the IASC Executive Committee took the initiative in developing a Science Agenda for the organization along with a set of criteria to be used in selecting themes or projects for inclusion on the IASC Science Agenda. The 1994 IASC annual meeting approved an initial Science Agenda containing four broad themes and a larger number of focused topics or science priorities. As refined during intervening months, the current version of the IASC Science Agenda contains ten distinct science priorities.

Table 1

CURRENT IASC SCIENCE PRIORITIES

1. IMPACTS OF GLOBAL CHANGES ON THE ARCTIC REGION AND ITS PEOPLES
   - 1.1 Effects of Increased UV-Radiation
   - 1.2 Barents Sea Impact Study (BASIS)
   - 1.3 Bering Sea Impact Study (BESIS)

2. ARCTIC PROCESSES OF RELEVANCE TO GLOBAL SYSTEMS
   - 2.1 Mass Balance of Glaciers and Ice Sheets
   - 2.2 Terrestrial Ecosystems and Feedbacks on Climate Change

3. NATURAL PROCESSES WITHIN THE ARCTIC
   - 3.1 Arctic Marine/Coastal/Riverine Systems
   - 3.2 Disturbance and Recovery of Arctic Terrestrial Ecosystems

4. SUSTAINABLE DEVELOPMENT IN THE ARCTIC
   - 4.1 Dynamics of Arctic Populations and Ecosystems
   - 4.2 Sustainable Use of Living Resources of High Value to Arctic Residents
   - 4.3 Environmental and Social Impacts of Industrialization on the Arctic

A prominent feature of ICARP was a recurrent consideration of the principles or criteria governing the selection of topics for inclusion on the IASC Science Agenda. By the end of the conference, the distinctive role of IASC in the overall realm of Arctic science had been clarified considerably. IASC will seek, in the first instance, to work out a division of labor in Arctic science, leaving important topics to other organizations that are particularly well-suited to address them. For its part, IASC will act deliberately to set priorities rather than seeking to provide an umbrella under which everyone can find shelter. This makes it essential to spell out what a number of ICARP participants called the "IASC flavor" or, in other words, what it is that make topics particularly appropriate for IASC attention. What emerged from these deliberations is the conclusion that IASC should develop research projects that (1) are problem driven in the sense that they address issues of current public concern, (2) are integrative in the sense that they deal with dynamic systems in holistic terms, and (3) are synthetic in the sense that they require contributions from a variety of disciplines or fields of study.

3. The ICARP Process

The establishment of a science agenda marks the beginning rather than the end of the process of science planning. In the case of IASC, the 1994 annual meeting not only adopted the IASC Science Agenda but it also accepted an American proposal to hold an International Conference for Arctic Research Planning (ICARP) in the United States during December 1995. As stipulated in the American proposal, ICARP was conceived from the outset as an exercise in science planning rather than as a more conventional science conference in which principal investigators present reports highlighting the most important of their recent findings. The decision to proceed with ICARP set in motion an extended preparatory process presided over by a Program Steering Committee and a Local Arrangements Committee working under the supervision of the IASC Executive Committee.

The centerpiece of the IASC preparatory process was the establishment of a set of ten core groups or drafting committees, one for each of the focused projects included in the IASC Science Agenda. Composed of 6-8 individuals drawn from

a number of disciplines and parts of the Arctic and chaired by a prominent scientist, each core group assumed responsibility for preparing draft science and implementation plans for one of the IASC science priorities in preparation for the December 1995 meeting. To lend structure to this exercise and to ensure a measure of comparability in the draft plans, the Program Steering Committee provided the core groups with a set of planning guidelines spelling out questions to be considered in the preparation of draft science and implementation plans. The resultant drafts provided the basis for discussion by considerably larger Working Groups during ICARP itself.

The Working Groups, including representatives of the community of funders, managers, and users as well as the community of working scientists, revised and extended the draft plans. The ICARP process featured several cycles of Working Group discussions, reports from the Working Groups to the conference plenary, and continued discussion on the part of the Working groups. At the end of the week, the groups brought their consensus texts to the closing plenary for acceptance. Executive summaries of the reports of all ten Working Groups are included in this overview document. The texts of the full reports from the Working Group are included in the ICARP proceedings.

4. Unifying Theme

The interests of both scientists and policymakers are diverse, and efforts to force their efforts into highly structured programs are bound to fail. At the same time, there is much to be said for identifying broad, integrative themes that can provide a backdrop for the work of sizable groups of individual scientists and help to unify a diverse array of scientific activities into a whole that is greater than the sum of its parts. The unifying theme which emerges from ICARP is: Arctic Systems: **Natural Environments, Human Actions, Nonlinear Processes**. Overall, this theme highlights the need to endogenize social forces in order to understand the dynamics of large systems that regularly undergo dramatic changes, some of which are nonlinear and even chaotic in nature. Improvements in our understanding of Arctic systems will be central to dealing with a variety of problems arising in the high latitudes during the foreseeable future. The Arctic also offers particularly striking exemplars of a range of phenomena often discussed under headings like the Earth as transformed by human actions. Research on large dynamic systems in the Arctic can therefore play a major role in advancing knowledge of increasingly important phenomena throughout the world.

The scientific challenge presented by the analysis of Arctic systems is substantial. Much of western science has proceeded by focusing on smallscale, manipulable systems and examining their behavior in a reductionist fashion through a liberal use of *ceteris paribus* assumptions. There can be no doubt about the success of this approach in dealing with a wide range of topics. Yet such an approach has limited value in the search for knowledge of Arctic systems. The need here is to improve our understanding of large systems in which human actions play a major role and nonlinear processes are widespread. This calls for a thematic or problem-driven mode of analysis which encourages scientists representing a variety of specializations to work together to understand the dynamics of complex systems rather than abstracting away a large number of relevant factors in the interests of proceeding independently and with a minimum of contact with colleagues in other fields of study. It also leads to a heightened interest in insights generated by other modes of thought including traditional ecological knowledge.

5. Crosscutting Issues and Integration

Each pair of science and implementation plans produced by ICARP is designed to stand on its own and provide guidance for those whose work centers on an individual science priority. Nonetheless, it became clear during the course of the conference that there are a number of crosscutting issues that require attention in thinking about all of the IASC science priorities. Some of these crosscutting issues are perennial concerns that do not call for detailed consideration here, even though they are matters of great importance for the success of Arctic science. These include matters like logistical support for scientific research in the Arctic and data management. At the same time, several crosscutting issues that are less familiar but equally important emerged as major concerns during ICARP. The most notable of these involve (1) integrating the contributions of the natural sciences and the social sciences to address matters of public concern, (2) communicating across distinct knowledge traditions, and (3) building mutually beneficial partnerships with Arctic residents.

