

# 2006 Annual Report

## CBMP

Circumpolar biodiversity  
Monitoring program

2006 ANNUAL REPORT



## CAFF Designated Agencies:

Environment Canada, Ottawa, Canada

Finnish Ministry of the Environment, Helsinki, Finland

Greenland Home Rule, Ministry of the Environment, Nuuk, Greenland

Icelandic Institute of Natural History, Reykjavik, Iceland

Directorate for Nature Management, Trondheim, Norway

Russian Federation Ministry of Natural Resources, Moscow, Russia

Swedish Environmental Protection Agency, Stockholm, Sweden

United States Fish and Wildlife Service, Anchorage, Alaska

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 CAFF Designated Area





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# 2006 annual report

on the

## Circumpolar Biodiversity monitoring program

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For more information on the CBMP  
please visit [www.cbmp.is](http://www.cbmp.is)

CAFF CBMP Annual Report 2006  
October 2006

Presented to the Arctic Council Ministers  
Salekhard, Russian Federation  
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## History of the CBMP

Recognizing the need for coordination and closer collaboration for Arctic biodiversity, Arctic scientists and communities started to integrate their research and monitoring efforts through CAFF-sponsored workshops with the first one in Reykjavik in 2000. This initial groundwork led to presentation of the Circumpolar Biodiversity Monitoring Program Framework Document and eight supporting documents to Arctic Council Ministers in November 2004, at the Reykjavik Ministerial Meeting. Arctic Council Ministers formally endorsed the CBMP and requested that CAFF begin implementation of the program (Reykjavik Declaration, 2004).

Iceland initially lead the CBMP, with Canada assuming the lead in April, 2005. The CBMP was formally launched at a meeting of over 50 Arctic scientists and representatives of the Indigenous organizations in Cambridge, U.K. in September 2005. The program has quickly grown, and partnerships have been secured with over 40 key organizations worldwide. An international Steering Committee and six task teams have been established:

- Indicators
- Data management
- Community-based Monitoring
- Remote Sensing
- Funding
- Assessment and Outreach

The Senior Arctic Officials in their October, 2005 meeting in Russia endorsed the work to date and expressed their support for continued development of the program. All Arctic Council countries pledged support to the CBMP at the CAFF XI Biennial in Ylläs, Finland in June 2006 and committed their national monitoring programs to coordinate with the CBMP. The CBMP is well under way to achieving coordinated monitoring in the Arctic.



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## Introduction - Global significance of Arctic biodiversity

The Arctic's brief, but intensely productive summers, in both the marine and terrestrial environments, attract hundreds of migratory species, linking the Arctic's biodiversity to biodiversity around the globe.

Two-hundred and seventy nine species of migratory birds breed in significant numbers in the Arctic. Of these species:

- Thirty reach southern Africa
- Twenty-six reach Australia and New Zealand
- Twenty-two reach southern South America
- Several pelagic species reach the southern oceans

Also participating in the global migration, are several species of land and marine mammals, such as the Gray and Humpback Whale who travel to the Arctic each year. While the Arctic is often thought of as having relatively low biodiversity i.e. few species, compared to other parts of the globe, it harbours very high genetic diversity, reflecting the many unique adaptations species have developed in response to the extreme conditions of the Arctic environment. These genetically distinct sub-species act essentially as species, filling critical ecological niches. The Arctic also hosts globally significant fish stocks, contributing twenty-eight percent of the global marine commercial fish catch.

While Arctic ecosystems are clearly of economic importance, one of their special assets is the fact that they are some of the world's few remaining pristine, undeveloped environments, encompassing vast wilderness areas, where ecosystem processes continue to function in a largely natural state. The Arctic plays a key role in the physical, chemical and biological balance of the globe.



Photo courtesy of Oleg Mineev, Institute of Biology, Komi Scientific Centre of Ural Division of Russian Academy of Sciences

## Arctic biodiversity under threat

Dramatic changes now underway in the Arctic, anthropogenic and natural, are severely threatening the resilience and sustainability of the Arctic's living resources. Of most concern is climate change, where serious impacts to Arctic biodiversity are already being seen, and where much larger impacts are expected this century. By the year 2100, the Arctic is expected to warm by between 3 to 5°C over land, and 7°C over the oceans, contributing to dramatic changes to Arctic ecosystems. There is predicted to be:

- (1) a greater than 50% decline in summer sea ice extent; and
- (2) the northward expansion of southern species and ecosystems displacing currently existing Arctic species and ecosystems such as Polar Deserts and tundra.

Climate change is increasingly challenging the resiliency of the Indigenous Peoples of the North, as the affects to plants and animals and their habitats, have direct impact on Indigenous cultures and livelihoods. In addition to climate change, the still relatively pristine Arctic environment is also under increasingly severe pressures from regional development in the form of roads, pipelines, oil and gas seismic lines, urbanization, forestry, mining, agriculture, hydro-electric development and so on.

