UNITED STATES ARCTIC RESEARCH COMMISSION

ANNUAL REPORT FISCAL YEAR 2006

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January 31, 2006

To: The President
The President (pro tempore) of the Senate
The Speaker of the House of Representatives

It is my pleasure to forward the Annual Report of the US Arctic Research Commission for Fiscal Year 2006 as referenced in the Arctic Research and Policy Act (ARPA) of 1984 (as amended).

Fiscal Year 2006 was proved to be an outstanding year in the life of the Commission. As has been our record in past years, the Commission's activities reflected our increasing interaction with Arctic research entities at the local, state (Alaska), national, and international levels. The Commission's autonomous office in Anchorage, opened in August 2003, continued to facilitate in meeting our objective of support of research conducted in, and for those who live in, America's Arctic.

A summary list of the "Highlights of Commission Activities–FY-06" follows. It briefly summarizes the Commission's expanding role as an active and integral force in the planning and implementation of the nation's Arctic research and research policies, as mandated by the ARPA and as articulated by the Interagency Arctic Research Policy Committee through the National 5-Year Arctic Research Plan.

As Commission Chair, I am both privileged and proud to lead this agency whose activity and achievements, I submit, belie its small size of seven (part-time) Commissioners and three four-time staff.

Very respectfully submitted,

George B. Newton, Chair
U. S. Arctic Research Commission

Annual Report
of the
UNITED STATES ARCTIC RESEARCH COMMISSION
to the
PRESIDENT and CONGRESS of the United States

Fiscal Year 2006

United States Arctic Research Commission
4350 North Fairfax Drive, Suite 510

Arlington VA 22203

Preface

The Arctic Research and Policy Act of 1984 as amended (Public Law 101-609) requires that the US Arctic Research Commission, which was established by this Act, submit to the President of the United States and the Congress, not later than 31 January of each year, a report describing its activities and accomplishments during the immediately preceding fiscal year. This requirement has since been dropped from the law. However, the Commissioners of the Arctic Research Commission have declared their intention to continue publication of an annual report. To that end, the Commission presents the following report for fiscal year 2006 (1 October 2005 through 30 September 2006). For a description of the activities of the Commission in previous years, see its Annual Reports (Table 1 on inside back cover).

Contents

Highlights of Commission Activities, Fiscal Year 2006

- Conducted four public meetings in Corvallis and Newport, OR (Oregon State Univ.); Seattle WA, (Univ. of Washington); Arlington, VA, Barrow and Anchorage AK.
- Negotiated the additional release to the public of Arctic Ocean bathymetry collected by the US Navy nuclear submarines during the period 1993-2000. The data came from 11 cruises covering approximately 25,000 track miles under sea ice.
- Continued proactive support for US ratification of the Law of the Sea (LOS-82) Treaty, working with both committees and individual members of the Senate, and various offices of the Executive Branch.
- Participated in the meetings of the Alaska Ocean Observing System (AOOS) as a full Board Member; assisted in the development of a AOOS Strategic Plan and establishment of a working group on Alaska coastal sea ice.
- Reviewer of the Interim and Final Report of the National Academy of Sciences Committee on the Assessment of USCG Polar Icebreaker Roles and Future Needs.
- Assisted in developing & establishing of the Alaska Center for Climate Assessment & Policy (ACCAP) at the University of Alaska Fairbanks. ACCAP is funded by NOAA as one of a group of Regional Integrated Sciences & Assessments (RISA) programs; USARC is a member of the ACCAP Steering Committee.
- Advisor to the Panama Canal Authority briefing the senior Canal managers on upcoming Arctic meetings and continuing climate change issues and research.
- Sponsored, organized and participated in an international, Society of Naval Architects & Marine Engineers ICETECH 2006 conference in Banff, Alberta.
- Organizing committee member and sponsor for the Alaska Marine Science Symposium.
- Sponsorship and participation in the 2nd International Conference on Arctic Research Planning (ICARP II) in Copenhagen, Denmark (November 2005).
- Continued providing counsel to the North Slope Science Initiative (NSSI) as a non-voting member of the NSSI Oversight Group; worked to ensure appropriate strategic directions for NSSI and provided counsel on the selection of the members of the NSSI Science Technical Group.
- Continued an active and influential role in U.S. involvement in Arctic Council affairs under the leadership of the State Department. Provided leadership and management, staff support for the Council's Arctic marine Shipping Assessment (AMSA, 2005-2008) for which the Deputy Director is Chairman and U.S. lead contact. Participated in the meetings of the Council's working group Protection of the Arctic marine Environment (PAME).
- Made a presentation to the Biannual meeting of the Advisory Board of the Law of the Sea, Monaco, sponsored by the International Hydrographic Commission
- Made an invited presentation to the Marine Board of the National Academy of Sciences in Washington on the linkage of US accession to the Law of the Sea Treaty and development (economic/commercial/security) of the Arctic Ocean.
- Made presentation on Arctic Ocean Notices to Mariners System and the control/research on oil spills in the Arctic Ocean.
- Attended the Ninth meeting of the Alaska Ports Workshop, in which the USARC was a co-sponsor with the UAA. (Jan). Visited the UAF campus in Fairbanks, meeting with the research and science faculty.

- Attended the World Economic Forum held in Davos, Switzerland, as a technical expert on the Arctic Ocean and climate change.
- Attended a workshop on Technology for Improving Communications in the Arctic Ocean adjacent areas held at APL/UW.
- Attended Arctic Science Summit week in Potsdam Germany.
- Attended the quarterly meetings of the State Department ad-hoc committee on the Law of the Sea and Article 76 surveys to extend US sovereignty over its ECS.
- Attended the Annual symposium on Capitol Hill sponsored by the University of Virginia Law School center for Ocean Law and Policy.
- Gave presentation on the development of an Arctic Ocean Notices to Mariners System for all nations at the Arctic Shipping Conference, St. Petersburg, Russia.
- Attended the annual Meeting of the Arctic Research Consortium of the United States (ARCUS) held in Washington, DC.
- Attended the annual meeting of the Committee on the Promulgation of Radio Navigation Warnings, part of the World Meteorological Organization (WMO) held in Halifax, Nova Scotia, at the invitation of the US National Geo-Spatial Intelligence Agency (NGA) to discuss the Arctic Ocean maritime safety.
- Attended a workshop in Ottawa, Canada, on the Law of the Sea Treaty and considerations for US accession and the surveys required by Article 76.
- Met with Chief of Naval Research in Arlington, VA, to discuss US science community's interest in the Submarine Science Cruise (SCICEX) Program.
- Attended and delivered the keynote address 4th Annual International Conference on Civil Engineering, held at the University of Maine in Orono.
- Attended and was luncheon speaker at the Annual Meeting of the North American Ice Service, addressing "the" ongoing environmental changes being observed in the Arctic and their long term impact on the need for an expanded ice service for the area by both the US and Canada.
- Completed negotiations, identified funding, and commenced the digitizing of archived (classified) Arctic Ocean sound speed profiles collected by US Navy nuclear submarines during 1968-2000. This represents a significant data rescue effort, which should be released to the general science community in FY 2006.
- As full member of the Governance Board of the Alaska Ocean Observing System (AOOS), led effort to establish an Alaska sea ice subcommittee within AOOS to address stakeholder and research requirements for sea ice in Alaska's coastal seas.
- Continued to submit recommendations to oversee implementation of improvements to the Arctic Maritime Safety Information (AMSI) database system. AMSI is the International Arctic Ocean equivalent to the temperate ocean Notices to Mariners system, managed by the National Geospatial-Intelligence Agency (NGA). Motivated the US to propose creation of five new navigation areas (NAVAREAS) in the Arctic Ocean as part of the Worldwide Navigation Warning System (WWNWS).
- Continued leadership of a working group of international experts examining issues related to 'Scaling in Arctic Terrestrial Systems.'
- Oversaw the final, formal release of updated position information derived from the Submarine Ice Exercise (SCICEX) cruises conducted aboard USS Hawkbill in 1998 and 1999. These data will substantially improve the

bathymetry/hydrography data collected during the two cruises.

- Continued liaison with Canada and Denmark in efforts to acquire US bathymetry data of the Arctic Ocean for use in preparing each nation's claim to extend the outer limits of their continental shelf, as authorized under Article 76 of the LOS Treaty.
- Enabled the declassification and release of previously classified post-World War II, permafrost research, [Newton, George] which had been long sought by a member of the permafrost research community, thereby allowing its publication and release to the [Newton, George] Arctic research community.
- Participated as a charter member of an interagency working group on integrated Bering Sea research; worked to draft a future research strategy for the Bering Sea in response to regional climate change.
- Participated as a member of the North Pacific Research Board.
- Supported the development of the Arctic Council's 'Arctic Marine Strategic Plan.

Major Research Priorities

During Fiscal Year 2005, USARC published its biennial *Report on Goals and Objectives for Arctic Research*, which is required by The Arctic Research and Policy Act of 1989 (as amended) containing five major research priorities. These priorities are the Commission's focus in 2006, as well.

Studies of the Arctic Region and Global Change: The Arctic Research Commission supports the growth of the Interagency SEARCH program into a fully developed program with a common research agenda and an integrated budget approach. It also encourages US researchers to collaborate with international colleagues. In addition, the Commission recommends an international program to promote the recovery and/or re-establishment of the most important hydrometeorological monitoring stations for systematic detection of contemporary and future environmental change.

Studies of the Bering Sea Region: The Commission encourages planning activities of the North Pacific Research Board and the Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative (AYKSSI) related to the Bering Sea and its watershed and recommends a Bering Sea Ecosystem Summit. It also supports immediate expansion of joint Russian-US research to include annual research cruises and appropriate support for related research both within NOAA and through extramural funding paths.

Research on Health of Arctic Residents: The Arctic Research Commission supports the implementation of the third focused, interagency program to coordinate and emphasize research on health concerns in the Arctic and to build links to the health research programs of other Arctic nations. It also supports the continuation and expansion of the NIOSH program for reduction of injury and death in Alaska's important industries.

Research on Civil Infrastructure: The Commission recommends continuing support for the US Army Cold Regions Research and Engineering Laboratory and encourages their participation in infrastructure research in Alaska. It also recommends the implementation of the recommendations in the *Report on Climate Change, Permafrost and Impacts on Civil Infrastructure. In addition,* the Commission recommends that the Department of the Interior and the National Geospatial-Intelligence Agency take steps to acquire and make available precise geospatial data for maps of the US Arctic.

Natural Resources: The Arctic Research Commission recommends that Federal agencies immediately commence a comprehensive program of research on oil in ice based on the Commission's Special Report, *Advancing Oil Spill Response in Ice-Covered Waters*. It also recommends that the affected agencies include new research funding in their requests for re-authorization of OPA 90.

Background

The main purposes of the Arctic Research and Policy Act as amended (Public Law 101-609, see Appendix B) are:

1) to establish national policy, priorities and goals and to provide a Federal program plan for basic and applied scientific research with respect to the Arctic including naturals resources and materials, physical, biological and health sciences, and social and behavioral sciences

2) to establish a US Arctic Research Commission to promote Arctic research and to recommend Arctic research policy

3) to designate the National Science Foundation as the lead agency responsible for implementing the Arctic research policy

4) to establish the Interagency Arctic Research Policy Committee (IARPC) to develop a national Arctic research policy and a five-year plan to implement that policy.

The Arctic Research and Policy Act of 1984 was amended in November, 1990 to increase the number of Commissioners appointed by the President of the United States from five to seven voting members. Four members are from academic or research institutions; two members from private industry undertaking resource development in the Arctic; and one member from among the indigenous residents of the US Arctic. The Director of the National Science Foundation serves as an ex officio member.

The Commission staff consists of an executive director in Arlington, Virginia; the Deputy Executive Director and Alaska Office Director in Anchorage, Alaska; an administrative officer, and a secretary in the Arlington office. The Alaska regional office of the Commission is located in Anchorage.

The Commission holds business meetings and conducts public hearings in Alaska and elsewhere to receive input, and makes site visits and field trips to research facilities and projects throughout the Arctic. It publishes an annual report and co-sponsors a publication with the Interagency Arctic Research Policy Committee, the *Arctic Research of the United States*. Major recommendations of the Commission on Arctic research policy, program priorities, and coordination efforts are published on page 7 of this publication, as well as in letters to appropriate agencies.

Funds for the operation of the Commission are appropriated by the Congress in the National Science Foundation budget and expended by the Commission with administrative support from the General Services Administration. The budget in FY 2006 was $1,560,788.

Response to Mandate, Fiscal Year 2006

For the effective accomplishment of its mandated duties, the Commission must identify problems, needs, and make recommendations on basic and applied Arctic research. Most of the issues to be addressed emerge from public meetings regularly held in Alaska, Washington, D.C, and from field visits to relevant sites in the Arctic and institutions conducting Arctic research.

Meetings during Fiscal Year 2006:

October 25-26, 2005, 77th Meeting, Corvallis, OR

January 19-20, 2006, 78th Meeting, Seattle, WA

April 18-20, 2006, 79th Meeting, Arlington, VA

June 27-29, 2006, 80th Meeting, Barrow/Anchorage AK

The summary of Fiscal Year 2006 Commission meetings are provided in Appendix A. Appendix B is a list of other meetings attended by Commission members and staff.