The development of a series of science and implementation plans around a set of priority topics is no small achievement. Yet those most knowledgeable about the nature of international science planning pointed out repeatedly during ICARP that there is little prospect of success in pushing forward ten separate initiatives at the same time. The implication of this is that success for IASC during the next stage of science planning is likely to require a strategy of establishing priorities among the priority topics that make up the current IASC Science Agenda. Broadly speaking, there are two approaches to this task. One involves ranking the existing priorities in terms of the criteria of attractiveness and feasibility, where attractiveness is a measure of interest in the topic from the point of view of public concerns as well as science and feasibility is a measure of the ripeness of a topic for scientific attention in the near future. An alternative - but not mutually exclusive - approach centers on the idea of integrating some of the existing IASC priority topics to form research projects that are obviously important and that can obtain broad support within both the science community and the community of funders, managers, and users. ICARP itself did not have the authority to arrive at any decisions about matters of this kind. But the conference did crystallize this issue in a manner that should stimulate discussion and prepare the way for thoughtful consideration at future IASC meetings, starting with the 1996 annual meeting scheduled to take place in Bremerhaven during April.

6. Future Directions and Next Steps

The IASC Science Agenda is a living document. New focused topics and even broad themes should be added to the agenda from time to time; existing topics should be reconstituted or eliminated as research advances and priorities shift. The central thrust of ICARP was to move forward regarding topics currently on the IASC Science Agenda. But the conference also provided an opportunity for participants to interact informally in the interests of articulating new issues that fulfill the criteria IASC uses in developing its science agenda and that may prove attractive for inclusion on this agenda in the future. During ICARP, one new theme emerged with sufficient clarity to be reported on at the conference's final plenary. An outline of this theme, entitled "Rapid Cultural Changes in the Circumpolar North," is attached to this report as an appendix.

ICARP was by no means an end in itself; it was a step in an ongoing process that stretches all the way back to the International Polar Year of 1882-1883. Under the auspices of IASC, this process has now led to the adoption of an international Arctic Science Agenda and the development of science and implementation plans for the focused topics included on this agenda. A number of participants in the December 1995 conference spoke of this achievement as a defining moment for IASC. In its first five years of operation, IASC developed considerable organizational capacity. Now it is in the process of defining its scientific identity and distinctive role; the work of ICARP moved this process a long step forward.

Because IASC is not itself a funding agency, the next stage in this process will require active engagement on the part of scientific establishments operating within IASC member countries and in supranational settings like the European Polar Board. IASC expects to play an active role in this process, facilitating coordination among scientists located in member countries and disseminating the results of Arctic research to influential members of the policy community. A key feature of the process will be the development of a small number of integrated core projects that are scientifically feasible and substantively attractive to working scientists, funders and managers of scientific research, and permanent residents of the Arctic.

Part 2

WORKING GROUP REPORTS

Ten pairs of science and implementation plans were developed as tangible products of ICARP. Based on initial drafts prepared by the core groups, each set of plans was refined during the course of the conference by a Working Group and accepted in plenary at the end of the conference. These plans, drawn up by working scientists as well as representatives of the community of funders, managers, and users of Arctic research, should provide guidance for international coordination in this field over the next 5-10 years. The full texts of the plans are included in the ICARP Proceedings. What follows are executive summaries for each pair of plans.

1.1 Effects of Increased UV-Radiation

Scientific Approach

Determine the impact of solar UVB on

- human health
- terrestrial ecosystems
- aquatic ecosystems
- together with socio-economic effects on

Northern societies and settlements in order to predict, prevent and mitigate the adverse effects of changes in UVB radiation

The success of this program relies on a thorough understanding of the climatology of UVB radiation in the Arctic.

Key Science Questions

This proposal is designed to take an integrative, multidisciplinary and unified international approach to

- identify
- quantify
- model and predict the short and long-term effects of both natural UV radiation and increased levels of ambient UVB on diverse Arctic ecosystems and human populations

In consultation with Northern communities, this program will be based on both monitoring and experimental studies utilizing key Arctic sites to promote interdisciplinary synthesis.

Action Required from IASC

- Communicate the established scientific priorities to funding agencies
- Provide information about this project to potential funders/users
- Provide international endorsement of these scientific objectives and implementation plans
- Facilitate the coordination of funding mechanisms in support of these international projects
- Provide a forum for Arctic site selection
- Develop mechanisms for cross-project communication
- Provide assistance with the establishment of a support system through a project officer
- Disseminate the scientific information obtained in these projects to the public

Linkages Within IASC and Beyond

ICSU/SCOPE; ICSU/SCAR; AMAP; WCRP/SPARC; IUCH; UNEP; IGBP.

Seeking linkages to appropriate indigenous peoples organizations and the Northern Forum.

Users/Funders			
RESEARCH AREA	PRODUCTS (examples)	USERS	FUNDERS
Human health	Risk assessment	Northern Communities	UNEP
	Medical advice	Health care providers	Northern Communities
	Prevention services	WHO	National Health organizations (e.g. NIH, MRC, Wellcome Trust etc.)
		International Union for Circumpolar Health (IUCH)	CDC
		Clinical and preventive service agencies	
		UNEP	
Aquatics	Advice on fishery and marine mammal management	Fisheries and aquaculture	NOAA National fisheries management agencies
Terrestrial	Advice on reindeer/ caribou management	Northern Communities Wildlife managers	Northern Communities
Social Sciences	Socio-economic risk assessment	Indigenous populations Economic forecasters	Departments of health, welfare and social services

Projected Timetable

Research project 5-10 years

1.2 Regional Cumulative Impacts - Barents Sea

Introduction

The overall goal of the Barents Sea Impact Study (BASIS) can be summarized as follows: to assess the impacts of global changes on cultural, socio-economic systems depending on renewable and non-renewable resources in the Barents Sea region.

To this end, the following objectives have been specified:

- Assess the likely magnitude of global changes and their sub-regional to regional manifestations for the major bio-geographical components of the Barents Sea Region including an evaluation of past global changes.
- Predict/assess the consequences of these changes for the terrestrial, freshwater and marine environments as well as for the major economic sectors in the region.
- Determine the cumulative impacts of global changes for all relevant components of the Barents System.
- Identify specific environmental threats for the human population posed by glo bal changes in the Barents Sea region.
- Investigate possible policy options for mitigating the most severe cumulative impacts of global changes for the Barents Sea Region. Determine likely predictive scenarios for the overall consequences of global changes for specific sectors of the national or regional economies and possible strategies to minimize economic losses.

Scientific Approach

The main instrument for carrying out BASIS will be scenario studies outlining possible alternative global change processes. This will lead to an assessment of major impacts on the physical and biological level of either marine or terrestrial/fresh-water ecosystems. The specification of particular physical or biological impacts will depend on the questions addressed on the societal and/or economic level. This approach largely follows the methodology developed by the Intergovernmental Panel on Climate Change (IPCC) which was adopted for IPCC cumulative impact studies.