# Circumpolar Biodiversity Monitoring Program (CBMP) and the Arctic Climate Impact Assessment (ACIA)

In 2004, the Arctic Council released the Arctic Climate Impact Assessment (ACIA). In response to the global importance of the Arctic's biodiversity, the increasing pressures on this biodiversity, and our limited capacity to monitor and understand these changes, the ACIA recommended that long-term, Arctic biodiversity monitoring be expanded and enhanced. The Conservation of Arctic Flora and Fauna Working Group of the Arctic Council (CAFF), received Ministerial endorsement in 2004 for the CBMP as CAFF's cornerstone program. The Circumpolar Biodiversity Monitoring Program, was formally launched in September of 2005 in cooperation with the UNEP-World Conservation Monitoring Centre in Cambridge UK, and is the primary vehicle through which CAFF will follow-up to the ACIA. Refer to Annex I for detail on specifically how the CBMP addresses the biodiversity-related recommendations of the ACIA.



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The Circumpolar Biodiversity Monitoring Program is, first and foremost, a coordinating entity:

- for existing Arctic biodiversity monitoring programs;
- for initiating new programs to address gaps in knowledge;
- for data gathering and data analyses;
- for coordinating the communication of results.

It is a mechanism for harmonizing monitoring efforts across the Arctic in order to improve our ability to detect significant trends within a reasonable time frame and improve our ability to effectively report on these trends, engaging diverse audiences such as northern communities, scientists, governments and the global community. Information on exactly how Arctic species are responding to these anthropogenic and natural changes is currently widely scattered among scientists, government institutions and northern communities. The CBMP has been designed to integrate existing information and monitoring efforts to understand the types and extent of change; and to develop strategies for adaptation to and mitigation of impacts. The CBMP functions as an international forum of key scientists and conservation experts from all eight Arctic countries, the six international Indigenous Organizations of the Arctic Council, and a number of global conservation organizations.

*Purpose: The purpose of the CBMP is to strive for conservation of biological diversity, to halt or significantly reduce its loss, and provide information for the sustainable use of the Arctic's living resources for the Indigenous Peoples of the Arctic, and other Arctic residents and stakeholders inside and outside the Arctic.*



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### *Justification for the CBMP:*

- *Comprehensive circumpolar information* is needed to *make the best conservation decisions* as pressures on the Arctic increase.
- *Collaboration increases efficiency in the use of human and financial resources*
- *Circumpolar collaboration increases effectiveness of conservation work* by creating "the big picture" - providing the critical circumpolar perspective, as opposed to each country working alone on these issues.
- *Public interest in Global Change is high* and increasing. Key question: 'What is happening to the climate and the Arctic environment?'
- *The Arctic Climate Impact Assessment and its recommendations* moved the Arctic into the spotlight, requesting that much more work is needed to understand what is happening.
- *Melting sea ice* is creating increasingly more accessible oil and gas prospects in the region, possibilities for regional development, and shipping traffic across the North Pole.
- *Political support is high*: the Arctic Council Ministers from all eight Arctic member states endorsed the CBMP as CAFF's cornerstone program.
- *Convention on Biological Diversity's 2010 target* to significantly reduce the global rate of biodiversity loss.
- *International Polar Year 2007-2009*



Photo courtesy of Dr. Christoph Zückler



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### *Objectives and products of the CBMP:*

- Identify and communicate:
  - Status and trends of biodiversity in the circumpolar Arctic
  - Populations, species, key habitats, and ecosystems under threat
  - Emerging issues (provide early warning of changes to habitat and species)
- Provide information and work with researchers and managers to increase knowledge and action on biodiversity loss
  - Are trends regional or circumpolar?
  - What are the main threats to biodiversity?
  - What actions can we take?
- Build and maintain cost-effective monitoring capacity (identify links and overlaps among programs; identify and fill gaps)
- Help address the critical needs of the Indigenous Peoples in preserving their communities, cultures and livelihoods.
- Assist policy and decision-making regarding sustainable development in the Arctic as it relates to biodiversity, and provide the information needed to develop mitigation and adaptation strategies.

Products envisioned include annual data reports, interactive mapping of databases, a user friendly website, and a comprehensive 2010 Arctic Biodiversity Assessment.

The Arctic Monitoring and Assessment Programme (AMAP), another Working Group of the Arctic Council, and CAFF will join efforts in developing joint monitoring projects to combine biodiversity data with contaminants and climate data. The CBMP will make use of the broad wealth of biodiversity data and monitoring capacity, providing an opportunity for integration of data and coordination of monitoring and allowing for the integration of biodiversity data with physical and chemical data in order to facilitate a better understanding of the processes driving changes in Arctic environments.