Appendix A: Summary of Commission Meetings
Fiscal Year 2006

US ARCTIC RESEARCH COMMISSION
77TH MEETING
25-26 OCTOBER 2005
OREGON STATE UNIVERSITY
CORVALLIS OR

In attendance:

Commissioners

Mr. George Newton, Chairman
Mrs. Michele Longo Eder
Mrs. Mary Jane Fate
Mr. Duane Laible
Dr. Thomas C. Royer
Dr. Susan Sugai
Mr. Mead Treadwell

Staff

Dr. Garrett Brass, Executive Director
Dr. Lawson Brigham, Alaska Office Director
Ms. Kathy Farrow, Staff

Attendees

Mark Abbott, COAS; **Matthew Alkire,** COAS; **Tim Boyd,** COAS; **Kelly Falkner,** COAS; **Michael Freilich,** COAS; **David Graham,** COAS; **Kimberly Hageman,** ORST; **James Hemmings,** OSU; **Rich Holdren;,** OSU; **Linda Lamb,** COAS; **Alan Mix,** COAS; **Rachel Mueller,** COAS; **Quin Ourada,** GEO; **Roge, Samuelson,** COAS; **Jud, Scott,** COAS; **E, Sherr,** COAS; **Barr, Sherr,** COAS; **Yvett, Spitz,** COAS; **Josep, Stoner,** COAS; **Kimberly, Tanner, OSU; Ka, Yates,** COAS

October 25, 2006

Welcome

Once the Commissioners and staff introduced themselves, Ed Ray, president of Oregon State University (OSU), welcomed the Commission and introduced it to the wide array of University assets that makes OSU an "extraordinary" site for oceanic and atmospheric studies. Ray stressed the interconnections within Oregon, between Oregon and the nation, and the global economy, as well as linkages within the natural environment. While the Arctic system may be distant from Oregon, it is linked to the state through its impact on ocean circulation, the climate, fisheries, natural resourced-based activities, recreation and the economic environment. OSU's strategic plan focuses on thematic areas. It is not about rankings or bragging rights but on areas where OSU is able to make contributions today and in the future. Two areas the University has selected to focus on are earth system science and sustainable use of natural resources throughout the world.

Comprehensive Research Priorities

Rich Holdren, Senior Associate Vice President for Research, explained that OSU is the nation's best-kept secret in terms of research. It is among the top 100 research universities and one of 13 to 15 universities that do not have a medical school or school of public health to help support its placement. The research at Oregon State is both very broad and deep covering a wide band of federal agencies, private clients, and state governments, both within Oregon and really across the west. The school is building on collaborative strengths, working across boundaries.

OSU anticipates increased coordinated hiring among and between colleges to address these broad issues. Its 950-tenure track faculty, that serves about 19,500 students, about 3,000 graduate and 16,500 undergraduate students have been successful in obtaining grant funding. In the fiscal year that just ended in June, faculty was able to bring in awards of about $209 million. Over the last ten years there have been 164 patents awarded. In addition, the university established twenty-two start-up companies, 15 of which are still active, and based entirely on OSU technologies.

Holdren mentioned that OSU has the distinction of being a land grant, sea grant, space grant, and as of a little bit more than a year ago, a sun grant institution—the only university that provides full service across all of those. Its engineering school is also home to one of the world's largest basins for testing the effects of tsunamis. The college of health and human sciences is studying the effects of contaminates on Native American diets and that influence once they return to their traditional diets. The college of agricultural sciences' marine mammal program, tags whales and tracks them all over the world via satellite.

OSU is working toward developing targeted programs of excellence, to build innovation and bring economic development to the citizens of Oregon and beyond. For example, a collaborative program to look at coastal security issues is underway with Pacific Northwest National Laboratory, a national laboratory based in Richland, Washington, the University of Washington, Seattle, and the University of Alaska campuses.

Newton asked whether the unique device patent applications and the spin-off companies that base themselves on the technology developed at the university are stimulated by any other outside source or are they derived exclusively from within the university. Holdren said of the 22 companies set up, those have evolved completely through faculty support with a little help from the university. OSU is moving into a new era now in that the state sets up an investment fund subsidized by private citizens. The university is also seeing a tremendous amount of interest and activity within the state's business sector to promote and develop new companies and new

technologies. The first effort was and is commercializing and providing a platform for nanoscience technologies.

Treadwell suggested that getting the kind of monitoring in Arctic projects the Commission wants to have endorsed is an economical and technical challenge and that it might want to take a look at some of OSU's nanotechnologies and other ideas and consider their specific Arctic component.

Brass asked Holdren to discuss the sustainable rural communities' initiative because the US Department of Transportation defines a rural community as one with no road access to its capitol. Since there is no road access to Juno, every community in Alaska is rural, including Anchorage. But there are hundreds of very small communities that are off the power grid, off water and sewer grid, and off the highway grid but they have access by water and air to the capitol and generate their own power and take care of their own sewage and water.

Holdren said the initiative is built on bringing technology capabilities to the smaller rural communities to get them more involved in the state economy. It includes Oregon, in that like the rest of the nation, the state thrives on small businesses that employ 50 or fewer workers. What OSU is trying to do there is help those communities find ways to create new businesses that literally will sustain their way of life that can endure the challenges they face.

Ocean Observing Infrastructure

Mark Abbott, dean, College of Oceanic and Atmospheric Sciences (COAS), discussed the college's focus on global scale processes that include reviewing the history of the earth to understand how the future might be involved. This is being done through studies in paleooceanography or geo-chemical studies; the bio-geo-chemistry of the ocean and how it operates in terms of carbon cycling; a whole range of polar studies, both in the south and in the north, and lastly, numerical modeling of understanding the Earth as a system. Another focus is regional scale processes and the impact of these global scale processes on regional scale studies. Ultimately, Abbott says it is fundamental research looking at the ocean and atmosphere as an integrated system.

Many of the initiatives are beginning to emerge from the interests of the faculty and funding agencies. The college is moving into new areas taking real time perspectives and making predictions. Facilities are being improved, as are observing, data processing and data delivery systems. Collaborations are underway with NOAA and NASA to design the next generation of satellite tools. They are assessing use of remotely operated vehicles and autonomous underwater vehicles, gliders, drifters and a series of the ocean class ships for meeting their research demands. In addition, they are working on a range of IT information systems modeling and data management. These activities are underway in an attempt to build an integrated, service-based ocean-observing infrastructure that can provide answers to a whole range of different questions focusing on more than just interesting science or management considerations.

Brigham asked what Abbott meant by coastal security issues and what kind of collaboration is involved with Alaska and the University of Washington. Holdren answered that OSU is working with Department of Homeland Security to track vessels from their point of origin, where they come into US waters, by analyzing various types of radar to using the Navy SOSUS system. The University will ultimately house data that pertains to public health threat issues such as oxygen zones and the red tides. A new faculty member is looking at the interaction between climate and the spread of mosquito borne viruses. He's looking at it as much more of a public policy issue. The National Institute of Health and the Department of Homeland Security are interested in supporting that work.

Tracking Freshwater in the Arctic Ocean

Kelly Falkner, College of Oceanic and Atmospheric Sciences, discussed the chemical oceanographic observations she has made in the Arctic since 1992. She explained that 10% of the world's river water empties directly in to the Arctic and 25% of the world's ocean shelves are in the Arctic. Both of these factors profoundly influence this ocean that constitutes but 1.2% of world ocean volume and just under 4% of world ocean area. The Arctic serves an important role in global heat and freshwater exchange and has exhibited dramatic changes in recent decades. Beginning in the 1980's, Atlantic waters pushed further into the Arctic and were the warmest ever observed over the period of record extending back to the 1930's. Atmospheric circulation became more cyclonic driving a westward shift of the transpolar drift and shrinking of the Beaufort gyre as evidenced in the International Arctic Buoy program. Surface ice cover has been on a downward decline since 1978. The satellite record indicates this amount to be about 6% decline in area per decade with four record minima years occurring over the last 4 years.

As a contribution toward understanding both the causes and implications of these changes, as they are manifest in ocean circulation, Falkner has been using chemical tracers to track the pathway and the destiny of fresh and other upper ocean water types within the Arctic. Salinity signals are confounded by river, precipitation and sea ice melt/formation contributions. Hence, other tracers are required to distinguish these sources such as oxygen isotopes, barium and terrestrial dissolved organic carbon. She has exploited fixed nitrogen and phosphorus relationships to help delineate Pacific versus Atlantic water contributions. By combining all these tracer observations, one can mathematically deconvolute Pacific, Atlantic, Eurasian River, North American River and Sea Ice components at any given point. Dr. Falkner has been mapping these components both in space and time in a variety of programs including the North Pole Environmental Observatory, Northern Baffin Bay and Canadian Archipelago Through flow Study and platforms of opportunity including ships, aircraft and submarines.

Falkner concluded that working in the fickle Arctic environment remains challenging. An effort to retrieve moorings from the sea ice in spring 2005 from the Canadian Archipelago Through flow Study was unexpectedly thwarted by hurricane force winds. Fortunately, no one was injured, all gear was retrieved and contingency planning was such that another attempt will be mounted in the Summer 2006.

Changes in the Arctic

Tim Boyd, College of Oceanic and Atmospheric Sciences discussed the SCICEX program, particularly his participation with the cruise of the Cavalla in 1995. Water sampling showed that water over the mid-ocean ridge continues to warm and increased salinity exists throughout the Arctic Ocean. Numerous recent observations indicate that the Arctic is undergoing a significant change. In the last decade, the hydrography of the Arctic Ocean has shifted, and the atmospheric circulation has undergone a change from the lower stratosphere to the surface.

Typically the eastern Arctic Ocean, on the European side of the Lomonosov Ridge, is dominated by water of Atlantic origin. A cold halocline of varying thickness overlies the warmer Atlantic water and isolates it from the sea ice and surface mixed layer. The western Arctic Ocean, on the North American side of the Lomonosov Ridge, is characterized by an added layer of water from the Pacific immediately below the surface mixed layer.

Data collected during several cruises from 1991 to 1995 indicate that in the 1990s the boundary between these eastern and western halocline types shifted from a position roughly parallel to the Lomonosov Ridge to near alignment with the Alpha and Mendeleyev Ridges. The Atlantic water temperature has also increased, and the cold halocline has become thinner. The change has

resulted in increased surface salinity in the Makarov Basin. Recent results suggest that the change also includes decreased surface salinity and greater summer ice melt in the Beaufort Sea.

Newton commended Boyd for providing the necessary priorities that served as the basis for a proposal boilerplate to create a real scientific need for sound speeds profiles and temperature and salinity data that Newton had sought for many years. Newton will offer Boyd and OSU the proprietary interest in the resulting dataset that came out of his efforts. The data will eventually go to the public

Magnetic Pole Shift
Joe Stoner, paleomagnetist, OSU, discussed the shift of Earth's north magnetic pole—about 1,100 kilometers out into the Arctic Ocean in the last century. At that rate, the pole could move from its current placement in northern Canada to Siberia by the middle of this century. This rapid movement is likely part of a normal oscillation not the wholesale about face of the Earth's magnetic field. Eventually the oscillation will probably bring the magnetic pole back to Canada. This variable movement takes place about every 500 years, manifesting itself in a "jerk" of the magnetic field that brings about abrupt geomagnetic changes. It also might cause Alaska to lose visual access to the Northern Lights.

Calculations of the North Magnetic Pole's location from historical records only goes back 400 years which is why Stoner and his colleagues have examined the sediment record from several Arctic lakes focusing on Murray and Sawtooth lakes on Ellesmere Island. They drilled down the 40 to 80 meter depth of the lakes, coring and recovering sediment cores between 50 centimeters and five meters deep from the bottom of the lakes. Their samples generated sentiments from 5,000-year-old deposits.

Treadwell asked if anyone tied this geomagnetic shift to any other phenomenon besides the aura oval in terms of climate or in terms of the intensity. Are we shielding ourselves with more or less radiation and thus having heat effects and that sort of things?

Stoner said that there are some more speculative relationships between the timing of the last shift with the initiation of the little ice age and the last archeomagnetic jerk. There are potential shielding aspects in terms of cosmic ray interactions these shifts may induce that could potentially have affects on climate through charged particles, possibly cloud nucleation, the timing of geomagnetic changes and climate changes in the hollow scene. It is suggested that there could be a relationship but it's very early on in terms of knowing exactly how and where. But there are some tantalizing timing issues.

Treadwell asked how the Commission could help Stoner get more data. Stoner said that what is needed is more coring in the right locations.

Contaminants in National Parks
Kim Hageman, OSU, Organic Analysis, spoke about contaminants—their volatility and impact in the Arctic national parks, as well as the threats they pose to wildlife and humans that consume them, particularly the native Arctic people whose diet is largely composed of the native foods. The National Parks Service (NPS) has become concerned about these volatile compounds when atmospherically transported. Through a program titled the Western Airborne Contaminants Assessment Project (WACAP), NPS is collecting information about their sources, distribution, destiny and potential impact. In addition to other western US parks, WACAP is seeking results from Noatak and Gates of the Arctic and sub-Arctic Denali.

Hageman's discussion focused on results in snow, fish, and organics concluding that the current use pesticides, banned pesticides, PCBs, and PBDEs compounds are undergoing atmospheric transport and deposition to the Arctic and alpine ecosystems in national parks in the Western US. According to the global desolation theory, the highest concentrations of the most volatile compounds are found in Alaskan snow (alpha HCH) and in fish (alpha HCH and HCD). Correlation analysis indicates that regional agricultural influences pesticides distribution. However, Alaskan sites are receiving pesticides from background and long-range sources. PCB and PBD profiles in Alaskan sites indicate that regional sources are contributing.

She said that national parks should be regarded as sentinel ecosystems and even though contaminants are found in them, they still are some of the country's least contaminated environments and so its important to keep an eye on them. Also, because the parks are not receiving direct input of contaminants, they can be used to study the atmospheric transfer processes.

Royer asked whether Hageman had considered the transport from the western side of the North Pacific. Hageman said it would be great to start looking into that. She thought when they are determining long-range sources, they really could be from anywhere. He colleagues put an air-sampling site in Japan and supported one in Siberia too.

Sugai asked whether Hageman had sampled the same fish species in all the lakes or is she looking at different fish at different sites. **Sugai** pointed out that at Toolik Lake, a long-term ecosystems lake that is north of Brooks Range, she found lake trout to be 50 to 60 years old. In that case, the fish have a great deal of time to be affected by a number of variables including contaminants as well as age. Hageman said the same species are not found at all the lakes but the fish part of the project does involve looking at all kinds of different variables associated with the fish.

Rediscovering King Island

Deanna Kingston, anthropology, OSU, has been studying the Inupiaq villagers who formerly lived on King Island in the Bering Sea between Alaska and Russia to capture and secure the unique history of surviving King Island elders. The focus was to integrate elders' traditional knowledge and modern scientific techniques that descendants are taught in their current educational settings.