Another important element of BASIS will be the synthesis and integration of existing knowledge, which will lead to an overall understanding of particular elements of the Barents Sea system. In so doing, existing gaps in knowledge will be identified and subsequently addressed through specific investigations. In carrying out BASIS, care will be taken to harmonize data and information in order to enable exchange between BASIS and other impact studies carried out in the Circumpolar North, particularly the Bering Sea Impact Study (BESIS). The comparison between BASIS and BESIS and their iterative improvement will be the prerequisite for a successful, Arctic-wide impact study, which will provide unique and essential information for a large region of the Earth.

An issue specific to impact studies has to do with communication strategies related to stakeholders in the region. It is the stakeholders who ultimately specify the questions to be answered on the societal level as mentioned above. Therefore, they have to be involved early on in order for them to gain an understanding of and have an interest in the results of the BASIS study.

Actions Required from IASC

Support from IASC is requested with regard to he following issues:

- As outlined above, involving the stakeholders in the region will be of paramount interest in the BASIS study. Therefore we plan to hold a stakeholders' meeting in early 1996 and request support for a limited number of participants (in particular from Russia) for the meeting.
- It will be necessary to hold at least one meeting of the BASIS Working Group during Spring of 1996. This will be combined with a meeting of reviewers who will evaluate letters of intent submitted by research institutions interested in participating in BASIS. The review board will consist of members of the Working Group as well as representatives of stakeholders. We request support for some of the participants in these two meetings.
- During early summer of 1996 we will bring together the principal investigators who were selected based on the letters of intent submitted earlier. Principal investigators will submit sub-proposals, which will be integrated into

an overall proposal to the Commission of the European Union (CEU). Again, support for participants in this meeting is hereby requested.

- Based on the experience gained during the Mackenzie Basin Impact Study (MBIS), maintaining a project secretariat for a study such as BASIS will significantly facilitate and enable a successful execution of an impact study. We hereby request Support from IASC to cover at least part of the costs of such a secretariat.
- A final request for support relates to the issues of advocacy for BASIS by IASC. Current practices of funding organizations still favor disciplinary studies. However, one of the core characteristics of BASIS will be its interdisciplinarity. IASC should strongly support such an approach and seek the understanding of funding organizations in order for these studies to receive appropriate resources.

Linkages Within IASC and Beyond

BASIS has very strong links to BESIS (Bering Sea Impact Study) but equally to almost all of the IASC core projects. These links should be strengthened through the proposed change in the composition of the IASC Global Change Working Group (i.e. making the chair persons of the core groups members of the Working Group).

Equally close ties will be maintained with MBIS. To that end, the chairs of BASIS and BESIS will participate in meetings of MBIS later in 1996.

Furthermore, BASIS will profit from close links to other, large international global change programs in the framework of the International Geosphere-Biosphere Programme (IGBP), the World Climate Research Programme (WCRP; in particular the Arctic Climate System Study, ACSYS), and the Human Dimensions of Global Change Programme. Finally links should be established to relevant national programs carried out in the Arctic.

Users/Funders

Main users of BASIS results will be regional authorities as well as industry active in the region. Furthermore, it is expected that indigenous organizations, particularly the Saami Council and appropriate organizations of the Nenets people will be interested. Therefore, we plan to establish links and communication with these groups through the Barents Euro-Arctic Council (BEAC) and its Regional Council. This will be facilitated primarily through stakeholders' meetings. It is also expected that BEAC will provide limited funds for carrying out BASIS. However, major funding will be requested through the CEU and national funding organizations. In addition, we will also aim to be supported from major industries active in the region.

Next Steps and Projected Timetable

The sequence of events for the next year will be as follows:

Date (all 1996)	Actions
February/March	Stakeholders' meeting and establishment of review committee
March	Call for Letters of Intent (the exact issuing date will depend on whether or not a stakeholders' meeting can be held prior to March 1996)
15 April	Deadline for Letters of Intent
May	Selection of sub-projects and call for submission of sub-proposals
Early summer	Meeting of principal investigators or sub-projects
Fall	First draft(s) of research proposal(s) to the CEU and call for comments
December	Submission of proposals(s) to CEU

The total duration of the project should comprise two three-year periods.

1.3 Regional Cumulative Impacts - Bering Sea

Introduction

- Assess the magnitude of changes in the Bering Sea region as a consequence of global change.
- Predict/assess the consequences of these changes on the physical, biological and socio-economic systems in the region.
- Determine the cumulative impacts of these changes on the region, including assessment of past impacts.
- Investigate possible policy options to mitigate these cumulative impacts.
- Design and implement a field research program to address any gaps in the information needed for the impact assessment.

Scientific Approach

Our proposed approach is to construct impact scenarios based on computer models, including regional climate models, and on information and data on past impacts and their causes. We plan to analyze/synthesize/integrate all available data to assess the likely future impacts in the region, following the Inter-Governmental Panel on Climate Change (IPCC) methodology. Additional, limited field work will only be performed if we identify information gaps.

Key Science Questions

We will focus primarily on the impacts of global change on:

- Commercial, recreational and subsistence fisheries.
- Marine mammal and bird populations (marine ecosystems)
- Resource-dependent communities, particularly on subsistence hunting and fishing
- Terrestrial and fresh water ecosystems
- Non-renewable resource development and their transportation
- Public and private infrastructure: buildings, roads, airports and sea-ports
- Biodiversity

Actions Required from IASC

It is essential to set up a coordination mechanism to integrate the global change-related elements of all the IASC core projects. We have proposed a reorganization of the IASC Working Group on Global Change to include one senior representative (chair?) of each of the 10 IASC core projects, plus regional representatives. We also need approval/support for a permanent secretariat, to be shared between BESIS and BASIS. To link us to the IGBP/WCRP/HDP agenda we urge the quick signing of a MOU with START. Finally, we need funding for workshops to begin the impacts assessment process.

Linkages Within IASC and Beyond

Links need to be established with all other relevant IASC projects, and with national projects and international groups involved in global change studies. As discovered through the experiences of MBIS (Mackenzie Basin Impact Study) particularly strong linkages need to be established early with the regional stakeholders/residents.

Users/Funders

Users of BESIS results include the indigenous people of the region, industry, government agencies at all levels, international governing bodies such as the Inuit Circumpolar Conference and Arctic Council, and international science groups such as the IPCC which is assessing the impacts of global climate change. Funding for BESIS is expected to come primarily from the U.S. Government (NOAA, NSF, NASA) and perhaps Native organizations such as the Alaska Eskimo Whaling Commission, and from various organizations in Japan, Russia, Canada and other countries.

Next Steps

Following IASC approval and actions taken as listed above, the BESIS process can begin immediately, and will proceed according to the timetable below.

Projected Timetable

- Early 1996: First meeting with stakeholders/Native groups
- Mid. 1996: First prospectus calling for potential participants in BESIS
- Fall 1996: Proposals submitted to funding agencies
- Early 1997: First full impacts workshop

Successively, improving impacts assessments will be attempted over a five-year period. BESIS will gradually merge with BASIS and other regional studies. The comparison between BASIS and BESIS and their iterative improvement will be the prerequisite for a successful, Arctic-wide impact study, which will provide unique and essential information for a large region of the Earth.