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*Key developments over the last year:*

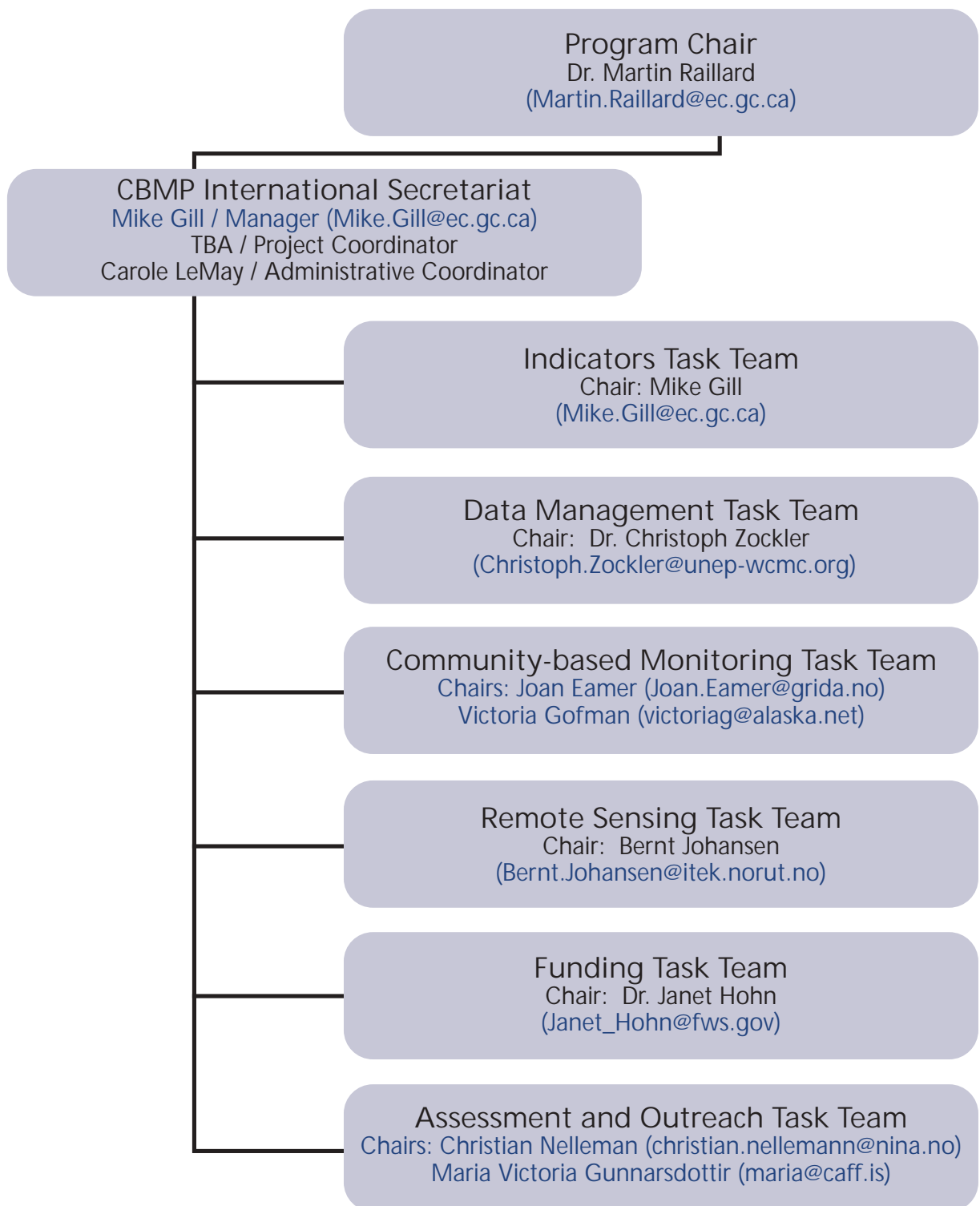
- The CBMP was officially launched in Cambridge, U.K. in September 2005
- Biodiversity indices and indicators have been developed for the program
- UNEP's World Conservation Centre has been identified as a key partner for the web-based data portal for the CBMP.

- The CBMP received formal endorsement from the International Polar Year committee and was considered a key 'cluster' program.
- Draft Data Management, Indicator and Remote Sensing Strategies have been developed.
- Several pilot projects have been launched.
- A funding application to the Canadian International Polar Year was submitted 30 March 2006.
- Funding from other sources has been pursued and decisions are pending.
- A joint workshop with the oil and gas industry's International Petroleum Industry Environmental Conservation Association (IPIECA) was held in June 2006 in Tromsø, Norway to discuss common Arctic conservation issues and areas for potential collaboration.
- Canada has taken the lead of the CBMP, following Iceland, and has established an international secretariat. Canada is providing two full time and one half-time staff to the program.
- An international Steering Committee (twelve members from six countries) has also been established along with six task teams (Indicators, Data Management, Community-based Monitoring, Remote Sensing, Funding, and Assessment and Outreach).
- All eight Arctic Nations have confirmed their support for the program and are providing resources.
- Over forty organizations have established formal linkages to the CBMP thus far.
- Dr. Martin Raillard, CBMP chair from Environment Canada, started a one year sabbatical, concentrating full time on the CBMP, in June 2006, based in Geneva, Switzerland.



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This organizational structure will be updated at the next CBMP workshop in November 2006 in Anchorage, Alaska, to include representatives from all Arctic Council Nations.