During the four-year project, the OSU researchers and colleagues from Alaska took Inupiaq elders to the island, where they provided their recollections of collecting greens, hunting marine mammals, fishing, gathering bird eggs and observing landforms, weather conditions, and village life. Inupiaq teens recorded those recollections, at the same time, visually documented many of the plants, birds, rocks and other subjects referred to by the elders.

Science, in fact, may provide a key for helping indigenous peoples of the area prepare for potential effects from apparent global warming. Some of the first major impacts could hit the polar regions. Understanding the effects of melting icecaps, rising waters, changing currents and altered habitats can influence their dependence on fish, birds and sea mammals. In turn, the elders' knowledge may help scientists better understand the complex interactions between weather conditions, the environment and natural resources.

King Island has been vacant since the mid-1960s when jobs became scarce and the village school shut down.

Chair's Report

George Newton, Chair, United States Arctic Research Commission (USARC), reported his activities since the last meeting.

June 14—Attended a meeting at the National Geo-spatial Intelligence Agency to discuss their concept of a new Notice to Mariners System in the Arctic Ocean. It creates the infrastructure that is essential to the Arctic that is more accessible to maritime transportation, both surface and subsurface. The concept will be introduced at an upcoming meeting and proposes to divide the Arctic Ocean into five separate areas and make assignments under the worldwide navigation warning system to various countries. Russia would get two, US would get one, Canada would get one, and there would be sort of a tossup between Norway, Denmark and perhaps the United Kingdom for the last one. This has to be ratified by a certain percentage of members of the organization.

June 14—Met with Bill Woolf of Senator Murkowski's office to brief him on the substance of USARC's meeting in Anchorage.

June 21—**Garrett Brass**, USARC Executive Director, and **Newton** met with Dave Balton, the new Deputy Assistant Secretary of State for Oceans and Environmental Science, to urge the selection of a Senior Arctic Official (SAO) who would not only represent the United States at the Arctic Council but also lead the Arctic Policy Group, with an agenda broader than that of the Arctic Council. They had a positive response to that, subsequently, naming of a new Senior Arctic Official, Julie Gourley.

June 29—Attended the Arctic Policy Group meeting at the Department of State with **Brass**, **Commissioner Mead Treadwell** and **Lawson Brigham**, USARC Alaska Office Director.

July 5—Met with Dennis Conlon the National Science Foundation (NSF) to work on the Foundation's Brief urging the Navy to renew the SCICEX program. That brief is now tentatively scheduled to be presented to the Commander of Submarine Forces in Norfolk on the week of the November 14.

July 6—**Brass** and **Newton** met with the majority and minority representatives of the Senate Committee on Homeland Security and Government Affairs to brief them on recommended changes to the Arctic Research and Policy Act.

July—Worked with **Brass** to revise and distribute the revised USARC work procedures and responsibilities for the staff.

August 4—Met with Dr. Tom Pyle for lunch to thank him for his service and support of the Commission while he was the Arctic System Science Section Head at the National Science Foundation.

August 5-15—Conducted interviews for a new publications specialist. Procurement was cancelled and has been restarted.

August 9-11—Traveled to Seattle to work with **Commissioner Duane Laible**, **Brigham** and Kathy Farrow to prepare an USARC brief for the National Academy of Science of Study on U.S. Polar Icebreaker Needs and Missions.

August 17—Attended the IARPC staff meeting at the Foundation, which was procedural in nature.

August 23—Communicated with several members of the Arctic Ocean research community attempting to gain input on the equipment and layout for world-class icebreaker research capability, which was requested from the icebreaker Glacier organization. Contacted **Brass** while he was on the Healy in this effort and got significant input. Others have indicated that they would submit input directly.

June-August and the first week of October—Worked with the Mineral Management Service on the selection process of the prospective Executive Director.

August 18—Attended the Arctic Policy group meeting at the Department of State.

August 30-31—Traveled to Portland, Oregon to provide guidance to the evaluation committee for the Executive Director selection

September 19—Lunched with Ray Arnaudo, Department of State, current acting Senior Arctic Official for the Arctic Council, who is moving to a new post in the US Embassy in Moscow. He indicated that he will keep the Commission on his email list.
September 19—Briefed about audit for fiscal year 2004 being conducted on the Commission by GSA. The Commission was hurt because the contract for bathymetry data digitized last year was not awarded in the proper sequence.
September 20—Wrote a paper to be presented at the advisory board of the Law of the Sea Meeting Conference that Newton attended and prepared an accompanying visual presentation.
September 21—Met with Captain Dennis Hung, Navigation Department, and Commander Tom Wojahn, Manager of Icebreaker Programs, of the Coast Guard to determine why the US Coast Guard Icebreaker Healy crew was reluctant to submit a formal notification of the maritime hazards the ship was creating while in the Arctic Ocean during this summer's cruise. The Arctic Maritime Safety Information System, four international treaties and three US government directives say that if a craft creates a maritime hazard, it must be reported. Their answer was that their Coast Guard commanders were not responsible to do anything unless the Coast Guard put out a regulation that provides authorization.
October 5—Met with staff officers from Senator Joseph Lieberman's office and the Senate Committee on Homeland Security and Government Affairs to discuss the Commission's change to the Arctic Research and Policy Act. Was asked to do so by the majority staff representative. It was clear to both **Newton** and **Brass** that staff wanted to determine if there was a political agenda to the change. **Newton** explained their objectives in Arctic research and that the direct customers are the Arctic Research community alone.
June-October—updated list of accomplishments including

- creation of the five new Arctic navigation areas/worldwide navigation warning system.
- release of the renavigated position data from the National NGA's Special Projects Office for the 1999 SCICEX cruise. This has been an 18-month effort, to gain their cooperation and response, to get this done. Newton had to call in the CNO's staff to start a fire under them and was successful in about a 48-hour period.
- monitored the completion of the digitizing, organization and documentation of the Arctic Ocean sound speed profiles.
- succeeded in gaining verbal approval for the release of more Arctic Ocean bathymetry data from the Navy. It will be data collected on classified cruises been the years 1993 and 2000.

October 10-12—Attended the bi-annual meeting of the Advisory Board of the Law of the Sea at the International Hydrographic Bureau in Monaco. An important outgrowth of that meeting was that the Canadian and Danish delegates asked Newton to work with them and be the US front person to improve the international research in the Arctic Ocean now being held up by the Russian government. The fees requested by the Russians to conduct research in the EEZ of both the Swedish government and the German government were so excessive that both countries did not choose to accomplish any research. It is an international problem.

Treadwell mentioned that he thought that topic was on the agenda for the Senior Arctic Official's meeting but was not certain. Brigham said the discussion was centered on the exorbitant fees Russians want to charge for transit all across the Russian Arctic. **Newton** said that this issues deals with exposure and access to the exclusive economic zone for which one makes application to the controlling government.

Commissioners Reports
Treadwell traveled with the US Air Force to attend a meeting of the restoration advisory board that is working to dismantle the dewline site. The first major Arctic dewline site was built in Kaktovik, which is the Arctic National Wildlife Refuge. Erosion in Kaktovik since 1963 is quite extraordinary. The US Air Force is spending close to $25 million a year to clean up contaminants and to dismantle these sites through Operation Clean Sweep. The Air Force spent considerable

time with the community identifying what buildings they want to save. There is currently an ADEC risk assessment that requires Federal and state cooperation to develop equations to come up with enforceable sites—specific levels for cleanup of contaminants. He participated in a number of discussions that related to differences between civil government, tribal government, and native corporations. He encouraged the Commission to work with native entities to ensure that it is getting the input that it needs.

- He attended the change of command ceremony of the new Alaska Commander, General Douglas Fraser. He was sworn in by Admiral Fallin who discussed Arctic climate change and how the role of the Alaska commander will change dramatically.
- Met with an Australian researcher conducting a major dig for dinosaurs on the Colville River.
- Discussion with Jamie Morrison about logistics for the North Pole environmental observatory.
- Met with an Oregon researcher Tony Leiserowitz, Decision Research, who has an NSF grant to look at Alaskan attitudes on global climate change.
- During the summer he worked with Alaska's state representatives in Washington on the energy bill. The Commission received support through Bill Woolf for the Barrow Science Center, the Fairbanks Engineering Center and the authorization for NSSI.
- Treadwell suggested that the Commission spend some time discussing a plan to ensure its research objectives, especially for the Bering Sea, are taken care of. He believes there are some major research opportunities for ecosystem science and monitoring.
- Met with the Secretary of Transportation when he spoke in Alaska in July. Briefed him on the various kinds of work going on Arctic shipping.
- He spoke to the World Wilderness Congress and attended a briefing given by **Brigham** on Arctic shipping.
- He distributed a letter that Governor Murkowski sent to the Foreign Minister of Iceland moving forward the Alaska-Iceland Shuttle Study Concept that the Institute of the North is working on.
- He and **Brigham** met with CRREL to encourage them to be more actively involved in the infrastructure study coordination that had been sought and is reflected in the minutes to this meeting. **Brass** asked how they were going do it. **Treadwell** said he believes the Commission has some leverage. During the meeting, they discussed various ways to raise the visibility of this study.

Commissioner Mary Jane Fate attended several meetings about upgrading commercial subsistence fishing on the Yukon River.

- Prepared for the Alaska Federation of Natives annual meeting. Resolutions were introduced in relationship to research in the State of Alaska—waters, air and land for villages and statewide. One such resolution was titled "In Support of the Alaskan Native Community Being Kept Informed of Research Activities Being Conducted In Different Areas of Alaska."
- The Dalton Highway has been turned over to the State of Alaska for management of the corridor even though it is on Federal lands. Its use was a big issue.
- **Fate** also discussed the limited entry permits for fisheries on ocean and/or rivers; where they are, who owns them and where do they reside—inside of Alaska, in a foreign country, or the lower 48.
- She received a fax from Patricia Cochran, ANSC in Anchorage, concerning her commission's newsletter and a 2005 international workshop on indigenous observations of ecological and climate change.

Commissioner Thomas Royer participated in the down select process for the new executive director.

He also noted that he attended the Pisces meeting in early October where a paper was presented discussing the sailing of the RV Xuelong, the Chinese icebreaker. It discussed the results of its cruise to the Arctic Ocean and along the coast of Alaska in 2003. China indicated that they plan to contribute to the International Polar Year (IPY) with the third and fourth expeditions in 2006 and 2008 to the Arctic to study air sea fluxes and carbon relative to climate variability in both the Bering Sea and Western Arctic Ocean.

He also attended a multidisciplinary meeting in Sitka called Paths Across the Pacific in mid-July. A Trans-Pacific Inuit Expedition was discussed with the primary goal to honor the accomplishments of ancient people's of the Pacific rim islands and coasts and to celebrate their extraordinary skills in exploring and migrating from Asia to the new world and in advancing sea canoe and skin boat technology. This volunteer expedition is an international and interethnic reenactment of the highland, hoping route via North Pacific Ocean and Aleutian Islands. The object is to paddle an Umiak skin boat starting from Nemuro, Japan in April 2008 following a water route from Siberia to Sitka, Alaska, which is 4,000 miles and do it under four months.

Commissioner Duane Laible's activities were principally preparing for the presentation that he made to the National Federal Science Committee in Washington on August 24 and 25. The upshot of that was that the presentations of the thoughts of the Commission were well received. He also had some private conversations with individuals on the committee and spent some time last week with the Commandant of the Coast Guard, who has some icebreaking experience. The general conclusion is that it is highly unlikely that the Polar Sea and the Polar Star will ever be refurbished in the way that the Coast Guard would envision.

From those discussions, Laible also understood that the Alaska Region Research Vessel (ARRV), which is not an icebreaker but is important to the future of research in the Arctic, is probably not going to happen for a long time even though it is formally in the budget. He said the reason is that there is no will at NSF to be creative about getting it done. It will happen in due course and due course, in his opinion, is that the first cruise will be in 2010 and that's just abominable.

He was in Houston at the annual convention of Society of Naval Architects. The most important shipping efforts in this next 10 to 15 years are going to focused on transported liquefied natural gases. There are about 400 ships under order. These are very sophisticated, very expensive ships and they have essentially occupied all of the capacity in the shipyards that have technology available today to build the L&G tankers. The American Bureau of Shipping (ABS), which establishes the standards of construction for ships, acknowledges that it is going to happen and we are going to see real transport in the Arctic sooner than later. As far as he can tell, except for the occasional cruise of the Healy, there will be little information released about what is happening in the Arctic.

Commissioner Michele Longo Eder participated in a down select committee with **Royer**, Sugai, and Dr. Jackie Grebmeier for the position of Executive Director. She has also been working with **Sugai** and **Brass** in regard to the Commission's budget.

She attended the meeting of the North Pacific Research Board last month for discussion about the Alaska Region Research Vessel pursuant to **Royer's** request. Dennis Wiesenberg made a presentation to the North Pacific Research Board requesting that they send a letter of support to OMB requesting that it be funded. The North Pacific Research Board enthusiastically endorsed that request, and the letter was sent.

The North Pacific Research Board has, from 2002 to 2005, funded $17 million in research grants as a result of four requests for proposals between 2002 and 2005. Generally the categories of research have been in oceanic salmon, other fishery related research, fish habitat, marine mammals, seabirds, general ocean, inconsistent studies, education outreach and synthesis. They've just issued their request for proposals for 2006. She made RFPs available to Commissioners that identify the research priorities for 2006 funding that involves the Bering Sea Integrated Ecosystem Research Program.

Staff Reports

Brass outlined his Healy trip. While onboard, he discussed a philosophical proposal with Martin Ackerson and Yngve Kristoffersen, University of Bergen, Norway from the University of Bergen, about the nations with territorial claims in the Arctic outside their EEZ and that they should consider a research preserve in the Arctic. Research could go on without permeating problems and exploitation would be prohibited without specific permission from the territorial holding state. At the same time, but it would be free for research external to everybody's EEZ. Brass suggested to Ackerson that it would be harder to get that proposed in the United States since it hasn't signed the Law of the Sea Treaty yet, than it would be if he might work on it. Ackerson said he would see whether or not the Swedish delegation to the United Nations might make such a proposal.