2.1 Mass Balance of Arctic Glaciers and Ice Sheets

Introduction

Arctic ice sheets and glaciers play a critical role in the climate system and thus also have a fundamental impact on society. Glacier variations affect global sea level on timescales as short as decades. The sensitivity of Arctic ice caps and glaciers also suggests that they may provide an early warning of climatic shifts. The Greenland ice sheet is by far the most important for sea level change, but the smaller glaciers and ice caps will give the first detectable response. Recent ice cores from Greenland indicate highly unstable climates during interglacial periods. The studies also indicate close links between ice masses, rapid iceberg and meltwater production and the ocean and atmospheric circulation. This has wide implications about future climate evolution and impacts on the environment at different scales.

The objectives of the study of Arctic glaciers and ice sheets are:

- To predict the change in ice volume in the Arctic, that may occur in the next decades to several centuries, as a result of possible climate change for different climate scenarios
- To give input to the estimate of future rates of sea level change
- To validate and provide data to GCM-models
- To reconstruct the past, Holocene climatic variations in the Arctic

Scientific Approach

The principal points of the proposed scientific program are:

- To determine the present geometry of the Arctic ice masses and their rates of change
- To determine mass balance components and their altitudinal and regional variations in relation to climate
- To evaluate the physical controls on the dynamics, spatial extent of ice streams and outlet glaciers, and switching between different flow regimes
- To reconstruct climate variations from ice cores and other sources. ICAPP - Ice Core Circum Arctic Paleoclimate Programme - is a part of this approach. The program has already started under the IGBP - PAGES umbrella

Actions Required from IASC

- Encourage a bipolar approach, sponsor a joint IASC/SCAR workshop in 1996
- Fund a state-of-the-art report
- Encourage joint projects between IGBP and IASC, i.e. ICAPP under PAGES
- Fund core group activity
- Support and lobbying of future IASC projects in funding agencies

Linkages Within IASC and Beyond

The Mass Balance projects give input to several other programs. Glaciers, ice caps and ice sheets mass balances are important parts of the global sea level response. Fresh water input to the marine environment has an impact on the marine biology and the ocean drift systems. Increased melting will also influence the environment on ice-free land areas. Further deep and shallow ice-core drilling will enhance knowledge of the regional variability of past climate, as well as the poorly known spatial and temporal distributions of the precipitation in the Arctic.

Thus, the studies will give input to:

- IASC projects
- 1.2 BASIS
  1.3 BESIS
  2.2 Terrestrial Ecosystems
  3.1 Arctic Marine Systems
- Other international programs: IGBP - PAGES, WCRP- ACSYS, GCOS, QUEEN
- And on different levels also to SCAR-projects, EISMINT and ICSI

Users/Funders

The users are on different levels in the international community:

- IPCC
- Governments
- Other research groups as mentioned above
- Offshore activity
- Water management
- Insurance companies

Projected Timetable

The research projects defined under Scientific Approach are on different levels and thus different timescales are required. There will be many subprojects, some of them are already well prepared and ready to go. Other projects need an organizing period of a couple of years to define key areas and methods. Some projects will be of a monitoring type that require remeasurements, for instance, every five years to detect changes.

Others, like the ICAPP ice core drilling project can be implemented during a few years. ICAPP has already started and is ready to continue. After a five year period the whole project should be restructured and evaluated.

Next Steps

In 1996, the first steps to a Circumarctic program will be taken through continuation and further development of the ICAPP ice core program and three planned workshops:

- A first joint IASC/SCAR workshop: This will be the first bipolar approach with the objectives to look at glaciers, ice caps and ice sheets mass balance contributions to the global sea level change. The workshop will be arranged in Norway in June in connection with an international conference on changing glaciers. The workshop will be co-sponsored by WCRP and ICSU.
- The Sixth workshop on mass balance of the Greenland ice sheet and related topics was held at the Geological Survey of Denmark and Greenland (GEUS) in Copenhagen 22-23 January, 1996. The idea is to extend this well-established workshop to cover the entire Arctic region and later make this into Arctic Glaciology workshops or symposia.
- Annual Meeting of the Working Group on Arctic glaciology in the Autumn of 1996: Themes will be the running implementation plan, update the plan, initiate new projects, promote effective information exchange of running projects, initiate and discuss international cooperation.

The prospects for MAGICS (Mass Balance of Arctic Glaciers and Ice Sheets) are good because:

- The topics are not covered by another program
- There is international interest in many countries
- The infrastructure is already there
- It is a bipolar approach
- The time is right and mature to make this a part of WCRP

2.2 Terrestrial Ecosystems and Feedbacks on Climate Change

Introduction

Arctic terrestrial and freshwater ecosystems are important at regional and global levels. They provide essential resources for the peoples inhabiting the Arctic while representing one of the Earth's last great wildernesses with specifically adapted and sometimes unique biodiversity. Interactions between Arctic ecosystems and the atmosphere contribute to the climatic system on a global scale.

Global change in the Arctic is likely to be greater than elsewhere. The climate of the Arctic is currently changing by up to +1. 5°C per decade in some areas and future changes are predicted by GCMs to amplify global average temperature increases of 1.5 to 5. 5°C by 2 to 3 times.

Arctic ecosystems are likely to be particularly sensitive to change. They are extremely vulnerable to any perturbations because species diversity is low and the loss of one or more species could have disproportionally large impacts on ecological function. Also, many Arctic organisms are already experiencing multiple stresses.

Changes in Arctic ecosystems will affect regional resources and the global climate system. Changes in active layer processes, nutrient availability, productivity and ecological diversity will directly affect the structure and functioning of ecosystems, the availability of resources for northern peoples, and the ways in which the ecosystems respond to and recover from disturbance. Longer term migrations of species and ecotones could potentially change Arctic landscapes. Such changes will affect trace gas flux and energy balance feedbacks to the global climate system but their magnitudes are uncertain.

Key Science Questions

To understand, quantify and predict patterns of response of Arctic terrestrial and freshwater ecosystems to global change and feedback from the ecosystems to the climate system. We need to understand the environmental and biological controls on, and spatial and temporal variability in feedbacks from:

- surface energy and water balances
- consequences for ecosystem structure, of cycling and storage of carbon and nutri ents
- trace gas fluxes

Scientific Approach

Research at a few intensively studied, well instrumented field sites within BASIS and BESIS sectors will focus on detailed and mechanistic investigations of processes. These will be integrated with observations made at extensive field sites located throughout the Circumpolar Arctic where less detailed measurements and remote sensing will encompass spatial variability. A combination of experiments, description, modeling and monitoring will be used. New approaches include establishment of super sites, use of mobile laboratories and research teams and extensive application of existing molecular techniques. Scaling-up techniques will be employed and developed.