Photo courtesy of Oleg Mineev, Institute of Biology, Komi Scientific Centre of Ural Division of Russian Academy of Sciences

## Updates from Task Teams

### 1) Indicators

The Indicator Task Team hosted three workshops over the past year to identify the priority biodiversity indices and indicators which will form the core of the CBMP. The workshops helped define the criteria and approach for selecting the indicators and indices, identified the priority indicators and indices and identified lead agencies for the various indicators/indices. The workshops were well attended by scientists and community experts representing all Arctic Nations, international Indigenous organizations and a number of international non-governmental organizations mandated with conservation of Arctic biodiversity. The indicators chosen strongly represent the Convention on Biological Diversity's Headline Indicators as well as existing Arctic biodiversity monitoring capacity and expertise. A draft Indicator Strategy has been circulated within the CBMP Steering Committee and the task team, and a final draft is currently under development. The final draft will be sent out for a wide peer review involving community experts, scientists and others across the Arctic, involving experts representing the key international conservation organizations. With the strategy in place, next steps will include conducting an analysis of current Arctic biodiversity monitoring capacity, investigating the elemental, geographic

and design deficiencies in our current monitoring, and development of an Arctic biodiversity monitoring strategy that addresses the outcomes of the analysis. Target ranges for indicators will be developed with full consultation.



Photo courtesy of Dr. Christoph Zöckler

### 2) Data Management

At present a draft document has been circulated within the CBMP Steering Committee and the CAFF Management Board, outlining the overall management of the data. This document is an early draft featuring the areas of data collection, data presentation, integration and dissemination. It also identifies a few pilot projects to test the data interoperability and explore the issues and constraints in managing a range of very different biodiversity data. The pilots aim to address the different data areas, such as remote sensing, community-based monitoring and the species networks, already well established within CAFF. The Seabird Information Network (SIN) is the first pilot where work has already begun to establish a web-based interface to enhance interoperability between the many different databases joining SIN. Other pilots follow suit, once financial resources have been established.

### *3) Community-based Monitoring*

This task team has identified a number of issues that discourage regional CBM projects from joining larger networks. Concerns about data management processes in larger programs or networks present the strongest impediment in garnering communities' support and interest in participation in the CBMP. Considering that the CBMP will have to rely on available and new information collected and held by communities including traditional ecological knowledge, it is important that this issue is addressed immediately. For this purpose, together with other task teams, CBM leads are planning a workshop to ensure effective, scientifically and culturally appropriate organization of community-based monitoring and research in the Circumpolar Biodiversity Monitoring Program. The workshop that will be held in November in Anchorage will develop recommendations for the CBMP data management strategy and will devise a draft implementation plan for the Bering Sea Sub-Network (BSSN) as one of the key CBM components of CBMP.



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Key participants to this CBM workshop will include representatives from community-based organizations (CBO) that have the most advanced environmental data management programs; representatives from the expert task teams of the CBMP Steering Committee, and the representatives from the BSSN partnering organizations.



Photo courtesy of Dr. Christoph Zöckler

### *4) Remote Sensing*

The remote sensing task team is now drafting a remote sensing strategy, and will identify circumpolar pilot projects to establish some of the baseline data needed for ecosystem analyses related to climate change and other natural and anthropogenic impacts.

### *5) Funding*

A donor agency workshop will be planned in Washington DC in early 2007, for additional contributions, and the funding task team will continue to raise resources for the program.

### *6) Assessment and Outreach*

A proposal for a 2010 Arctic Biodiversity Assessment was submitted to Arctic Council Ministers for endorsement at the 2006 AC Ministerial meeting in Salekhard, Russian Federation. The CAFF International Secretariat and the CBMP International Secretariat are working together to develop the CBMP website. This project is part of the larger project to upgrade the CAFF website. The CBMP website will be the main source of information for the CBMP and the website address is [www.cbmp.is](http://www.cbmp.is).

The CBMP and CAFF International Secretariats are also working together to develop promotional materials such as posters and brochures for the CBMP. An extensive communications plan for education and outreach will be developed and executed as financial resources become available. Part of this plan will include interactive mapping of the CBMP data, combined with remote sensing data on a circumpolar scale. The two secretariats will also continue to jointly produce annual reports.



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Komi Scientific Centre of Ural Division of Russian Academy of Sciences

## International Polar Year – the CBMP as a project

The CBMP was endorsed as an IPY project, and a major funding proposal was submitted to the Canadian IPY Secretariat in March of 2006. This substantive proposal seeks funding to bring together existing biodiversity information in a comprehensive database, to conduct a thorough analysis of the gaps in current Arctic biodiversity monitoring capacity, to develop an international monitoring program that addresses these gaps and to make this information available to all users through the development of a web portal, regular newsletters and reports. The proposal also seeks funding for assistance in staffing the

International Secretariat, for developing course curriculum (related to biodiversity monitoring and conservation) for northern universities and for development of the 2010 Arctic Biodiversity Assessment. Decisions regarding Canadian funding for the IPY program are expected by December.