Brigham hosted a full entourage of various visiting scientists this summer who were in the USARC office for a day or two including the permanent participants of the Arctic Council.

- He chaired the PAME Workshop on Arctic Marine Shipping in Albert, Denmark on the protection of the Arctic marine environment that is working on a robust interdisciplinary complex study of merging climate information—the change of sea ice retreat and regional economical development with regards to marine shipping. The study is trying to forecast how much shipping might happen in the Arctic Ocean, 2020, maybe 2050. The ultimate issue is what are the societal, environmental, and economic impacts of shipping in and around the Arctic Ocean.
- He also participated in a national academy committee providing it with his views on the current world polar ship fleet and what the various ships, from naval warships to commercial icebreakers, and their roles are.
- **Brigham** also discussed a meeting of the Asian Pacific Center for Security Studies that is now run by the former ASAF Pacific commander, General Brown. **Brigham** plans to suggest to Brown that Brown and the Marshall Center in Europe together look at an Arctic Security Meeting.
- He talked with the Chief of Staff of the Canadian Air Force in Anchorage who said that Canada and the United States have not yet really begun to talk about mutual security interests in the Arctic Ocean but must.

SCICEX and the Law of the Sea Treaty

Newton made a presentation concerning the SCICEX program and how it relates to the Law of the Sea Treaty and Arctic Ocean research needs. SCICEX comprises six submarine cruises, conducted between 1992 and 1999, which resulted in more than 95,000 kilometers of track taken from the Arctic Ocean seafloor. Since then, the submarine force was reduced by roughly one-half, making the use of these platforms for research, very different. However, the science community sought more research opportunities from the Arctic. The only means to that end is to create a national imperative.

That imperative came in the form of the Law of the Sea Treaty, Article 76. It had the potential to extend radically the outer limits of the US portion of the continental shelf, 78% of which is in the Arctic Ocean and includes the Bering Sea, the Chukchi Cap, the Beaufort Sea and two small areas off the East Coast of the United States. The only way to collect the reliable information needed for this particular system in the Arctic Ocean is via the submarine.

The opportunities are significant in the areas of commerce, economic development, security and sovereignty. Each creates its own set of research requirements that are not only important for Article 76 but to determine how to exploit the various opportunities.

CIFAR and NOAA's New Battle Plan

Sugai made a presentation on the Cooperative Institute for Arctic Research (CIFAR) programs and changes in NOAA's Arctic Programs. CIFAR is a NOAA cooperative institute and is aligned with all University of Alaska campuses. It was established in 1994 and is the only cooperative institute conducting Arctic research. Its themes are atmospheric and climate research, marine ecosystems, tsunami research, climate modeling, fishery oceanography, contaminants, hydrographic and sea ice studies, and beta archiving supports. Marine ecosystem studies have four projects and hydrography, contaminants and fisheries each have one. NOAA directly funds CIFAR projects, the largest amount, $2.5 million, is dedicated to CIFAR's tsunami-observing center in Alaska and its associated research.

Recently, however, NOAA changed its operational approach to what they call matrix management themes. This model incorporates national goal themes toward which NOAA-based institutes have to direct their outcomes. These themes include ecosystem, climate, weather and water, commerce and transportation. CIFAR and the other cooperative institutes are expected to create NOAA projects and services that are outcomes, and deliver them to its stakeholders who will in turn judge how effectively CIFAR is addressing these outcomes. They are then included into the NOAA strategic plan.

To work within this new model, CIFAR will collaborate across all the line offices of NOAA. Its program requires cooperation with stakeholders or "CIFAR's Fellows"—colleagues from throughout research, industry and government—to initiate various workshops in an effort to accommodate its small administrative budget. That approach allows them to organize and produce events across a wide spectrum that at the same time, meet NOAA's objectives. These have included planning sessions for both IPY and SEARCH and an Alaskan coastal erosion and climate change workshop that resulted in the drafting of a science plan of damage prevention in coastal regions.

Engineering and Permafrost

Ted Vinson, Professor of Civil Engineering, OSU, discussed permafrost engineering issues and the difficulty of predicting future trends in permafrost conditions. In the current climate change environment, engineers become applied scientists—interpreting science and adapting it to the future. This is important because for the projects that are built today, engineers want to minimize the lifecycle cost and be relatively sustainable into the future. They have to figure out what is

causing global climate change. Vinson outlined the many variables and predictions that they could use to get an answer.

He discussed the recent construction of the Qinghai Tibet Railway and the scientists and engineers' design considerations, particularly global climate change. The Qinghai Tibet Railway is about 1,142 kilometers and it runs from Golmud up in the Tibetan Plateau to Lhasa. About 630 kilometers traverses a permafrost region of which 420 kilometers is what is called warm permafrost—about minus 1.5 to zero degrees centigrade—on the verge of thawing.

It's very difficult, in terms of the science, engineering, environmental and logistical considerations. The many bridges along the way are dry bridges. They were constructed to isolate the railroad line from the underlying warm permafrost and, more importantly, to minimize any disturbance of the ground thermal regime that would thaw the permafrost and in the eventuality of climate change as it was forecast for this project. If there was no climate change, there wouldn't be nearly as many bridges.

He then discussed an underground utilidor in Barrow that runs from the high school to a housing development in pre-climate change. The utilidor is unique because it is a buried utilidor, buried in permafrost. Early on, he had to consider its temperature tolerance by measuring the long-term air temperature—warmer, colder and normal conditions. He also considered what is called the upset condition that was two successive warm years. It all comes down to predicting the future.

Basically there are two approaches in engineering practice—the deterministic approach where one assumes a trend line and basically decides based upon fact assumed input. The other is just understanding that there is uncertainty in a problem. The only way to deal with uncertainty is to deal with the population of values, the actual distribution of values. This approach allows one simply to combine distributions of any number of parameters through a deterministic model to produce a probabilistic outcome.

October 26, 2006

Ice Cores and Abrupt Climate Change

Ed Brook, Geo-Sciences Professor, OSU broke his talk into four sections:

- ice core climate records and the record of very abrupt climate change that exists in the ice core record, primarily from the Arctic
- greenhouse gases and specifically methane in the history of abrupt climate change
- methane tied up in clathrates and ocean sediments and how that might have something to do with climate change in the past
- ice coring in the Arctic

Ice is particularly interesting material for climate reconstruction for many reasons. One is that there are many different parameters that one can measure in ice to explain temperatures in the past, snowfall rates, the chemistry of the atmosphere, dust in the atmosphere. Ice accumulates relatively quickly relative to other kinds of sediments and one can get very detailed records. The most important thing about ice cores is that they provide direct records of the composition of the atmosphere in the past. The oldest ice core record of atmospheric CO2 is now about 780,000 years coming out from a core in the Antarctica.

Greenland is by far the best place for ice coring in the Arctic because ice has accumulated in Greenland over the last 150,000 years or maybe longer. There is a great deal of ice there and so

one can get very old records in Greenland. But ice coring isn't confined to Greenland; there are shorter cores in places like Svalbard and the Eastern Canadian Arctic.

In the last 10,000 or 11,000 years, the climate was very stable climate in central Greenland. But the last ice age was particularly unstable. Oscillations in temperature go along with oscillations in snowfall rate and many other parameters. There are quite clearly real environmental changes that were very abrupt and very repeated in Greenland and some of them were extremely fast. At the end of the ice age, there was a temperature increase of about ten to twelve degrees centigrade. It happened over the course of a few decades. Snowfall roughly tripled within one decade. It is a real concern to understand why the climate system can do this.

Other parts of the world are going through abrupt gyrations that also cement the idea that the climate system is capable of abrupt shifts. What has been seen in Antarctica is that when there is a warming in Greenland it has been happening in Antarctica for several thousand years. And when Greenland warms Antarctica starts to cool. A pattern that is consistent with one proposed mechanism for these abrupt changes is the turning on and off of ocean circulation in the North Atlantic.

Every time there is a wiggle in temperature in Greenland, atmospheric methane goes up or down at almost exactly the same time. The standard interpretation of methane is that it's primarily produced in terrestrial wetlands. The alternate interpretation of the methane data is that methane is coming out of methane hydrates in marine sediments. This theory suggests that there is a huge amount of methane tied up in frozen methane hydrates all along the continental margins around the world. At the time of an abrupt climate change, something happens to bottom water temperatures in the ocean that can release this methane to the atmosphere. There is some evidence that this does happen in ocean sediments but the question is does it happen on any scale that's large enough to really change the atmosphere.

Brook is involved in an international group that represents all the nations involved in ice coring International Partnership in the Ice Coring Science (IPICS). In terms of the future of ice coring in the Arctic, this group is attempting to gather the international community to plan the next 10 or 15 years of science involved in this field. The group is interested in pretty complex projects in the future that are going to be expensive and hopes for international support on a variety of big projects.

Treadwell asked about the lifetime of methane gas. Brook described it as very short. A methane molecule that gets in the atmosphere stays there for an average of ten years. So it's always being pumped out of the sources and being removed relatively quickly. It is chemically turned into CO2 in the atmosphere.

Newton asked if there is discussion that at some point there may not have been ice in Greenland. Brook finds it hard to imagine that the ice sheet was completely gone. It could be that it got so warm that there was melting at the end of the last ice age and a certain section melted away. That is one possibility. There is some evidence that at the bottom of the ice sheets one finds a jumbled record of climate. The way this can be ascertained definitively is to look at the gas records. The real question though is did the margins retract or not. There are actually some ice caps on the margin of the Greenland ice sheet that are actually pretty old. Some of them almost go back into this time period too. That suggests that even these marginal domes were there. So in a sense there may be a little bit of a puzzle today because the Greenland ice sheet seems like it's melting.

Albedo in Greenland

Anne Nolin, Department of Geosciences, OSU, discussed recent large albedo decrease on Jakobshavn glacier in Greenland. It has been shown that the margin of the ice sheet are thinning and passive microwave estimates of melt in ice sheet show that there's an increase area in melt and that there are some connections also between the increase melt, in particular for the Jakobshavn ice sheet. Solar radiation is the most important component of the energy balance contributing to warming and melt.

Nolin wants to measure albedo from satellite because these changes are happening in places where it's difficult to make the measurements, and Greenland's a big place and NASA's satellites provide free data. It is important to make good measurements because if one makes bad measurements of albedo, thee is significant distortion. When there is a really bright surface, small errors then are essentially magnified. As a result, Nolin is using a new instrument, multi angle imaging spectra radiometer (MISR) that has nine different angles and provides more accurate and more robust measurements of albedo. It has fixed cameras at nine different angles so it is viewing at four angles in the forward direction and then one in the aft direction and its symmetrically four angles in the aft direction. It provides a better sampling of that angular distribution of reflective radiation that can then be used to compute albedo. It also has multi spectral data to get some idea of the broadband albedo.

The science objective now is to understand some more of the albedo variability, spatial temporal variability on the Jakobshavn Glacier. Passive microwave data continue to show large increases in the melt areas. Much more in higher areas of the ice sheet are now melting over. In just the past few years, areas above the 2,000-meter contour elevation line are now melting on a regular basis in the middle of the summer. And she has also had record low sea ice concentrations in the last four years.

It is possible to have a significant change in albedo that has nothing to do with melt, it just has to do with grain growth. Snow grains grow larger with warmer temperatures and more solar radiation as would be the case in the middle of the summer. What Nolin is seeing is warmer temperatures that are increasing the grain size and then potentially more melt ponds form. At the lower elevation sites, there is early melting and then it goes back up to close to normal because once melting starts everything out then there is only so much bare ice to expose. But the biggest change for the lower elevation sites is early melt. The biggest change for these higher elevation sites is melt, where it didn't occur previously. Nolin infers this just from albedo—from what is known about the relationship between albedo and melt.

In 2005 Nolin said something different is happening than what has been seen in previous years. In June the albedo went up which was completely unexpected. All of the other indicators in previous years have shown that warm temperatures allow them to predict a big decline in albedo. Instead, there was about a .1 difference in albedo and that is a big change. When expecting an albedo of .8 that means expecting 20% of that energy to be absorbed. But with an albedo of .9, only 10% of that energy being absorbed—half of what was expected. Nolin thinks that this is the effect of the sea ice clearing out of this area. She thinks warm temperatures effect the albedo in the beginning of the season but then, significant numbers of clouds (which had been the case) produce a lot of snow. Do warm temperatures then mean that there is more interaction between the clearing off of the sea ice? Does that mean there is more interaction then between the ocean and the atmosphere and therefore increased accumulation? The next step is to get the data from the automated weather stations and look at the changes in snow height in conjunction with the solar radiation measurements so one can assess cloudiness, accumulation and temperatures at these locations.

Brass asked why Nolin only used the red band for her satellite images. She explained that the red band is the only one on the MISR instrument that's at higher resolution than the others at all nine cameras and it's in the visible part of the spectrum. Snow is high in the visible and lower in the near infrared. So she used the red band on all nine cameras.

Exploring the Gakkel Ridge

David Graham, COAS, OSU, was part of an international team studying the petrology and geochemistry of the Gakkel Ridge in the Arctic Ocean. For Graham, the aims of the expedition were to press models for what actually happens as seafloor spreading rates approach zero and in particular to look at the rate of magna production. And by these two approaches, one was to determine the relative importance of seafloor spreading on regional algorithms and hydrothermal activity. The second was to actually explore the composition of the underlying mantel beneath the Arctic Ocean, which they knew essentially nothing about before this cruise. The cruise took place between August and September 2001 on the U.S Coast Guard icebreaker Healy in collaboration with the German icebreaker *Polarstern*.