Actions Required from IASC

- Provide mechanisms for cross-disciplinary Circumpolar communication (workshops, intercomparison exercises)
- Identify funding bodies and represent Arctic interests to them
- Publicize the importance of the Arctic in the global context
- Facilitate logistical support within the Arctic

Linkages Within IASC and Beyond

- Within IASC to provide ecosystems expertise and underpin those priority areas with terrestrial and freshwater ecosystem components (e.g. BASIS, BESIS)
- At national and regional levels to integrate initiatives (e.g. ARCUS, ARTERI) and Circumpolar networks (e.g. ITEX, AMAP, CAFF, IPA)
- Internationally to facilitate ground truthing for remote sensing and modeling (e.g. GCMs)

Users/Funders

Likely users and funders are tabulated below. Governments are obligated through Rio-Conventions to monitor changes in biodiversity and sustainable development. In addition, a global fund for global environmental problems should be initiated.

	USERS	FUNDERS
Feedbacks from Arctic terrestrial and freshwater ecosystems	IPCC, national and international policy makers, energy industry, scientists e.g. GCM modelers	International and national funding agencies, national research councils and foundations, energy industry
Impacts on Arctic terrestrial and freshwater ecosystems	Arctic peoples, policy makers, Arctic resource agencies, conservationists, scientific community, tourism, scientists	International and national funding agencies, national research councils and foundations, regional indigenous councils

Next Steps

- An IGBP-GCTE Arctic Working Group has been formed and will develop and implement the work proposed here
- Discussion with IASC priority research areas which require a terrestrial ecosystem component to ensure compatibility and integration

Projected Timetable

1996-98	Integration of existing efforts, preliminary site selection and description
1998-2008	Implementation of major research
2008-onwards	Review and continuation

3.1 Arctic Marine/Coastal/Riverine Systems

Introduction

The Arctic system is a sensitive indicator of environmental changes. Understanding the evolution of Arctic climate as well as its feedback to the global system is necessary to decipher processes controlling climatic changes. To simulate the future development of the Earth's climate, after taking into account a greenhouse effect, it will be necessary to reconstruct the Arctic environment through recent geologic time.

The Arctic Ocean is surrounded by the largest continental shelves on earth. Being both large and shallow these shelves remain sensitive to sea-level fluctuations. Very large rivers drain onto these shelves which influence sea-ice cover and depositional environments. These rivers are major nutrient sources to the Arctic Ocean; the shelves are considered a major carbon sink. Sea-ice cover provides an important link to the Earth's global climate system through albedo feedback. Thus, the Arctic might become an early warning area for global climate change.

The coastal zones, and estuaries in particular, serve as the marginal filter for land-ocean fluxes including pollutants. Up to 90 percent of these fluxes are accumulated in the coastal zone. Taking into account that the Arctic shelf (especially the Siberian part) is drained by large rivers which flow through industrially impacted areas, these fluxes and their impact on the coastal zone ecosystems can be significant.

The Arctic is unique for the extent of huge areas underlain (in places greater than 500 m) by onshore and offshore permafrost. Permafrost has existed in places for more than one million years. The Arctic however, is not homogeneous, in places (Greenland) old (>100 ky) ice sheets remain, while in many other locales (Baffin Island, Novaya Zemlya) ice sheets have formed more recently (10 ky). Rapid climate change across the Arctic has occurred in recent geological time (<10 kyr) and has been nonsynchronous when it occurred. In more recent history (<50 yrs) glacier termini have rapidly retreated in parts of the Arctic while in other areas there has been little change. As a consequence it remains difficult to predict the change in sea-ice extent and iceberg production that so strongly influences transportation routes.

There are many aspects of land/sea interaction in the Arctic about which we have little understanding. For instance, our knowledge of the climatic impact on sea-ice formation is very limited, making it difficult to predict possible future global climatic changes. This holds true in particular for the Siberian shelf seas, which, for logistical and political reasons, have long been inaccessible to the international scientific community. Large amounts of Arctic sea ice are formed over these shelves, underscoring the central importance of the shelves and their processes for the climate system. In their role as source areas for the Transpolar Drift and of sediment-loaded sea ice, the surrounding seas are of particular interest.

We know little about the extent of, and reason for, snow accumulation in our recent past and therefore about growth and extent of Eurasian ice sheets, some of which appear to have formed in a marine environment. Feedback mechanisms involving the role of river discharge and sediment transport on the extent of sea-ice cover and on regional ecosystems remain uncertain. We are not sure of centennial and millennial rates of sea-level change in the Arctic margins. With such uncertainties we are presently limited in our ability to model and predict the full impact and extent of climate change in the Arctic.

Ecosystems of the coastal zone are extremely sensitive to anthropogenic activity which increased its scales and rates drastically during the last century. Commercial usage of the Northern Sea Route, extraction of non-renewable resources, particularly oil and gas developments, and their new infrastructure create new types of interaction between natural and anthropogenic systems. We need to evaluate the impact on global changes of social and economic systems as well as the response of economic activity and their impact on natural systems. Such assessments will be the scientific basis for integrated management of the coastal environment.

The overall objectives and goals can be summarized as follows:

- Land/sea connection: present and past natural processes on the Arctic continental margin as a continuum with particular reference to the effect of riverine and other coastal fluxes
- Forcing functions: rate and degree of environmental changes
- Arctic processes and climatic change: databases and models for reconstructing the past, understanding the present, and predicting the future

Scientific Approach

Interdisciplinary research programs and bilateral/multi-national investigations.

Major research foci

- Watershed: dynamics and delivery
- Ecosystems dynamics: biogeochemical cycles and biota
- Cold system dynamics: snow, ice and permafrost
- Coastal fluxes: physical, biogeochemical and anthropogenic
- Regional and global environmental changes: impacts on sea level, freshwater input, ecosystems and man-made structures
- Climatic verification and prediction: present, past and future on hydrology, sea-ice cover, permafrost, glaciers and biota
- Economic and social impacts of global change in Arctic coastal zones

Actions Required from IASC

It will be necessary to hold at least one international workshop in order to identify priorities of scientific projects, such as working areas, logistics, funding sources, and implementation plans.

Linkages Within IASC and Beyond

IASC Working groups:

1.2, 1.3, 2.1, 2.2, 4.3	high interrelationship
3.2, 4.2	medium interrelationship
1.1, 4.1	low interrelationship
International:	ACSYS, CAPE, GISP/GRIP, LOICZ, NAD, ODP, PALE, QUEEN
Bilateral:	Russian-German Cooperation: Laptev Sea System Eurasian Arctic Land-Shelf System (U.S./Russia, proposed)

Users

- International scientific community
- National and regional authorities
- Economic developers

Funders

- National and international funding agencies as well economic developers

Timetable

- Within the next 6 months IASC Workshop
- 1996 Pilot phase
- 1997 to..... Scientific research programs

3.2 Disturbance and Recovery of Terrestrial Ecosystems

Introduction

To predict the environmental consequences of disturbance by establishing ecological criteria based on physical, chemical, biological and climatic data from a wide variety of disturbed and threatened sites. Under this general heading a number of specific objectives are listed below which highlight particular areas where more information is urgently needed.