### Linkages

The CBMP is an umbrella organization that has established professional linkages with many partners. In addition to CAFF's Circumpolar Seabird Expert Group (CBird) and Flora Expert Group (CFG) which are circumpolar, the following organizations have been engaged in the CBMP to this point:





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#### Canada

- Environment Canada, Canada
- Arctic Borderlands Ecological Knowledge Cooperative, Canada
- Inuit Circumpolar Conference, Canada

#### Denmark

- Indigenous Peoples Secretariat, Denmark

#### Faroe Islands

- Faroese Museum of Natural History, Faroe Islands

#### Finland

- Ministry of the Environment, Finland
- Saami Council, Finland
- Finnish Environment Institute, Finland

#### Greenland

- Greenland Ministry of Natural Resources

#### Iceland

- Icelandic Institute of Natural History, Iceland

#### Netherlands

- Wetlands International, Wageningen, The Netherlands
- University of Groningen, The Netherlands

#### Norway

- Norwegian Polar Institute, Norway
- UNEP/GRID-Arendal, Norway
- NORUT Information Technology Ltd., Tromsø, Norway
- The University Centre in Svalbard, Norway
- Directorate of Nature Management, Norway



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#### Russia

- Ministry for Foreign Affairs, Russia
- Russian Association of Indigenous Peoples of the North, Russia (RAIPON)
- Moscow State University, Russia
- Russian Academy of Sciences, Russia
- Ministry of Natural Resources, Russia

#### Sweden

- Swedish Environmental Protection Agency, Sweden

#### Switzerland

- International Union for the Conservation of Nature, World Headquarters, Switzerland
- University of Basel, Switzerland

#### United Kingdom

- UNEP World Conservation Monitoring Centre (UNEP-WCMC), Cambridge, UK
- University of Stirling, United Kingdom
- Microsoft Research Cambridge, United Kingdom



Photo courtesy of Oleg Mineev, Institute of Biology, Komi Scientific Centre of Ural Division of Russian Academy of Sciences

#### United States of America

- U.S. Fish and Wildlife Service, Anchorage, Alaska
- Aleut International Association, Anchorage, Alaska
- National Oceanic and Atmospheric Administration, United States
- National Snow and Ice Data Center, United States
- Marine Mammal Commission, United States
- University of Alaska Fairbanks, United States
- Census of Marine Life, United States



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### *CBMP Species Networks as of 2006*

- CAFF Flora Expert Group (CFG) – also serves as the IUCN Arctic Plant Specialist Group
- Human-wild *Rangifer* Systems (CARMA)
- International Tundra Experiment (ITEX)
- Seabirds (CAFF Seabird Expert Group (CBird))
- Shorebirds (CHASM)
- Bering Sea Sub-Network

### *In process of being established:*

- Arctic Char
- Polar Bears
- Geese

## Future Actions

- The CBMP is preparing a detailed implementation plan and has scheduled a workshop in Anchorage, Alaska from Nov. 29 – Dec. 1, 2006 that will bring together Arctic experts to assist with this task. Arctic Council countries will then be able to identify the elements of the CBMP that they are prepared to fund.
- The Indicators, Data Management, and Remote Sensing Strategies will be finalized and published.
- A community-based monitoring workshop is also scheduled in Anchorage, Alaska (Nov. 27 and 28) in order to define the

scope, intent and role of this element of the program.

- A donor agency workshop will be planned in Washington DC in early 2007, for additional contributions, and the funding task team will continue to raise resources for the program.
- As resources are secured, the CBMP implementation plan will be put into action, and the CBMP will begin development of strategies for adaptation to and mitigation of impacts.



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The CBMP Secretariat and task teams will directly contribute to the 2010 Arctic Biodiversity Assessment, and the Assessment itself will also assist in further defining the long-term direction and development of the CBMP.

As resources are secured, the CBMP Secretariat is expected to grow with the hiring of a communications coordinator, project coordinators, database managers and GIS technicians.



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## ANNEX I:

# ACIA Recommendations and relationship to CAFF's Circumpolar Biodiversity Monitoring Program

Review of ACIA Chapters in context of ongoing and future work

CAFF has reviewed the scientific chapters of the ACIA in the context of ongoing and future work. The CAFF 2006-2008 Work Plan reflects the priorities of executing projects called for in the ACIA scientific recommendations for follow-up.

Please refer to the CAFF 2006-2008 Work Plan for details.

In addition, special focus has been placed on the Circumpolar Biodiversity Monitoring Program (CBMP) endorsed by the Arctic Council Ministers in 2004 as a cornerstone program of CAFF. Although the CBMP is clearly focused on tracking the status and trends of Arctic biodiversity, it will, to a large extent, be accounting for and tracking impacts to biodiversity derived from climate change, thereby fulfilling, fully or in part, many of the recommendations made by the Arctic Climate Impact Assessment. The following lists the ACIA recommendations partially or fully relevant to the CBMP and provides a short explanation as to how the CBMP might address them.

## Chapter 3

*ACIA Recommendation: For some areas, such as the central and eastern Russian Arctic, few or no current records of indigenous observations are available. To detect and interpret climate change, and to determine appropriate response strategies, more research is clearly needed.*

Community-based monitoring techniques will be employed by the CBMP to track the status and trends of Arctic biodiversity and understand the mechanisms driving this change, such as those from human-induced climate change. The CBMP's approach will likely be through several regional partnership programs, new or existing, that utilize indigenous observations on changes, specific to Arctic biodiversity.