One of their major accomplishments was the high-resolution map of the sea floor of the Gakkel Ridge. This map covers approximately 1100 km of the ridge, with an average width of about 25 km, at a resolution of less than 10 meters. Hydro cast sampling provided evidence of hydrothermal venting in the water column of the Arctic Ocean and the presence of vent-related biota. They sampled about 200 sites uncovering seafloor rocks along the Gakkel Ridge between 8 °W and 85 °E. The ridge can be divided into three major geological regions:

- western zone, which is basically characterized by continuous volcanism
- sparsely magmatic region in the center that is the deepest section of the Gakkel Ridge and has the lowest abundance of volcanic activity and rare but abundant basalts.
- eastern magmatic zone, which is actually characterized by punctuated volcanism.

Mantle peridotites are directly emplaced onto the seafloor along the ridge axis; the petrologic results show that the extent of melting in the upper mantle beneath ocean ridges is not a simple function of spreading rate. The underlying mantle exerts some important controls on the melting and the chemistry of the surface basalts and peridotites. Graham found this isotopic boundary within the sparsely met magmatic zone, which may actually be related to earlier tectonic history.

Newton asked how the plumes might influence Arctic Ocean circulation. Graham said from the rise height and the thickness of the plume and understanding something about the water column structure, which is very weakly stratified in the region, one can make estimates of the actual power of the motion. But he has looked at the calculations and they have a very large uncertainty.

Brigham asked what would be Graham's the next expedition. Graham said there was a proposal following their discovery to try to do some autonomous underwater vehicle searches and perhaps sample any biological material that was there. The biogeography implications are very large from studying this area. However, Graham's priority is continuing the analytical work on the rocks he retrieved, focusing on the peridotites.

Ocean Inhabitants from Smallest to Largest

Ev Sherr explained the lack of data about platonic food webs in the Arctic Ocean compared to the rest of the world ocean. Fortunately over the last decade or so some major expeditions have geared up, which have allowed sampling. After an introduction detailing how Arctic Ocean food webs work including what its stocks are and how important various parts of the communities in food webs are, Sherr outlined a few of the voyages from which she has acquired data.

As part of the SHEBA/JOIS drift experiment, Ev and **Barry Sherr**, COAS, OSU, continually analyzed abundance and biomass of autotrophic and heterotrophic microbes in the upper 120 m of the water column of the ice-covered central Arctic Ocean from November 1997 through August 1998. Microbial biomass was concentrated in the upper 60 m of the water column. There were low but persistent stocks of heterotrophic and autotrophic microbes during the winter months. Phytoplankton biomass began increasing when winter snow melted from the ice pack in early June, after which there was a progressive decline of nitrate and silicate in the Euphotic Zone. Stocks of bacteria and heterotrophic protists approximately doubled during the growing season, increasing the phytoplankton biomass.

The 2002 and 2004 shelf basin interaction process studies that the Sherrs participated in involved analyzing at carbon flux from very productive Arctic shelves to relatively unproductive basin systems. The whole point was to evaluate to what extent carbon fixed on these shallow, very productive shelves was transported out into the basins and might support basin food webs because the basin productivity still is fairly low.

In the SBI Program, between 2002 and 2004, the Sherrs found significant interannual variability. The initial phytoplankton stocks measured as chlorophyll A at the beginning of the experiments in 2002 were quite a different year than in 2004. The water was warmer even in the spring by at least a half a degree. There was less ice, and because there was less ice, there was more open water for phytoplankton to come up in both Spring and Summer of 2004. Their results varied substantially from those achieved by colleagues in other parts of the world.

The Sherrs also participated in the Study of the Northern Alaska Coastal System (SNACS) project The coupling between atmosphere, sea ice, ocean, bowhead whales, and subsistence whaling by the Native human populations is fundamental to the physical-biological-human systems of the Northern Alaska Coast. Whale migration routes and habitat use are determined by zooplankton aggregations, which are driven by oceanographic conditions, which depend on the climatic regime. Successful hunting depends on interactions between environmental and societal factors that vary each year and are driven by forces originating outside the system. This environment-whale-human factor comprises a system that is vulnerable to both global climate and human generated change. SNACS seeks to identify and understand the complex linkages, mechanisms, and interactions within and between the atmosphere, ocean, and human components forming a complex natural system that may be critically affected by environmental variability.

Fate commented that Alaska's natives are concerned about the drastically changing river models. Sherr said that the natives have known long before the rest of the world that something is going on. They have stories about species of grass growing up around Barrow that they never saw before.

Newton asked from Sherr's experience working with the native whaling groups/teams, how far off shore do they hunt? She said that don't go very far.

Royer asked what limits the Spring blooms. Is it nutrients? Sherr said that because they were drifting, they could have been going through patches of phytoplankton. They also found that the water structure is such there are not a lot of renewal of nutrients. There are some nutrients but they were not too high and that initial spring bloom just essentially stripped out all the nutrients. Sherr said though that they are not certain because they were drifting and weren't marking the same water mass. **Royer** also asked whether the absence of ice algae was going to affect the higher trophic levels of the sea. She said no, that the cocopods in water will feed whatever is in the water. Sherr did add that cod feeds on the anthropoids and they do the same on ice algae to

maintain their stock over winter and in the early spring before the phytoplankton get going. Therefore, she has a feeling that those groups might be negatively impacted once the ice retreats.

Treadwell asked if there is something that the Commission should encourage to be part of the Barrow Center operating program as it expands. Sherr said that NOAA is supporting some of moorings in the Bering that is helpful and suggested a regular cruise to measure basic mooring findings. She also suggested that more instruments could be put on the moorings including acoustics that can measure zooplankton bottom mass. **Treadwell** suggested formulating a specific recommendation to that area and asked for Sherr's help. She said that the cable observatory could be on the list but it should be interactive between the problem managers and scientists. Though recommendations shouldn't be anything too specific, just a general recommendation that it needs to be monitored over the next 50 years as things change. She said there needs to be specific monitored sites so there is continuity in various parts of the Arctic. Treadwell suggested that they might be part of the NNSI plan because while it is primarily terrestrial, he can't think of any oil development there that doesn't involve that interaction with the near coast too.

Creating a Model

Yvette Spitz, OSU, reviewed the components and their importance to creating an Arctic ecosystem model. Spitz says it is an interdisciplinary approach, one that can be enhanced or diminished by the data and collaboration with colleagues . In the Arctic model, it requires combining the data obtained in the projects or studies with other models such as a circulation model, an ice model or a solar radiation model.

In addition to generating the data, the process is computer intensive. For a one-year simulation on the super computer, it takes about one day to measure the data circulation alone. Adding the ecosystem data will now double, triple or quadruple the time necessary. This equals four to five days for just this portion of a year's worth of data. Understanding that modelers needs two or three years to ensure useable and meaningful data means that the process means that the process will take several years to reach a conclusion. Then there is the sifting through the data to fill in the blanks plus cooperating with colleagues and their findings. Bringing all this together may produce a valuable result or may signal the beginning of other rounds of testing and modeling.

Drilling in the Arctic

Alan Mix, COAS, OSU, discussed the two drilling proposals now in play. The first one focuses on tectonics climate and sediment, erosion and sedimentation processes. The idea is trying to understand what's going on in this very rapidly uplifting system. Mix was involved in survey operations on the RV Ewing. They combined some water column studies, including temperature salinity, isotopes, and biology. They performed high-resolution swath bathymetry; there were some particular challenges in some of these complex fjord environments.

They also faced a number of challenges including marine mammal issues, tourism, and obtaining the materials and infrastructure they needed. The latter proved cumbersome enough that they contracted out some of these operations off to industry that was very cost effective.

In the second proposal on high-resolution paleoclimate, they are asking questions like what is the role of the ocean in driving climate change in this region, including climate change on land. What will it do under situations of global warming? Have there been regime changes in that variability? What they are going to do is try to go back and get the law of records that will allow them to address those issues and to look at this kind of variability at times in the past that were either colder or warmer than at present and try to get a handle through that, of what may happen in the future. Some of what were time water glaciers in the past have now retreated and are no

longer touching salt water. They went and sampled around some of those. They will investigate issues regarding fresh water entering the ocean. They will also be able to monitor changes in the salinity of the North Pacific.

Royer commented about the potential for marine archeology using sub-bottom profiling and especially out at the shelf break, the drowned river sites. Mix said that some of the sediments that have already been recovered indicate that the Sitka Sound fjords were freshwater lakes, which means there's land out there filled with freshwater diatoms on the bottom. The outer Sitka Sound was absolutely flat. That's an interesting case because nobody has documented the glacial forebulge. If the glaciers come, they're heavy, and they push the earth down. However, they push some of the mantle out underneath and then it bulges up and actually sticks up above sea level and makes land.

Laible asked about the UNOLS long core projects and whether that is part of the project going forward? Is that 30-meter core? Mix said they it is and that part of this is choosing the right tool for the job. There are some sites where 10-15 meter cores do the job and others where one needs 30-50 meter cores. Some of them are going to need 300-meter access and some are going to need kilometer access. That's why, to do the full picture, this will require repeated engagements with the right tools, with the right platforms, etc.

Treadwell advocates any research that would support amendments or revisions to the impending Marine Mammal Protection Act and recommends Commission backing.

US ARCTIC RESEARCH COMMISSION
78TH MEETING
25-26 JANUARY 2006
Applied Physics Lab, University of Washington
NOAA Pacific Marine Environmental Lab and
NOAA Alaska Fisheries Science Center
SEATTLE, WA

In attendance:

Commissioners

Mr. George Newton, Chairman
Mrs. Michele Longo Eder
Mrs. Mary Jane Fate
Mr. Duane Laible
Dr. Thomas C. Royer
Dr. Susan Sugai
Mr. Mead Treadwell

Staff

Dr. Garrett Brass, Executive Director
Ms. Kathy Farrow, Staff
Dr. Lawson Brigham, Acting USARC Executive Director

Attendees

Bernard Coakley, University of Alaska Fairbanks**; Dennis Darby,** Old Dominion University**; Doug DeMaster,** science director, AFSC**; Mark Koehn,** PMEL**; David Martin,** APL**; Sue Moore,** APL**; Jamie Morison,** APL**; Dick Moritz,** APL**; Jim Overland,** PMEL**; Pierre Rampal,** Laboratoire de Glaciologie et Géophysique de l'Environnement**; Ignatius Rigor,** APL**; Drew Rothrock,** APL**; Phylis Stabenow,** PMEL**; Harry Stern,** APL**; Mark Wensnahan,** APL**; Rebecca Woodgate,** APL**; Jinlun Zhang,** APL

January 25, 2006

Dr. David Martin, Associate Director of the University of Washington Applied Physics Lab, welcomed the Commission. He provided a brief overview of the Lab and its activities. Martin mentioned APL's very strong background in acoustic and remote sensing, physical oceanography and engineering. Their work takes place all over the earth from the cryosphere in the Arctic to the East China Sea in the tropics. APL maintains a very strong and robust sea tracking ability for ocean science, ocean engineering and Arctic work. The facility is unique as one of four university research centers affiliated with the Navy. Others include the Applied Business Lab at the Johns Hopkins University and two applied research laboratories, one at the University of Texas at Austin and one at the Pennsylvania State University. These are designated as unique entities by the Department of Defense.

Their Arctic and polar science work includes operational ocean gliders, buoyancy powered vehicles for long-term endurance under the Labrador Sea. These operational ocean observing systems are designed for both operational and research, determining how energy-efficient devices for persistent littoral coastal undersea surveillance are made. Their work also involves counter-mine warfare, primarily in the acoustic field looking at high frequency acoustics for imaging buried objects underneath the sediment. APL's work also incorporates significant work on high-resolution sonar.

The Commission then discussed a wide array of political/socio-economic military issues related to the Navy and its interest in the Arctic. Commissioner

Chair's Report
November 2—attended a workshop sponsored by the Norwegian Embassy in Washington where he gave a presentation on research related to combat oil spills and ice and the current and future oil interests occurring in the Arctic. Representatives attended the workshop from the oil industry, the US State Department, the Department of Commerce, Department of Energy and academia. Following the presentation, the group talked extensively about oil spills and ice. Newton reiterated that there are four essential organizations and groups that will suffer mightily in oil spill in ice conditions: the oil industry, the public in general, the governments involved or all governments in the Arctic and most importantly, the environment. He proposed an emergency response center to not just deal with physical and material casualties of ships in the maritime environment but with all things requiring action response in the Arctic.
November 3—addressed the Marine Board, the National Research Council at the Tech Center on improving access to the Arctic Ocean and the opportunities it presents stressing the US need to ratify the Law of the Sea Treaty.
November 9—with Commissioner Treadwell, participated in a breakfast meeting that included the President of Iceland, James Connaughton, head of the chair of the Council of Environmental Quality, Senator Murkowski's staff, Bill Wolfe, and a representative from the Governor Murkowski's office. An opportunity arose to talk one-on-one very quickly with James Connaughton about the prospects of our ratifying the Law of the Sea Treaty. Based on that discussion, Newton wrote an op-ed piece supporting the Treaty.
November 19—attended a meeting of the Explorers' Club in Washington dealing with climate change given by the ex-editor of the *USA Today* weather page.
December 1—met with Julie Gourley, the new Department of State Senior Arctic Official, Ray Arnaudo and USARC **Executive Director Garrett Brass** to introduce Gourley to the Commission and the Arctic environment. Gourley will be a definite improvement to the Arctic policy group in that she will address more than just Arctic Council matters at future State Department meetings.
December 2—attended the retirement ceremony of Captain Zdenka Willis of the US Navy at the Naval Observatory. The Commission worked very closely with her when she was Director of the

National Ice Center in preparing a scenario for the US Navy in an ice-free Arctic environment. It was one of the early national statements that there's going to be a different Arctic in the future and Willis motivated that effort. At that meeting, he met with a staff member at ONR about its participation in the role of the submarine science program and the nation's understanding of the Arctic Ocean.
December 5—held discussions with the maritime safety division of the National Geographic Intelligence Agency, Geospatial Intelligence Agency (NGA) to talk about the new proposed change to the Worldwide Navigation Warning System and the addition of five new navigation areas in the Arctic.
December 9—along with Brass met with Dr. John Norton Moore at the University of Virginia Law School Center for Ocean Law and Policy to discuss the content and the focus for a proposed op-ed piece to be offered to a national newspaper on the US' needs to accede to the Law of Sea Treaty.
December 13—traveled to Norfolk with Dr. Dennis Conlin, National Science Foundation (NSF), to attend his brief concerning why the US science community would benefit from a more robust submarine science research program in the Arctic or the SCICEX Program. The presentation was given to the Deputy Chief of Staff for Operations on the staff of the Commander on Naval Submarine Forces. Gained valuable concessions that deal with earlier and timely notification that there will be a voyage research opportunity without divulging the classified nature of the combination cruise. This is a considerable improvement over what was previously received.
December 16—attended the Commission staff Christmas lunch.
December 22—attended ceremony and delivered remarks of thanks to Chuck Myers on his retirement from NSF.
January 3-7—traveled to Anchorage and Fairbanks. In Anchorage he attended the UA Science to Engineering workshop on Alaska coastal erosion, which highlighted the need for additional research in coastal erosion in Alaska. In Fairbanks, he visited selected faculty at UAF. During the visit he had to return to Anchorage in order to attend the funeral for ex-Commissioner Jim Campbell and represent the Commission.