- Which disturbances give the greatest cause of concern? Can ecosystems be ranked in relation to their potential sensitivity to disturbance?
- Review knowledge that is necessary in order to be able to minimize future impact and mitigate damage from ecosystem disturbance.
- Investigate what artificial repairs have the greatest potential for rescuing ecosystems that have been damaged beyond a state where they might reasonably be expected to recover through natural recovery mechanisms (homeostasis).
- Implement an experimental approach to studying ecosystem disturbance and recovery. Devise landscape maps (land, soil, permafrost, etc.) and use these to establish criteria for landscape sensitivity to disturbance and recovery potential.
- Assess the functional responses of ecosystems to disturbance by monitoring overall processes through integrated analyses of carbon and nitrogen reserves and fluxes (c.f. Hubbard-Brook experiment). However instead of establishing one large experimental area, as in the Hubbard-Brook experiment, participants would be urged to use microplots (small scale experimental trials within definable watersheds) for small scale experimentation and assessments of resource fluxes and effects on experimental disturbance regimes.
- Review of impacts of pollution and disturbance on biodiversity. Here there is a need for the encouragement of research on the insidious effects particularly of low-level pollution often not noticed by the public at large on (a) species numbers, (b) alpha and beta diversity, (c) intra-specific variability (i.e. biodiversity within species) (d) community resilience to colonization by invasive species (e) the relationship between biodiversity and ecosystem function as assessed above.
- Integrate an evaluation of freshwater biota and water chemistry with landscape degradation. Assess the potential of using aquatic bioindicators as a means of detecting and evaluating landscape deterioration and ecosystem dysfunction.
- Devise management framework guidelines that will be "user-friendly" for native peoples.

Key Science Questions

As above, in the disturbance investigations, an essential aspect of this program is the maintenance of close research links between groups working in different parts of the Arctic to provide a concerted effort to establish ecological criteria for evaluating the natural recovery potential of ecosystems in relation to different degrees of disturbance. The criteria used will include;

- Listing and documentation of factors that limit recovery
- Assessment of acceptable timescales for attaining a satisfactory degree of recovery
- Assessment of homeostasis capacity in different Arctic ecosystems
- Establishment of definable "end-point criteria" as acceptable goals in recovery programs

Actions Required from IASC

- Enormous benefits could be enjoyed by using IASC to facilitate links with other groups. The disturbance and recovery group has designated Dr. P. Wookey, Department of Geography, University of Reading U.K.and Dr. A. M. Milner, Department of Environmental Science, The University of Birmingham, Edgbaston, Birmingham, B15 2TT as our liaison representatives.
- IASC could be of great service, particularly to younger research workers, by providing letters and other means of introduction to national science bodies and native agencies. In particular it would be much appreciated if IASC could assist in the flow of information between such bodies and research groups in need of support in the initial

stages of setting up investigations. If IASC could conduct some initial correspondence with native agencies on behalf of potential research groups this would be most useful. Other possible areas of assistance could include the production of a site directory, and the maintenance of sources of information on logistics and other baseline data.

- In the long-term the establishment of an IASC-supported international research station in the Arctic could do much to promote international Arctic research. In the short-term a depot of general purpose field equipment would be of great service.
- The establishment of an internetnewsletter deserves serious consideration.
- IASC might like to consider organizing an Arctic Workshop in 1997?
- IASC could play a most useful role in developing contacts with international companies exploiting the Arctic

Linkages Within IASC and Beyond

The need for incorporating a proper integrated assessment of disturbance and recovery in any long-term Arctic ecology research program is self-evident if Arctic science is to serve the serious needs of the inhabitants of the Arctic and respond to national taxpayers and funders in a manner which reflects the seriousness of current disturbance of Arctic ecosystems. This group therefore expects to have close links with BASIS and BESIS and with groups studying Populations and Ecosystems as well as Environmental and Social Impacts.

Users/Funders

The relevance of integrated disturbance and recovery studies throughout the Arctic on a Circumpolar basis should be emphasized, not just to national funding agencies but also to international companies exploiting the Arctic. The good offices of IASC could play a major role in this respect.

Projected Timetable

1996

- Preliminary map studies
- Researching of preliminary data sets and establishing proformas for future data collection
- Applications for funds for site reconnaissance and identification.

1996/7

- Publication of Rovaniemi symposium

1997

- Workshop Moscow /London to assess sites, prepare funding applications (Geography Department, Moscow University contacts: Prof. A. Tishkov, and Dr. G. Vilchek; Reading University: Dr. P. Wookey)

1998

- Commencement

4.1 Dynamics of Arctic Populations and Ecosystems

Introduction

Understanding the dynamic relationships between human populations and their biological resources as a basis for achieving sustainability of Arctic ecosystems.

- Arctic grazing systems
- Marine resource dependencies and climatic influences

Scientific Approach

Arctic grazing systems:

- Comparative analyses based on major regional research projects already in progress

These projects are examining the interrelationships between traditional dependencies of indigenous peoples on caribou and wild and domestic reindeer, the influences on these relationships of major industrial developments and western society. Focus is on reindeer husbandry in Scandinavia and Russia (Kola and Yamal peninsulas) and caribou hunting cultures in Alaska and Canada.

Marine resource dependencies and climatic influences:

- Primary focus on North Atlantic (especially Greenland) where climatological, human population demographic, and marine resource data are available for analysis of their interrelationships

Actions Required from IASC

Arctic grazing system:

- Support concept and assist in funding collaborative workshops, exchanges between projects, and final synthesis effort

Marine Resource dependencies and climatic influences:

- Support concept and assist in generating funding

Linkages Within IASC and Beyond

Arctic grazing systems:

- Involves collaboration between biological and social scientists (e.g. anthropologists and economists) and systems modelers, with input on climatology from physical scientists. Primary linkages include IASC priority projects 3.2, 4.2, and 4.3 and RAPON, IASSA, AEPS, AMAP and CAFF.

Marine resource dependencies and climatic influences:

- Multidisciplinary: data from biological, social and physical sciences with analysis including anthropologists and systems modelers. Primary linkages include IASC Priority Projects 1.2, 2.1, 2.2, 4.2, and 4.3 and BASIS, ICAPP, CAPE, OCC, ACSYS, and QUEEN.

Users/Funders

Users:

- Circumpolar countries, resource management agencies, regional governments, indigenous peoples, land managers, international agencies

Funders:

- international, national and regional government funding foundations and NGO's

Next Steps

Several major regional projects initiated. IASC can initiate and assist in the establishment of Executive Committees (one each for Arctic grazing systems and marine resource dependencies and climatic influences) to plan and develop necessary proposals and to facilitate workshops and interproject exchanges and develop integrated synthesis plans. Supplemental support is needed for continuation of Yamal research.