Photo courtesy of Association of Nenets people of "Yasavey"



*ACIA Recommendation: In Eurasia and Greenland, little systematic work on indigenous knowledge has been done, and research in these regions is clearly needed. Indigenous observation networks have been set up in Chukotka, Russia, and some projects have taken place in Alaska, but little systematic work has been done to set up, maintain, and make use of the results from such efforts.*

Systematic long-term community-based biodiversity monitoring programs that involve indigenous observations are expected to be developed in different parts of the Arctic such as in parts of Eurasia, where feasible.

*ACIA Recommendation: Problems to be tackled: determining how indigenous knowledge can best be incorporated into scientific systems of knowledge acquisition and interpretation; and; finding ways to involve indigenous communities in scientific research and to communicate scientific findings to indigenous communities.*

Through the CBMP's development of pilot community-based biodiversity monitoring programs, the program will be exploring ways for involving, utilizing and synthesizing information regarding that the status and trends of Arctic biodiversity derived from scientific, indigenous and citizen science-based approaches.



Photo courtesy of Inger Marie Gaup Eira

## Chapter 7

*ACIA Recommendation: There is also a need to identify and monitor currently widespread species that are likely to decline under climate change, and to redefine conservation and protection in the context of climate and UV radiation change.*

The CBMP will be monitoring a number of Arctic species, some of which are likely to decline under climate change. Pilot projects will be developed with AMAP. One likely project will focus on the polar bear as a species threatened with a high risk of extinction.

*ACIA Recommendation: The dominant response of current Arctic species to climate change is very likely to be relocation rather than adaptation. Relocation possibilities are very likely to vary according to region and geographic barriers. Some changes are already occurring. However, knowledge of rates of relocation, impact of geographic barriers, and current changes is poor. There is a need to measure and project rates of species migration by combining paleo-ecological information with observations from indigenous knowledge, environmental and biodiversity monitoring, and experimental manipulations of environment and species.*



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The CBMP will be monitoring, over time, the distribution of a number of biodiversity elements, such as the distribution and extent of Arctic biomes.

*ACIA Recommendation: Long-term environmental and biological monitoring are becoming increasingly necessary to detect change, to validate model projections and results from experiments, and to substantiate measurements made from remote sensing. Present monitoring programs and initiatives are too scarce and are scattered randomly. Data from the Arctic are often not based on organized monitoring schemes, are geographically biased, and are not long-term enough to detect changes in species ranges, natural habitats, animal population cycles, vegetation distribution, and carbon balance. More networks of standardized, long-term monitoring sites are required to better represent environmental and ecosystem variability in the Arctic and particularly sensitive habitats. Because there are interactions among many co-varying environmental variables, monitoring programs should be integrated. Observatories should have the ability to facilitate campaigns to validate output from models or ground-truth observations from remote sensing. There should be collaboration with indigenous and other local peoples' monitoring networks where relevant.*

*It would be advantageous to create a decentralized and distributed, ideally web-based, meta-database from the monitoring and campaign results, including relevant indigenous knowledge.*

The CBMP will be integrating and standardizing information from current monitoring programs using a decentralized, distributed web-based data portal and will be filling gaps in geographic, temporal and elemental biodiversity monitoring coverage as resources become available. The approach taken will utilize both remote sensing information as well as community-based monitoring techniques involving indigenous observations. CBMP will also compile a list of field stations in the Arctic, and their functions/applicability to CAFF's work. Pilot projects developed jointly with AMAP will also assist in filling knowledge gaps.

*ACIA Recommendation: Monitoring requires institutions, not necessarily sited in the Arctic, to process remotely sensed data. Much information from satellite and aerial photographs exists already on vegetation change, such as treeline displacement, and on disturbances such as reindeer/caribou overgrazing and insect outbreaks. However, relatively little of this information has been extracted and analyzed.*



With a circumpolar perspective, the CBMP will be implementing some remote sensing pilot projects that utilize remotely sensed data to determine the status and trends in the distribution of various arctic biomes as well as the extent of human impact on these biomes. The CAFF Flora Group has already begun work on mapping vegetation change and is setting up a workshop for mapping the boreal forests.

## Chapter 8

*ACIA Recommendation: Integrated circumpolar monitoring of freshwaters – key scientific gaps: the limited records of long-term changes in physical, chemical and biological attributes throughout the Arctic; differences in the circumpolar availability of biophysical and ecological data (e.g., extremely limited information about habitat requirements of arctic species); a lack of circumpolar integration of existing data from various countries and disparate programs; a general lack of integrated, comprehensive monitoring and research programs, at regional, national, and especially circumpolar scales; a lack of standardized and networked international approaches for monitoring and research.*

The CBMP's mandate includes Arctic freshwater systems where they pertain to the monitoring of biodiversity. Through partnerships with existing monitoring programs, the CBMP will assist in building capacity and coverage for long-term monitoring of Arctic freshwater biodiversity and will assist in the standardization, compilation, analysis, synthesis and reporting of status and trends information.

## Chapter 9

*ACIA Recommendation: The existing monitoring programs should be continued and expanded (high priority), both spatially and in breadth of measurement. New monitoring*

*activities should be established in areas where they are presently lacking and these should be designed to address the effects of climate change. Issues to be addressed include the timing and amount of primary and secondary production, larval fish community composition, and reproductive success in marine mammals and seabirds. Key ecosystem components, including non-commercial species, must be included.*

The CBMP is working with marine biodiversity monitoring partners to develop monitoring strategies and build capacity and coverage of current monitoring and assist with standardization, compilation, analysis, synthesis and reporting of marine biodiversity status and trends information.