- Met several times with representatives of the Department of Interior and National Business Center to prepare for the announcement of the renewed search for a replacement for the executive director.
- Received word that the digitizing of the archived sound speed profiles (1969 to 2000) that have been underway since last June had been completed and they are now in the hands of the final declassifying agent. The actual data was expected later in January and subsequently will be released to the public.
- Continued discussions with the US Navy on the release of additional bathymetry regarding the release of some non-sensitive data that some are nevertheless concerned about releasing.
- Prepared for the World Economic Forum in Davos, Switzerland at which he was asked to serve as the technical expert on a panel that will address the Arctic as the potential next frontier from an economic and political perspective. The rest of the world is getting the word on the importance of the Arctic. Newton then gave his presentation that he prepared for the meeting.

Commissioner Reports
Commissioner Mary Jane Fate discussed the many studies being conducted throughout Alaska regarding health education, economics, social needs and subsistence living with a central emphasis on self-determination. She also discussed access issues within the state and affordable energy. Fate also informed the Commission about the benefit of having native people conduct various studies since they are Arctic residents and therefore have keen insights into the way of life and language to better describe local conditions.

Commissioner Duane Laible attended the AICC meeting with Brass in December that focused on the interaction of the overall community that's interested in icebreakers and the research community. They heard a brief presentation about the Alaska research vessel and were involved in a discussion about the absence and need for open bridge wings. The community is very actively and aggressively using the limited facilities that are available, that is the Healy, and clearly the community interaction with the Coast Guard was very positive. There is a very strong movement to construct ice-breaking tankers. They are being built and Korea has lots of orders. The focus is to transport the oil. Laible will attend a World Maritime Transportation Conference in March.

Commissioner Tom Royer chairs the National Research Council on the Arctic Yukon that has an interest in sustainable salmon initiatives. They've completed the final report that has a total funding budget of $20 million.

Commissioner Michele Eder thanked the Commissioners for their participation at the 77th Commission meeting held at Oregon State University. She will join several other members of the Commission when attending the Alaska Marine Science Symposium.

Commissioner Mead Treadwell attended the 100th birthday party for Norman Long who was planning a trip to the North Pole this spring to celebrate his 100th birthday. He hosted the Dr. Ólafur Ragnar Grímsson, President of Iceland, in Washington and had meetings with Senators Murkowski and Stevens, Secretary Norton and her chief scientist Jim Jay and Jennifer Thompson from the Alaska office at the Interior Department and a breakfast with Jim Connaughton, Bill Wolfe, Jim Jay, Jennifer Thompson, Ray Arnaudo and Chip Abernathy. The President's agenda was to propose some cooperative research between Iceland and the United States on carbon sequestration, which the US is following up on with the Department of Interior. Grímsson came to ask the US to host the meeting after next of the Northern Research Forum, which would occur in Anchorage in 2008. He took on the measure of endorsing and moving forward with the Iceland Kodiak study, the shipping study and the bilateral study that is underway now between Alaska and Iceland. He also spoke with several senators while in Washington, DC concerning Arctic shipping and energy issues. He suggested getting a briefing for Senator Stevens on shipping and climate change. He met with Anna Gratula, the social science leader at NSF for programs about Arctic endangered languages. He met with Lassi Heininen of the University Arctic and the Northern Research Forum in Alaska about hosting the Northern Research Forum. He met with Dave Garman, the Undersecretary of Energy about pursuing the Arctic interest in the DOE budget. Garman said the department is very aware of the Arctic Energy Center and supports its work. He hosted a meeting with Mike Shraga, the University of Alaska geography program and Buck Sharpton the resident professor who asked for support for their program on Arctic analogs for the Mars missions with NASA. He also helped arranged a panel on climate change with Bob Corell and others before Commonwealth North in February.

Commissioner Susan Sugai, in her capacity at the Cooperative Institute for Arctic Research, issued a call for proposals for this year's Joint Russian-American Long-term Census of the Arctic (RUSALCA) Research Program in the Bering and Chukchi Seas.

Brass attended the AICC meeting and mentioned that the Coast Guard's efforts in relationship to communications have not been very successful at all. He also attended the Polar Research Board meeting where Ed Links discussed re-supplying the Antarctic and the subsequent meeting of the Ice Breaker Committee. He attended I-Carp II where he met with Peter Harrison from En Circ in Canada, Helena Ödmark from the Swedish Foreign Ministry, and Ambassador Vitaly Churkin from Russia who sought his suggestions on who should participate in a meeting of science ministers of the Arctic nations. He suggested Arden Bement, director of NSF.

Alaska Office Director and Acting USARC Executive Director Lawson Brigham hosted Julie Fishel, Ray Arnaudo, and Chip Abernathy in the Alaska office to discuss the Arctic maritime shipping assessment, the US role and its needs for funding. He worked with the North Slope Science Initiative to develop the process and the criterion for establishing the science panel. 65 people applied for 15 spots on this Federal advisory body that will advise the North Slope Science Initiative. He attended the Arctic Ocean Observation System (AOOS) meeting regarding the establishment of a sub-committee on sea ice in Alaska's coastal seas. A concern mentioned there was that the US does not have a century record of sea ice analysis in the Bering Strait region in the United States. The chief people haven't done the re-analysis and gotten up to date. The research community needs to decide if it is going to do integrated Bering Sea ecosystems analysis. He also attended a workshop on the sea ice issues hosted by the Fish & Wildlife Service and USGS where NASA explored the range of remotely sensing products and abilities.

Marine Mammals Help Define the Arctic Ecosystem

Sue Moore, APL, University of Washington, spoke about marine mammals as Arctic ecosystem sentinels. She discussed the extreme ice retreats witnessed in the western Arctic. For ice obligate marine mammals such as ice seals, walrus and polar bears, it's an immediate loss of their resting, breeding and feeding habitat. Marine mammals are ecosystem central in that they reflect biophysical variability, which is how the physical structuring responds to the biological component and as an ecological scale model. They are nutrient cyclers in that they recycle carbon and nitrogen, good contaminant monitors and, perhaps more importantly and getting back to the theme of humans, they're a cultural piece to the people that live in the Arctic. Moore discussed the tools necessary for study and their benefits in terms of locating data: various tagging programs, acoustic recorders, DNA and biochemistry tools, and traditional knowledge. Marine mammals are a kind of natural nexus to humans and they provide a top down view into the Arctic ecosystem and should be included in Arctic research planning from the outset.

Geophysical Findings on the HOTRAX Cruise

Bernard Coakley, Associate Professor**,** Department of Geology and Geophysics, University of Alaska, Fairbanks, spent two months on board the Coast Guard ice breaker Healy on a cruise from Dutch Harbor and the Aleutians to Tromso, Norway, where he served as co-chief of the marine geology and geophysics program. The main goal was to build on the previous successful scientific drilling on Lomonosov Ridge by taking those results and extending them across the basin by collecting link transector cores and geophysical data. In particular, the objective was the study of the area's internal structure and basin history. Their plan was to understand what the structure of these different features are, both the ridges and the basins, in order to look at the stratigraphy and see what can be reconstructed about the history of the Arctic Ocean. In addition, they wanted to link their findings with 29 cores that were previously collected and some 500 meters of mud to study the sediment paleoclimatology and oceanography. Finally, besides the scientific results that are very important, the group also wanted to use this opportunity to collect data that can be the basis for planning the next round of Arctic scientific drilling.

This cruise was in part in cooperation with the Swedish Polar Research Secretariat with a planned rendezvous with the Swedish icebreaker Oden. Throughout the trip, the ice was continuous, more than two meters thick in many places and in compression. The Healy met up with the Oden right about where the ice got problematic. The idea with working together was that Oden would sail ahead and clear way and so the Healy could tow its gear. The ice conditions created problems especially for the ships' equipment.

However, they were able to extract some 2200 kilometers of data during the course of the cruise. Coakley hopes that the results of the Healy cruise will inspire a national need for additional data to establish a maximum US claim and will open the door to renewing SCICEX and collecting more data in the Arctic all across northern North America.

Measuring Ice Draft at the North Pole

Jamie Morison, North Pole Environmental Observatory (NPEO), discussed the observatory's origin and its current activities related ice thickness. NPEO's goal is to provide sustained observations over a fairly wide area in a region that has shown evidence of change that is a good indicating region and then to provide collected data to the research committee and support other's fieldwork. When Morison measures thickness at the North Pole, he gets a pretty good indication of what's been accumulated over the whole basin. These measurements are made through automated drifting stations using buoys that drift with the ice over a year's time. NPEO also deploys deep ocean moorings that provide an opportunity to conduct hydrographic surveys using the operation's aircraft. They also participate with the International Arctic Buoy Program, placing two buoys each year. Morison discussed the rationale for placing buoys in one spot or another. They measure temperature and salinity, solar radiation, heat flux and, of course, ice draft.

Availability of Ice Thickness Data

Mark Wensnahan, Physicist, APL, University of Washington, discussed research methods for determining ice thickness and the frequent frustrations of researchers in finding data. Wensnahan discussed of gathering ice thickness data: coring, electromagnetic induction measurements and submarines.

He has been actively involved in processing submarine data collected over several years. While he has 60,000 kilometers of data available to him covering a large part of the Central basin, it doesn't cover the EEZs of other countries. Significant amounts of other data cannot be processed for various reasons including the fact that there is no ancillary navigation data to go with the ice drafts, data is classified and a lack of research during certain periods of time, for example 2000 to 2005— the modern fleet of boats does not include a recording device that provides usable data. As a result, submarines go to the Arctic, take data and record findings on paper charts. No digital recordings for processing.

Wensnahan also discussed moorings, how they calculate ice draft measurements and the minimal of this particular form of data. While there is some information located on the National Ice Center and NPEO websites, significant amounts are not available which frustrates end users who want to be able to compare it to model results. Ice mass balance buoys, on the other hand, have put out considerable data that is available on the Cold Regions Research and Engineering Laboratory (CRREL) website. CRREL developed these buoys and currently has six in Arctic locations. Wensnahan also discussed the use of satellite altimetry data to measure how high the ice is off of the sea bottom, which yields ice thickness data.

Each of these methods provides slightly different information: point measurements, measurements along a track, a map, short-term measurements and time series measurements.

Sediment Coring on the Healy-Oden Expedition

Dennis Darby discussed the sediment-coring portion of the Healy-Oden trans-Arctic expedition. The impetus for this cruise was the result of some work that was done seven or eight years ago that really upset the whole apple cart in the Arctic. Paleoclimatologists had essentially given up on the Arctic to produce a decent high resolution or moderate resolution of paleoclimatic records. The work, done by Lloyd Keigwin from Woods Hole, showed high resolution from the

Lomonosov Ridge. That inspired the impulse for this cruise and to collect cores from the Alpha-Mendeleev Ridge area and all the way across the Arctic. The effort was successful. The team got cores that were up to 16.7 meters long, most of which is probably Holocene. This will allow them to develop a very detailed, even decadal scale of changes that occurred. Of particular interest is the Arctic oscillation. Arctic oscillation controls ice drafting and where the sea ice moves.

Cores hadn't been collected in the central Arctic since the 1970s and Darby wanted to use the cruise to collect some new material. They secured cores that were twice as long as those previously collected. They collected 29 piston cores across the central Arctic. They also collected some very interesting sea ice samples.

They mapped the seafloor with multi-beam bathymetry and located mud waves that had never before been mapped on the seafloor of the Arctic Ocean. These waves are up to 50 meters in height and were plotted in several places including the inner ridge basin on the Lomonosov Ridge.

January 20, 2006

Oceanographic Observations and Research at PMEL
Mark Koehn, Deputy Director, Pacific Marine Environmental Laboratory, (PMEL) welcomed the Commission to this NOAA facility and provided an overview of its activities. NOAA developed four operational program goals that include the ecosystem, climate, weather and water, and commerce and transportation. PMEL's activities fall primarily under the ecosystem goal with a focus on ecosystem observations and ecosystem research.

Much of PMEL's work is tied to quality oceanographic observations. When this lab started up in 1973 there wasn't much in terms of quality oceanographic observations to work with so the lab dedicated itself to producing and obtaining quality observations. According to Koehn, these are essential for the climate work that is such an important part of what the lab does because that work leads to forecasting.

Climate programs were PMEL's claim to fame up until a year or so ago as its name was regularly associated with the TAO-Triton array used for observing and predicting El Nino storms. The 70 moorings that were developed and maintained for TAO-Triton are being transitioned to the National Weather Service because this is considered an operational program that should be maintained as a long-term system for climate prediction purposes. PMEL believes the program has tremendous research potential and is trying to maintain the ability to modify sensors or add sensors to the existing system.

Koehn mentioned that it is only one of about five entities in the US that deploys Argo floats. PMEL is trying to get up to an array of 3,000 worldwide. These floats last four to five years. They have enough battery power to cycle approximately 140 or 150 times and they're typically on a ten-day schedule. They park at 1,000 to 2,000 meters, rise up, take a profile, send it off, sink back down again, wait another 10 days and then repeat the cycle.