Projected Timetable

Three to five years.

Marine resource dependencies and climatic influences, requires development of proposal.

4.2 Sustainable Use of Living Resources

Introduction

The purpose of the theme is to identify critical issues and research needs that increase understanding of the basis for sustainable use of living resources. A further objective is to propose mechanisms that facilitate positive interaction between the science, management, decision-making and user communities, and especially to propose strategies that aim to create and sustain partnerships among those involved in research on sustainable resource use issues.

Scientific Approach

By means of an integrated and systemic approach to the issue, to gain a comprehensive understanding of the relationships between local use and management practices and national, regional and/or international regimes affecting sustainable use of Arctic living resources. The key components of the system under investigation include the relationships existing between the resource complex, social institutions and human behavior.

Key Science Questions

The key questions involve understanding the relationship between sustainable resource use and such important policy issues as the maintenance of cultural and bio-diversity, environmental integrity, social equity and community health. These questions will be addressed by investigating

- the nature of "appropriate" [i.e. sustainable] resource management regimes
- the relationship between cultural and biological diversity, links between indigenous/local and academic knowledge systems, the effects of non-local/global influences upon local practices
- differing systems of rights to resources
- "management" epistemologies and discourse analysis

Actions Required from IASC

IASC should insure that northern-based institutions become partners in this proposed science plan by identifying the appropriate partners, inviting their review of and input into the draft action plan, and their suggestions as to how to effect practical working partnerships for future activities.

Linkages Within IASC and Beyond

IASC should consider establishing a Human/Social Sciences Working Group and a secretariat or steering committee structure to facilitate continuing interaction among northerners and the international research community. The possibility of some joint arrangement with the AEPS Indigenous Peoples' Secretariat might be explored. In addition, ways of creating stronger working relationships with IASSA and IUCN should be examined. Serious early consideration should be given to linking this IASC activity with the Sustainable Use Initiative of IUCN (which has almost identical objectives but no Arctic Region specialist group).

Users/Funders

Within the north, various co-management and resource management boards are likely users, and in some cases are also potential funders. In addition, users' associations and local governmental, educational, and research institutions are both users and potential funders. Various intergovernmental organizations having sustainable resource use objectives are also potential users and funders: e.g., AEPS/Arctic Council Sustainable Development Initiative, the Northern Forum, NAMMCO, IUCN, etc. The usual national public and private agencies supporting scientific and environmental research undertakings are also potential funding sources.

Next Steps

Consultations need to commence in the north, as word of ICARP will likely spread in the Arctic and feedback and involvement will be expected in various jurisdictions that were unable to participate in the Hanover conference. Use of the IASSA and IASC electronic bulletin boards/home pages are among the means to be utilized in this wide-ranging consultation. This document should be considered a draft action plan until consultations are held with representative northern organizations.

Projected Timetable

A two-year period should be sufficient for consultations during which time the document is also discussed with academic researchers considered as likely partners in this proposed research agenda. As component parts of this proposed research agenda are included in on-going programs of research, an international conference to report progress should be held during 1997.

4.3 Environmental and Social Impacts of Industrialization on the Arctic

Introduction

The environmental, cultural, political and economic realities of Arctic communities have shifted radically, from a situation of income and livelihood based on harvesting the natural resources of the region, toward the growing importance of large-scale industries, increasing transfers, and international interdependencies. Today, large-scale extractive industries such as hydrocarbon development, mining and industrial fishing, heavily influence environmental conditions, while changing the fundamental socio-economic circumstances of human life in the Arctic. Against earlier perceptions of the Arctic environment as unspoiled and inexhaustible, the consequences of trans-boundary contaminants and resource exploitation are becoming an increasing concern. And from the image of Arctic communities as hunters and trappers engaged in traditional interdependencies with the environment, a conception of modernized societies is emerging. At the same time, sustainable development has become an important policy objective, highlighting the need to develop operational indicators and means for assessing sustainability.

Scientific Approach

The research aims to develop forms of interdisciplinary cooperation and integration that can provide a holistic account of the environment and social impacts of industrialization, and a practical basis for societal response. A range of methodologies at micro- and macro-scales of analysis are required, including, but not limited to, techniques conventionally associated with the phrase "environmental and social impact assessment." For example, the social dimension of the analysis will involve the use of methods for describing and analyzing regional processes of institutional transition, economic development, and ethnoscience modeling as well as for analyzing the broader structures and processes of nation-state economic interests, policies, and bureaucracies vis-a-vis their "hinterlands", together with "transnational" data and modeling to delineate global causes of, and responses to, industrialization in the Arctic.

An important consideration is how to provide context and continuity in our knowledge base; this to serve as a partial antidote to the "here today/gone tomorrow" pattern of research which accompanies politically controversial industrial development.

The research is directed toward developing various modalities for the implementation of the goals:

- Appropriate methodologies for evaluating the environmental and social impacts of industrialization.
- Development of rugged, versatile, integrated, user-friendly data environmental monitoring instruments and information structures.
- Integration of local knowledge and scientific research regarding environmental and social impacts.
- Communicative and institutional modalities of implementing science agendas, placing major emphasis on information dissemination.

Key Science Questions

General consequences of industrialization, including research concerning the consequences of:

- Changes in access and accessibility of the region
- Rapid urbanization
- New social structures
- Conditions for policy decisions
- Import bans and anti-fur campaigns
- Diversification of traditional vs. modern sector, income structure and social stratification, gender imbalance, and temporal character of economic activities
- Change in resource tenure arrangements
- Change in the balance between "natives" and "newcomers"

Large-scale industrial development, including research concerning:

- Minimizing the adverse impacts of industrialization by development of methodologies concerning:
  - Impact assessment and prediction
  - Environmental health indictors
  - Impact minimization and mitigation
  - Ecological restoration
  - Environmental planning and management information dissemination
- Large-scale and mega-projects' influence on local production
- The relationship between private and public sectors
- The influence of sites of military activity

Economic and Political Linkages of Indigenous Societies to Nation-State and Transnational Orders, which requires re-

search in:

- How social and cultural changes in Arctic societies vary in response to different patterns of political and economic involvements
- Property rights at various levels
- Decisionmaking and governance structures
- Internal structures of social and cultural change
- Transnational linkages and structures

Industrial use of the marine renewable resources, involving research in:

- The Arctic marine ecosystems and their variabilities
- The biological complexity and multitude of the Arctic marine environment
- The present and past pattern of fisheries, especially concerning discards and bycatches
- The interrelationship between local and global stocks
- Management and property rights
- Changes in consumption patterns and market access
- A two-element development strategy, aiming at local as well as global resources
- Knowledge acquiring and the complementary character of scientific and local knowledge
- The consequences of interaction between wild, enhanced, ranched and reared stocks
- The varied purposes of fisheries.