*ACIA Recommendation: An Arctic database should be established that contains all available physical and biological data.*

The CBMP is currently developing a web-based data portal that will access distributed databases, including ones containing marine biodiversity monitoring data, for the compilation, analysis and synthesis of biological information to determine status and trends.

*ACIA Recommendation: Past physical and biological data from the Arctic should be recovered. There are many data that are not presently available but could be recovered.*

If resources became available, the CBMP will assist with the recovery of archived biodiversity monitoring data that is not currently accessible.

## Chapter 10

*ACIA Recommendation: Monitoring is important for understanding how the Arctic's biodiversity is changing and whether actions to conserve biodiversity are being successful; monitoring needs to occur at both the system level and the species level.*

The CBMP's mandate is to coordinate monitoring of Arctic biodiversity including the tracking of the effectiveness of conservation efforts and the monitoring of species and systems.

*ACIA Recommendation: There needs to be a supply of trained ecologists who can devise appropriate circum-Arctic classifications of habitats and then survey them so as to measure their extent and quality and to establish their dynamics.*

Through collaborations with its partner monitoring networks, the CBMP will be developing a Circumpolar Boreal Vegetation Map, involving standardized habitat classifications and acting as a baseline for future monitoring of the trends in extent and quality of these habitats. This is a follow-up to the joint project with the CAVM – Arctic vegetation mapping group that completed the Circumpolar Arctic Vegetation Map.

*ACIA Recommendation: Inventories need to be generated for the Arctic's biodiversity (both species and habitats), indicating for each entry in the inventory where it occurs and either the size of the overall species population or the extent of the habitat. Such inventories need to be on a circum-Arctic basis rather than on a national basis as nations with arctic territory also have territory south of the Arctic.*

While the CBMP is not directly developing inventories, its partners will, in many cases, be the holders of information such as species populations and extent of habitats that will be accessible, in most instances, through the CBMP's web-based data portal. CAFF's Flora expert group, and seabird expert group are creating comparative inventories and red lists.

*ACIA Recommendation: Models need to be further developed to explore changes in biodiversity under the various scenarios of climate change. These models will need to explore biodiversity change in the sea, in freshwater, and on land.*

Biodiversity monitoring information managed by the CBMP will contribute to model development through the comparisons of regional differences in climate change impacts and the response of biodiversity to these impacts.

*ACIA Recommendation: Circum-Arctic monitoring networks need to be fully implemented throughout the Arctic. Data on the state of the Arctic's biodiversity, on the drivers of change in that biodiversity, and on the effectiveness of responses to those changes, need to be collected, analyzed, and used in the development of future arctic biodiversity policy.*

The CBMP will directly address all of these recommendations. Pilot projects developed jointly with AMAP will also address these recommendations.

*ACIA Recommendation: Attention needs to be given to establishing the kinds of subsidiary aspects of monitoring, such as integrated monitoring and monitoring of phenology, genetic diversity, and invertebrate fauna. These are vital if a holistic view is to be taken of the Arctic's biodiversity, its conservation in the face of a changing climate, and the management of the biodiversity resource for future generations of people to use and enjoy.*

The CBMP's biodiversity indicators include phenology and the monitoring of some invertebrate fauna.

*ACIA Recommendation: A suite of indicators needs to be devised and agreed, monitoring for them undertaken, and the results made publicly available in a format (or formats) so as to inform public opinion, educators, decision-makers, and policy-makers.*



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The CBMP now has a draft list of biodiversity indicators for circumpolar monitoring. The resulting status and trends information from these indicators will be reported on regularly in a diversity of formats to reach the wider public as well as decision and policy makers.

*ACIA Recommendation: Best practice guidelines need to be prepared for managing all aspects of the Arctic's biodiversity. These need to be prepared on a circumpolar basis and with the involvement of all interested parties.*

While not directly focusing on best management practices, the CBMP's biodiversity information will aid industry and governments in the development of best practices as the CBMP will not only track changes in biodiversity but investigate the causal mechanisms driving those changes, thereby informing best management practices.

*ACIA Recommendation: Integrated forms of management, incorporating the requirement for biodiversity conservation, need to be explored for all uses of the land, freshwater, and sea in the Arctic.*

The CBMP will produce policy recommendations based upon the status and trends it produces, especially where information regarding the mechanisms driving biodiversity change is available. This information could be used to develop integrated management approaches for the conservation of biodiversity.

*ACIA Recommendation: Biodiversity conservation needs to be incorporated into all policy development, whether regional, national, or circumpolar.*

The CBMP will produce policy recommendations for biodiversity conservation based upon the results produced through its circumpolar monitoring.

*ACIA Recommendation: All nations with Arctic territory should be working toward full implementation of the Convention on Biological Diversity, coordinating their work on a circumpolar basis, and reporting both individually and jointly to the regular Conferences of the Parties.*

The CBMP has adopted many of the CBD biodiversity indicators, when relevant to the Arctic. These indicators will allow the entire Arctic region to be able to report on progress made towards the 2010 CBD target.