PMEL's atmospheric chemistry program goal is to characterize the properties of aerosol particles to determine their impact on climate and air quality. The focus of their Vents program is on deep-sea ecosystem, looking at seafloor volcanoes and the impact of what they're spewing into the ocean. It's an exploration of volcanic ecosystems, characterization of the environment and discovery of unique biochemical environments. The program found vents in the west Pacific emitting nothing but liquid carbon dioxide. When researchers returned two years later the vigorous bubbling had persisted which created questions about the vents' impact.

NeMO is the observatory that they maintain off the Oregon coast comprises real time buoys with sensors on the seafloor that allow monitoring of temperatures on a daily basis. The program has two-way communications with the seafloor through iridium satellites and acoustic modems. Their tsunami program is one that has gained considerable attention in the last year. The National Tsunami Hazard Mitigation Program, which is made up of the five Pacific states, FEMA and US Geological Survey (USGS), was established for warning guidance, mitigation and hazard assessment purposes.

Studying the Bering Sea

Phyllis Stabenow, PMEL, discussed a new program, the North Pacific Climate Regimes and Ecosystem Productivity (NPCREP), a partnership between NOAA fisheries and NOAA researchers. The initial focus of the program is on the Bering Sea because it has a very strong climate signal—very sensitive to climate shifts—strong fisheries management and vast populations of birds and mammals. Eighty percent of the marine birds that nest in Alaska waters nest in the Bering Sea. It is a very rich place. In addition, numerous endangered species that NOAA also has responsibility for managing are present there.

In order to study this area effectively to meet the goals of NPCREP, Stabenow says that they have to follow the ice. Stabenow discussed variations in overall ice maximums and ice seasons. She would like to push the ice record back at least 50+ years to get have some sound, historical record.

In addition to the Miller Freeman, a ship that Stabenow describes as NPCREP's workhorse, the program deploys moorings for its research. In the summer researchers deploy surface moorings because they want to get some immediate real time data. These are not nylon moorings but metal tanks. They're strong enough that the ice can pull and drag them and not be completely destroyed. NPCREP has only lost two. They also have deployed subsurface moorings that have the capability of communicating with those at the surface. The moorings measure salinity, fluorescence and nutrients. A zooplankton captor will be placed on one of the moorings in order to make it a biophysical mooring, not just to collect physical measurements but biological measurements as well.

Her research has shown when there is ice over a mooring, there tends to be a bloom underneath if, that is, the ice is there late enough and there is enough light to support it. Stabenow indicates that when there is ice after early March, there will be a bloom there. There are a lot more zooplankton, they eat the phytoplankton and they feed the fish population. The bloom consumes all the nutrients in the upper part of the water column so there usually is not a bloom later in the year, only this ice associated bloom. If the ice has an early retreat there are very few zooplanktons in the water. It's too chilly for them. Early on the bloom develops stratification.

Bering Sea Changes Mean Arctic Changes

Jim Overland, PMEL, discussed the perceived changes in the Bering Sea and the impact those changes are having on the various fish and mammal populations. Salmon and Pollock, for example, are entering the warmer waters of the Bering Sea and have more niches to occupy. On the other hand, the marine mammals such as the walrus, seals and whales are forced to seek new habitats further North because their former habitats are gone. Overland says the "scary" part about this is that what's happening in the Bering is part of the larger climate picture of the Arctic. The sea ice area in September decreased about 20% and is projected to be below the trend line for 2005. About 20% of Tundra is gone over to the wetlands and shrubs. Overland believes that when researchers think about this, they focus on sea ice albedo. But the loss of tundra is at least as monumental a concern.

In the early to late 1970s and early 1980s there was a shift in the Pacific pattern. When the Pacific pattern was really strong, there was warming in Alaska and all of North America but cooler on the other side of the globe. In 1989 to 1995 the Arctic oscillation was strong and it had a strong Icelandic low which brings warm air into northern Europe and cold air from the Arctic down over west Greenland and Canada.

But from 2000 on, the temperatures are virtually warm everywhere in the Arctic. That's really important and that's new. The last time this happened, the cod moved all the way up along west Greenland and changed the whole ecology of the area. This pattern that has been witnessed in the last six years does not look like the Pacific patterns or the Arctic oscillation patterns. It is a new persisting climate pattern that has never been seen before going on in the Arctic.

Overland asks what is going on here. Certainly the ice reductions and other changes to the ecosystem—ocean currents, clouds, winds, global warming—are involved. However, these climate patterns have these five or six year timelines and this pattern has been around about that long. He said it is the classic example that by the time a plan is developed or is just about to be launched, the pattern will shift. In the long-term on a 20-year timeframe, Overland says there will likely be continued changes, but in fact, within the next five years, there might be a little slowdown and then rapid acceleration all over again.

The Commission visited the Alaska Fisheries Science Center for a presentation by **Doug DeMaster**, science director, and his colleagues. DeMaster asked for Commission support to procure a staff position dedicated to marine mammal research. **STAFF ACTION: Draft letter in support of new position.**

US ARCTIC RESEARCH COMMISSION
79TH MEETING
18-20 APRIL 2006
US FISH AND WILDLIFE SERVICE
ARLINGTON, VIRGINIA

In attendance:

Commissioners

Mr. George Newton, Chairman
Mrs. Michele Longo Eder
Mrs. Mary Jane Fate
Mr. Duane Laible
Dr Thomas C. Royer
Dr Susan Sugai
M Mead Treadwell

Staff

John Farrell, Incoming Executive Director
Kathy Farrow, Staff
Dr Lawson Brigham, Acting Executive Director

Attendees

Jonathan Berksen, USCG; **John Calder**, NOAA; **Paul Cutler**, National Research Council; **Margo Edwards**, AICC; **Chris Elfring**, PRB; **Mike Simpkins**, Marine Mammal Commission; **Simon Stephenson**, NSF; **Mike Van Woert**, NSF; **James Wemyss**, Senator Lisa Murkowski's Office

April 18, 2006

George Newton, Chair, US Arctic Research Commission opened the 80th US Arctic Research Committee meeting and gave an overview of his activities since the previous meeting in January 2006.

January 23-30—Attended the World Economic Forum and served on the panel concerning "The Race for the North Pole" featuring the positive aspects of climate change, improved access for economic development, commercial ocean transport, new ports, and new opportunities.
February 2 —Met with Captain Paul Stewart of the Office of Naval Research (ONR) to continue discussions of ONR's role in Arctic research and to address its responsibilities under the Navy/Science Memorandum of Agreement with respect to submarines as research platforms in the Arctic Ocean.
Throughout February—Worked extensively with the Department of the Interior and the National Business Center to prepare for interviews of USARC's Executive Director candidates.
February 22—Met with State Department staff to discuss the US initiating Arctic Ocean surveys as part of a claim to extend the outer limits of the Continental Shelf under the Law of the Sea, Article 76, in anticipation of the US signing the Law of the Sea Treaty.
February 25-26—Conducted interviews for the Executive Director position.
February 27-28—Attended a workshop on the technologies to improve communication and navigation for undersea vehicles under the Arctic sea ice.
February 28—Met with the National Geospatial Intelligence Agency Maritime Division concerning the increasing numbers of research buoys, moorings and floats that are present or being planned in the Arctic Ocean to determine how they can be more effectively reported through the Arctic Maritime Safety Information System.
March 1—Exchanged emails with the Senate Committee on Government Affairs and Homeland Security concerning Senate Bill S879, which is the proposed amendment to the Arctic Research and Policy Act of 1984.
March 2—Attended a retirement party for Dr. Bob Smith who is the staff geographer in the Office of Oceans and Environmental Science at the State Department and was primarily responsible for the Department's practical aspects of the Law of the Sea and all Article 76 claims that are received from other nations.
March 10—Arranged and attended a meeting with the Marine Board Executive Director and the Transportation Research Board staff to determine their interest in their doing a study of costs associated with the commercial development of the Arctic.
March 10—Completed an op-ed piece on the urgent need to ratify the Law of the Sea Treaty and submitted it to the *Washington Times*. To date, no response has been received and none is expected.
March 10—Met with John Farrell to discuss the Commission operations and the inner workings of the Commission Office.
March 13—Spoke with Dr. Dave Martin of APL UW who has submitted a proposal to the Naval Oceanographic Office to release ice draft data as an adjunct to further quantifying the redistribution of Arctic sea ice over the last 50 years. The proposal is intended to either refute or support several of the theories that say the ice is either being exported from the Arctic more rapidly or it is piling up along the Canadian Archipelago.

March 14—Held a meeting at Commission offices with the assistant naval attaché of the Embassy of the Russian Federation to discuss the Russian EEZ for research vessels under the Law of the Sea and also the maritime hazards reporting system in the Arctic.
March 15—Communicated with NGA and commented on the format changes—installing hyperlinks—to the Arctic Maritime Safety Information System website.
March 24-29—Attended the Arctic Science Summit week where **Newton** made a short presentation to the Arctic Ocean Sciences Board on the need to report maritime hazards to ensure research instrumentation in the Arctic Ocean. He also held informal discussions with the Canadian Hydrographic Service representatives that were in attendance and the Executive Director of the Canadian Polar Commission on the need to resolve the US-Canadian Arctic maritime boundary incident to Article 76 of the Law of the Sea.
March 31—Met with the NGA Maritime Division International Coordinator to further understand the US proposal to create five new navigational areas of the Worldwide Navigation Warning Service in the Arctic Ocean.
April 4— —Met with Ambassador Dave Bolton of the State Department Ocean and Environmental Sciences, Ray Arnaudo and Margaret Hayes about the Russian EEZ access for research. The Commissioners then held a lengthy discussion about resolution of maritime boundary issues with Canada and Russia.
April 6 —Met with Dr. Farrell about Commission operations.
April 10—Met with Chris Elfring, Executive Director of the Polar Research Board, to discuss the proposed marine board study on costs of Arctic Ocean development.
April 12—Participated in a luncheon strategy session with Dr. Rüdiger Wolfrum, the chief judge, the Law of the Sea tribunal and 10 other US citizens who support US accession to the Law of the Sea Treaty on how we can better use the support that exists for accession.
April 13—Met with Ray Arnaudo of the State Department who leaves to work in the U.S. (Moscow) embassy at the end of April.
April 17—Met with Dr. Bernie Coakley of UAF and Rear Admiral Jerry Ellis, whose division is responsible for submarine operations in the Arctic on the CNO staff, to hear Coakley make a presentation about the advantages and the need for submarines to do the EEZ and Article 76 surveys.

The Commission next heard from **James Wemyss** who discussed Arctic-related activities in Senator Murkowski's office. The Senator requested clarification on NSF's allocation of resources toward IPY. She was specifically interested in the human component not only the scientific aspect.

Lawson Brigham, Alaska Office Director and Acting and USARC Executive Director, discussed a "for internal-use only" Commission planning/meeting calendar to keep Commissioners and staff abreast of meetings at which there is some level of Commission participation.

The Commission then voted to seek a joint meeting between itself and the Canadian Polar Commission in October 2006. It was unanimously approved. The discussion then moved to a meeting location, funding requirements and the development of an agenda for the meeting.

PRB and IPY

Chris Elfring, Polar Research Board (PRB), discussed the Board's activities and coordination/participation in IPY. PRB strives to enhance understanding of the Arctic, Antarctic, and cold regions, undertakes studies and other activities at the request of Federal & state agencies, Congress, or other sponsors, or upon its own initiative. It serves as the focal point for US planning for IPY 2007-2008. A primary responsibility is to design studies and ensure that they are carried out successfully (on time and within budget), often working jointly with other NRC boards. It gets its core support from NSF, NASA, and NOAA and project-specific support from a variety of agencies and organizations. It reports to the Division on Earth and Life Studies (DELS) within the National Research Council.

Its vision for IPY 2007-2008 will be an intense, internationally coordinated campaign of polar observations, research and analysis that will further understanding of physical and social processes in polar regions, examine its globally-connected role in the climate system, and establish research infrastructure for the future.

Current PRB activities include US planning, international planning and communication and coordination. These incorporate issues such as the Arctic Observing Network, assessment of US icebreakers and environmental stewardship for exploration of subglacial lake environments. PRB is developing activities related to implications of changing ice conditions in the Arctic, assessment of state of knowledge and technical limitations for construction of gas pipeline in cold regions, mental and behavioral health issues in the Arctic and, frontiers in polar science in the areas of geology & geophysics and continued IPY involvement.

Developing an Arctic Observing Network

Paul Cutler discussed the need for a comprehensive Arctic Observing Network. The US needs an improved observation infrastructure that delivers a coherent set of Pan-Arctic, long-term, multidisciplinary observations. He pointed to the fact that observable changes, many of which have regional and global implications, are underway across the Arctic. The physical, biological, chemical, and human components of the Arctic system are interconnected and should be monitored in parallel, yet there is insufficient coordination and spatial and temporal coverage of observations to meet the country's needs.

The National Science Foundation (NSF) commissioned a report directed toward NSF and the broader U.S./international community that would incorporate vision and implementation ideas aimed at stimulating international dialog and action for the network. The report should provide guidance to help design an international Arctic land, atmosphere and ocean-observing network. It should incorporate an overarching philosophy of network design and key variables to monitor, existing and planned observing systems, needed infrastructure, data management and access issues and strategy for efficient, coordinated implementation.

The result was a report with two overarching recommendations.

- An Arctic observing network should be initiated using existing activities and with the flexibility and resources to expand and satisfy current and future scientific and operational needs. In its initial phase, the network should monitor selected key variables consistently across the Arctic system.
- Work to design and implement an internationally coordinated Arctic observing network should begin immediately to take advantage of a unique window of opportunity created by a convergence of international activities during the IPY that focus on observations.

The report contains key variables including data acquisition and data management, observing system development and maintenance and sustainability.