Coastal Zone development, including:

- Management schemes and new research approaches
- Consequences of the exploitation of the oil and gas resources
- Coastal consequences of local and distant resources of contaminants
- Social responses of industrialization of the Arctic coastal zone
- Typology of regional models of industrial development

Long Range transport of industrial contaminants, comprising research in:

- Pathways, dynamics and distributions of pollutants
- How scientific knowledge about environmental hazards impinges on local perception and knowledge
- Management responsibility of local, national and international resource regimes, including institutional and regulatory instruments.

Actions Required from IASC

Creating the arrangement of logistics needed such as:

- Communication equipment
- Databases with comparative data and archives including sound and image databases
- Transportation, in order to allow access to areas and communities
- Guidelines for research and information exchange, including directories of agencies, local community authorities and resource persons in the Arctic
- Extensive support for translation, interpretation, etc.
- Expeditions to get people together.

A primary function of IASC is seen as an organization facilitating the creation and maintaining of international linkages

Linkages Within IASC and Beyond

Substantial number of research linkages required, including: Funding linkages, government agencies, research programs as such and international linkages to:

- AEPS with special attention to the work on key principles for the EIS guidelines and work going on in AMAP, PAME and CAFF
- NAFO, ICES, NAMMCO, FAO and other international organizations and agencies

The fundamental questions in the creation of new linkages are:

- How do we reinforce the social component in the research projects?
- How do we reinforce the relationship to local communities?

Users/Funders

- National research councils
- Regional councils, i.e. Nordic Council, Barents Euro-Arctic Council
- Binational (e.g. joint National Science Foundation (U.S.) and Social Sciences and Humanities Research Council and/or Natural Science and Engineering Research Council (Canada) research in the North

Next Steps

Two workshops during fall 1996

Funding required: $10.000

Projected Timetable

The projects as described are VERY HIGH in preparedness, also with a high degree of POLITICAL PREPAREDNESS with Greenland as well as a number of Local/Aboriginal organizations directly involved in research activities, but LOW in resources.

APPENDIX

Rapid Cultural Changes in the Circumpolar North

The objective of this section is to analyze rapid cultural changes in response to stresses.

- Indigenous/local knowledge including communication across knowledge systems, intellectual property rights
- Cultural continuity: heritage, values, integrity
- Community viability
- The changing balances of power and self-determination

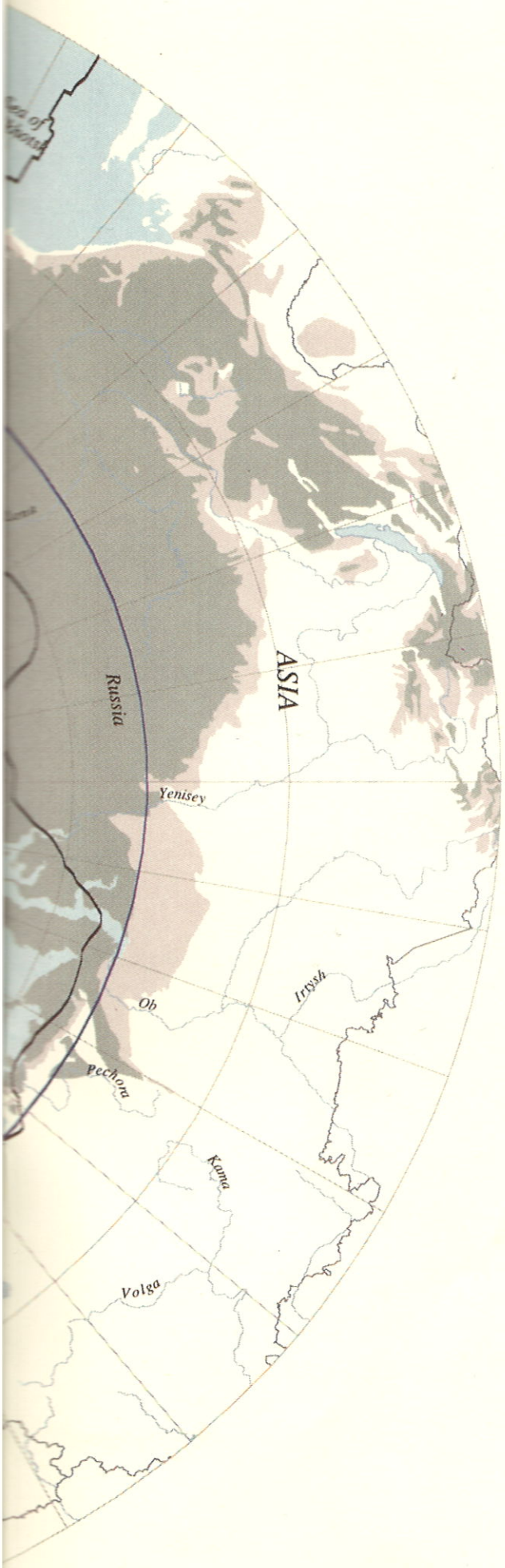
A proposal for the establishment of a new IASC Science priority.

During the IASC conference on research planning, the significance of cultural factors in scientific analysis came up in a number of ways. Various working groups, and a number of speakers, have advertised for scientific and indigenous knowledge on cultural issues to be incorporated in the research agendas. Other participants have stressed that indigenous, or local, knowledge has been invaluable to their research. At some of the working group meetings, it came up that there was a serious need for indepth research into specified cultural issues. To cope with the fact that none of the current four IASC priority themes focuses specifically on cultural issues, an initiative was taken by Dr. Igor Krupnik to formulate a research theme to be included in the future IASC science agenda. To address this research gap, and to address the concerns of the people living in the Circumpolar North, as this is mentioned in the IASC science agenda, a working group of 30-40 participants met twice during the Conference. The result was a unanimous suggestion for IASC to consider a new item of research priority under the name of "Rapid Cultural Changes in the Circumpolar North."

The proposal deals with fundamental research questions from which comparative and regional research projects can be expected to give new information and scientific knowledge. The working group made this proposal as the first step towards establishing detailed research projects and specified action programs. It is proposed that IASC adopt "Rapid Cultural Changes in the Circumpolar North" as an added item 5 to the list of science themes, and that the International Arctic Social Science Association (IASSA), on behalf of the research community, and as an advisory body to IASC, be given the responsibility to further develop this item.

It is thus the responsibility of the IASSA council, which includes four indigenous researchers, together with the chairperson of the three working groups on sustainable development, to solicit and incorporate input from scientists and from indigenous and northern institutions.

A draft research proposal will be prepared for the IASC council meeting in April 1996.



The Arctic Region

Legend

Continuous permafrost

Discontinuous permafrost

10°C - July isotherm

Arctic Circle
(latitude: 66° 33´ North)

UNEP

GRID-Arendal

Map compiled by Even Husby,
GRID-Arendal, March 20, 1996

Projection: Lamert Azimuthal - Equal Area

Trykk: GCS AS - OSLO