## Chapter 11

*ACIA Recommendation: Achieving effective conservation and management of wildlife in a changing Arctic will require a team-building approach among governments at all levels that relate to the environment and human well-being, and with all other groups with an interest in the Arctic. This effort should include the indigenous peoples and other residents of the Arctic, and scientists undertaking research in the Arctic, representatives of industry and business seeking development of arctic resources or other economic opportunities in the Arctic, those who travel to the Arctic for recreation or tourism, and the non-governmental organizations seeking to protect or sustain environmental, aesthetic, and other less tangible values of the Arctic in the broader interest of society. The successful management and conservation of arctic wildlife requires that these groups be represented in the management process and that adequate information is available for equitable consideration of the diverse interests that relate to arctic wildlife. The role of international, non-governmental environmental organizations is particularly important in maintaining focus of the public on the broad spectrum of environmental values existing in the Arctic when proposals for large-scale industry- or government-sponsored projects become politicized at the regional or national levels.*

The CBMP represents a multiple partner (governments, NGO's, indigenous people's, northern communities, industry, etc.), holistic approach to the monitoring and conservation of Arctic biodiversity. It strives to bring together diverse partners towards the common goal of conserving Arctic biodiversity in order to ensure human well-being both inside and outside the Arctic.

## Chapter 13

*ACIA Recommendation: Present monitoring of the physical and biological marine environment must be continued and in many cases increased. Basic research is a prerequisite for understanding biological processes. Modern technology enables the automation of many of the time-consuming tasks previously conducted from expensive research vessels, e.g., buoys can now be deployed in strategic locations on land and at sea for continuous measurement of many variables required in marine biological studies. The monitoring of commercial stocks must also continue, applying new technologies as these become available. There is a general shortage of ship time for sea-based work. Administrators or governments are often unaware of this, also that despite computers enabling more extensive and deeper analyses of existing datasets, people are still required to operate and program the computers.*

The CBMP will be working with its marine biodiversity monitoring partners towards the goal of continuing and increasing the effectiveness of current Arctic marine biodiversity monitoring efforts.

## Chapter 14

*ACIA Recommendation: Forest advance into tundra has the potential to generate a large positive temperature feedback. Unfortunately, the understanding of change at this crucial ecological boundary comes from a small number of widely separated studies undertaken to achieve*

*many different objectives. A coordinated, circumpolar treeline study and monitoring initiative will be necessary to address definitively the question of how and why this boundary is changing at the scale required to address its potential global importance.*

The CBMP, while not planning on directly monitoring treeline position, will be monitoring the distribution and extent of various terrestrial Arctic biomes. This information may be able to contribute, over time, to a greater understanding of the impacts of an advancing treeline on climate, but it may not be at an appropriate temporal scale for climate modelling. The CAFF Flora Group is currently mapping Arctic vegetation and is now working toward mapping the boreal forests and analyzing the boundary changes.

## Chapter 15

*ACIA Recommendation: There is a need for a carefully planned strategy, at the community and regional level, to monitor and document environmental change. Arctic Council members and program workgroups should provide technical assistance regarding monitoring strategies, climate impact mitigation and pilot studies, data analysis, and evaluation.*

The CBMP is developing a biodiversity monitoring strategy based on a set of indicators and including community-based and regional approaches.

*ACIA Recommendation: There are few data on climate change impact on regional biota. A critical need exists for the monitoring of wildlife diseases, and human-wildlife disease interaction. There are few data on climate-induced changes in the diet of subsistence species, which affects their nutritional value in traditional diets. Arctic Council programs have the expertise to design effective regional and international monitoring programs in cooperation with communities. This critical activity should be given a high priority.*

The CBMP, in collaboration with partner species monitoring networks, and in cooperation with AMAP on developing joint pilot project, will effectively address this recommendation. CBMP is developing a set of biodiversity indicators for long-term monitoring, that includes monitoring the presence and distribution of such impacts on wildlife as disease.

## Chapter 18

*ACIA Recommendation: Regional impacts: The ACIA mostly addressed impacts at the large-scale circumpolar level. The attempt to differentiate between impacts within the four ACIA regions was exploratory and did not cover these regions in depth. There is a need to focus future assessments on smaller regions (perhaps at the landscape level) where an assessment of impacts of climate change has the greatest relevance and use for residents in the region and their activities.*

The CBMP, in some cases, may be able to shed light on the impacts of climate change on biodiversity at the regional level, where regionally specific programs are implemented and data rigour allows for such an analysis. Seabird Expert Group projects on murre and kittiwakes specifically relate to climate change and are the first of their kind to be circumpolar.

*ACIA Recommendation: Observations and process studies: To improve future climate impact assessments, many Arctic processes require further study, both through scientific investigations and more detailed systematic documentation of indigenous knowledge. Priorities include collection of data ranging from satellite, surface, and paleo data on the climate and physical environment, to rates and ranges of change in arctic biota, and to the health status of arctic people.*

The CBMP's biodiversity indicators include the distribution and extent of arctic biota.



Photo courtesy of Dr. Christoph Zöckler