Commissioner Reports

Commissioner Tom Royer discussed his participation in the Alaska Marine and Science Symposium where one of the focuses was the retreating sea ice. While at the meeting he learned more about the Alaska Area Research Vessel (AARV) and the coordination of Federal funding for the ship. He attended the Exxon Valdez Oil Spill Trustee Council meeting where the discussion centered on continued, long-term monitoring efforts in the Gulf of Alaska. He also attended the American Geophysical Union Ocean Sciences Meeting in Honolulu. The Arctic was well represented by the science community at that meeting. He submitted a paper dealing with fresh water fluxes and heat in the Gulf of Alaska on a 35-year timescale. He was frustrated that others were doing the same on a three-year scale. He also participated in the NPRB Science Panel discussion about monitoring and modeling in the Bering Sea, the Gulf of Alaska Integrated Ecosystem Research Program regarding integrated programs for the Bering Sea and funding needs of the Oil Spill Recovery Institute.

Commission Michele Eder also attended the Alaska Marine and Science Symposium and heard presentations on sea ice thinning, the extent of reduction of multi-year ice and the role of PAME in conducting the Arctic marine shipping assessment. She also attended the North Pacific Research Board's meeting on March 29-31 in Anchorage. NPRB's RFPs for 2007, submitted in December 2005, appropriated $6 million out of $24 originally requested for research in the Bering Sea, Gulf of Alaska and other Arctic locations. Eder explained some of the details of the NPRB's RFP process.

Commissioner Mead Treadwell attended a meeting at the US Chamber of Commerce in Washington, DC and spoke about mapping and navigation needs in the Arctic, a subject important to Alaskans. He moderated a panel at the Alaskan Environmental Assembly covering the elimination of trans-boundary pollutants and the benefits that will mean to the Arctic natives. He also attended a meeting where Bob Corell led a town meeting on climate change with native leaders from around the state. He also led a workshop at the Alaska Press Club titled "Change in the Arctic," where he discussed climate, business and cultural changes in the region. He presented the resolution, drafted by **Lawson Brigham**, that the Commission had passed about the Explorer's Club a year ago at the Explorer's Club annual meeting. He briefed the Deputy Director of the Japanese First North American Division, the group that governs US-Japan relations regarding shipping in the Arctic, cooperation with Russia and monitoring networks. He wrote a request for

comment on the *Report on Goals and Objectives for Arctic Research*. He is shopping for collaborative software for a Commission internet website for posting working paper, presentations etc. for Commission and staff use. He met with Patricia Cochran and the General Counsel of the Alaska Federation of Natives concerning their lack of funding. He spoke with Chris Rose about an energy atlas that presents alternative energy sources for the entire state of Alaska.

Commission Susan Sugai attended the Alaska Marine Science Symposium where she spoke about her NPRB-funded project that allowed her to assist high school students and their teachers from schools around the state to do their own research on a pre-selected topic. This year the project addressed developing a marine resource ecosystem management plan involving a resource that was important within their communities. Once the research is complete, each tam prepared a written 15-page research paper, and gave a 20-minute presentation in Seward before other student teams and judges from the University of Alaska Fairbanks and Alaska management agencies. A video on the event was prepared by Deborah Mercy of the Marine Advisory Program and shown on Alaska One (Alaska public television).

Sugai discussed President Hamilton's strong support of IPY. This support has led to his devoting private and Federal monies to fund 10 two-year post docs and graduate student fellowships addressing IPY issues at the University of Alaska campuses. The school is also endorsing an IPY think tank where noted researchers are invited for periods of two to three weeks to give seminars for graduate students and professors. She attended a NOAA grants workshop in Seattle. Several presentations were made on how NOAA grants will be announced and processed entirely electronically.

Commissioner Duane Liable attended the World Maritime Technology Conference in London sponsored by the Marine Engineering Science and Technology in Britain. He learned of a trend to manage the unreliability of people on ships by using sensor-based shipping. This could have tremendous impact in the Arctic. He was disappointed that there was very little discussion of how the Norwegians and Fins are going to take Russia's oil to market. He will attend the Society of Naval Architects and Engineers-sponsored symposium in Calgary. This is really the premier technical discussion area for icebreaking technology. Glosten Associates was selected to strengthen the JOIDES Resolution. Laible also reported that there is no selected institution to construct or to operate the AARV. That activity will not occur until the funding is in place and then NSF will advertise with an RFP for an offering institution.

Commissioner Mary Jane Fate discussed attended several meetings including those of the Fairbanks Native Association and Yukon Corporation. She discussed the lack of funding for schools, education, physical health and mental illness treatment, drug abuse prevention and access. She and the other Commissioners then discussed changes that could be made to redirect the Alaska Native Science Commission to focus on filling some of the research needs that go unresolved or are imperfectly filled by today's

system. Fate also discussed the Breast Cancer Detection Center of Alaska that currently operates statewide.

Changes for the NOAA Climate Program Office

John Calder, NOAA Climate Program Office, discussed his transition from the now obsolete Arctic Research Office (ARO) to the Climate Observations Division. While the focus of the work is still on the Arctic, many of the other areas that ARO had focused on including contaminants and basic biology will be eliminated in favor of climate-related activity. However, Calder believes he can retain focus on some of these areas by maintaining a broad view of climate.

The program goals the Climate Program Office (CPO) currently focus on building and maintaining a suite of Arctic climate observing networks (ocean, sea ice, and atmosphere) in association with international partners. These include

- NOAA CMDL Barrow Observatory and the DOE Atmospheric Radiation Measuring Program Observatory
- Eureka Canada network on Ellesmere Island where NOAA and Canadian partners have deployed instruments to the observatory with the goal of having the full observatory in operational status by end of 2006
- Tiksi Observatory in Siberian Russia.

The goal of the observatory network is to provide long time-series data on clouds and cloud properties, aerosols, radiation, and trace gases.

NOAA will also continue to support long-term ocean and sea ice observations in the Arctic as a subcomponent of the NOAA Integrated Ocean Observing System. There are three elements to the Arctic component including ice-tethered buoys in the perennial Arctic sea ice, oceanographic moorings along the shelf and slope and in the deep basins and ship-based observations.

CPO's program goals also include supporting continuing analysis of Arctic climate data from program and other sources and providing data and analyses to operational centers, climate assessment activities, and the research community. Work continues to gather and analyze historical and current data from diverse sources to evaluate variability and change in Arctic climate. NOAA uses different approaches to collect and review data including gathering different types of data from throughout the Arctic region and analyzing spatial and temporal relationships as well as gathering historical data not yet in the digital archives to provide added context for more recent observations. This project will focus more explicitly on the northern Bering Sea and Chukchi Sea during FY2006 with the entire data rescue project to be completed in 2006. Another data source is the State of the Arctic (SOA) Report that involves experts from several countries preparing a report summarizing the current physical state of the Arctic that will be submitted for peer-reviewed publication during 2006. This will be an update to the Arctic Climate Impact Assessment to include newer information not included in the ACIA.

Finally, CPO's program goals involve participating in public education and outreach. The NOAA Arctic Theme Page (www.Arctic.noaa.gov) is a mechanism for describing NOAA's Arctic programs and for providing a scientific resource to the public.

April 19, 2006

OPP Budgetary and Operational Issues

Before discussing the Office of Polar Programs budget, **Mike Van Woert**, Executive Officer, Office of Polar Programs (OPP), introduced Simon Stephenson as the new science or section head for Arctic science. In the FY '06 budget, OPP has a solicitation out for IPY that closes May 1 at which point Van Woert feels OPP will have a better idea of what research is being proposed. However, there are four general solicitation themes that include

- ice sheet dynamics and stability
- Life in Extreme Environments and Prolonged Darkness
- Arctic Observing Network
- education and outreach that is a joint between the Office of Polar Programs and NSF's education directorate.

Van Woert identified a $20 million proposed increase for Arctic research in FY '07 so the budget would go from roughly $70 million up to just about $90 million. This number includes approximately $8.3 million for the Arctic Observing Network and $1.46 million in for the Bering Sea ecosystem study. He also noted that he first year of the BEST Program proposals are currently in panel and were allocated $1.46 million in the budget. OPP also has inserted $9 million for mostly Alaska infrastructure, primarily for upgrading the facilities at Toolik Lake. Funds are also available to develop instrumentation through the Barrow global climate change research facility and to upgrade the power line. Van Woert believes it will be an exciting time for Arctic research over the next couple of years. He also mentioned the vacated post that had been filled by Charles Meyers and that OPP is determining how best to manage that position and its associated duties. The OPP recently completed the eleventh bi-annual report of the IARPC and also responded to a request from Senator Murkowski concerning a breakdown for FY '06 appropriations and planned '07 appropriations.

The Commission then held a lengthy discussion with Van Woert and Stephenson about the funding and operational strategy for a number of OPP/NSF programs BEST, ARRV, polar ice breakers, cooperation of ISAC and COMAR, IARPC, functionally of IARPC.

Arctic Research and Logistics

Simon Stephenson, Section Head for Arctic System Science, OPP, discussed the areas of emphasis of NSF's Arctic research logistics: approach, access, maintaining and increased long-term observations. There is existing infrastructure in place and NSF is basically in a position in most of the Arctic to rent, lease, and borrow space from other people. NSF follows science and where the science proposals go, so it wants to remain actually fairly agile and flexible. For the most part, it does not want to build a big infrastructure and say it will build research programs around this site or on this facility. The Healy coming

online really changed NSF's program and it tries to base its approach on good relationships with those in other countries.

While most research projects are in Alaska (50%), many are being performed in other Arctic locations including Greenland. Even though NSF spends considerable time discussing larger facilities like Summit, Toolik Lake and Barrow, it is still in the business of supporting small research programs. One project involving safety provides medical help via a telemedicine unit based out of Anchorage. The project encourages and pays for field training, medical training and EMT activities. In the last six years, NSF has increased access to aircraft, particularly in Alaska, where it added aircraft support to a variety of projects. This access to airplanes has worked itself all the way through to the social science programs. Communications have also improved through use of iridium phones, V-sat and other communications systems. Collaboration with other Arctic countries has been mixed. Canadians cooperation has been outstanding with NSF, putting researchers on Canadian vessels regularly. Stephenson said that Europeans have been quite reluctant over these last six years to get on board mainly because a good deal of their focus has been on the Antarctic. That attitude is changing.

Marine Mammal Commission

Tim Regan, Acting Executive Director, Marine Mammal Commission (MMC), provided a broad overview of the history and purpose of the Commission. It was formed in 1972 in response to major issues involving commercial whaling, killing of harp seals in Canada, and deaths of millions of dolphins in Eastern Tropical Pacific tuna fisheries. Today, its science programs, which are congressionally directed, incorporate the effects of underwater sound, ecological role of killer whales, efficacy of research and recovery programs for the most endangered marine mammals, and future directions in marine mammal research. Specifically:

Sound in the Marine Environment—fund an international conference or series of conferences to share findings, survey acoustic 'threats' to marine mammals, and develop means of reducing those threats while maintaining the oceans as a global highway of international commerce.

The Ecological Role of Killer Whales—review available evidence regarding the theory that rogue packs of killer whales are wiping out discrete populations of the most endangered marine mammals."

Effectiveness of Marine Mammal Recovery Programs—review the biological viability of the most endangered marine mammals and make recommendations regarding the cost effectiveness of current protection programs

Future Directions in Marine Mammal Research—identify and evaluate threats to marine mammals, develop research recommendations to further our understanding of these threats and devise methods to address them and generate creative, proactive approaches for addressing issues affecting the conservation of marine mammals and their environments.

The MMC is involved in Arctic research activities including analyzing the effects of diet and predation on Arctic marine mammals including Bowhead Whales, polar bears, Steller Sea Lions, sea otters, Killer Whales, walrus and Western Gray Whales and the effects of climate change.

Coast Guard Role in the Arctic

Jonathan Berksen provided a status of the Arctic-related vessels. The Polar Sea is going through some maintenance work to sustain it operationally for the next two to four years depending on ice conditions. The *PolarStar* is in caretaker status, which means that the number of crew will go from 134 to 34, a reduction of 100 for a period of 18 months while the Coast Guard awaits the final national policy decision on icebreakers. The Healy has got a full schedule. It is departing at the end of April for cruises in the Arctic.

The future of icebreakers rests on the National Research Council icebreaker study. The Coast Guard expects this study to help clarify the long-term polar icebreaker needs and will likely suggest the need for more polar surface assets. In combination with the study, the Coast Guard is working with the Administration to initiate a national security presidential determination concerning icebreaker needs following the release of the report. In addition, Berksen quoted Commandant Admiral Collins' statement to the icebreaker committee that "the nation needs a polar icebreaking capability and the Coast Guard is the right agency to provide this service but it needs to be properly funded." The Coast Guard prefers to have the budget under its own authority but it is unsure whether or not it will happen in '07.

The Commission discussed a number of issues in relationship to budgetary and operational shortfalls including mapping, crewing models and connectivity in relationship to the availability of ice data.

AICC and Icebreakers

Margo Edwards, University of Hawaii, Arctic Icebreaker Coordinating Committee (AICC) Chair, outlined the purpose of the AICC which is to provide polar science projects with planning and scheduling assistance, facilitate communications between scientists, science funders and facility providers, provide oversight and advice to the UCSG for the purpose of enhancing facilities and science aboard their icebreaker fleet, solicit, synthesize and present the needs of the Arctic science community to the Coast Guard and promote new technology for Arctic assets in order to maintain cutting edge capability for these facilities.

Edwards discussed the steps AICC took to make needed improvements in research and data gathering methods on the Healy. These included new equipment for the main lab, maintaining the warmth of water samples and gathering data from the ship's sensors.

Results from recent field programs aboard the Healy included collecting 470 meters of sediment core—a record for the Arctic, photographing "bugs" under the ice and conducting multi-channel seismics from the back deck of the Healy. These and other programs will continue throughout 2006.

The Commission discussed several safety issues including the lack of properly trained medical personnel onboard the Healy, especially in conditions as severe as the Arctic. Commissioners also addressed the safe use of helicopters on icebreakers, whether they should be commercial Coast Guard operators, and the number needed to adequately serve an icebreaker.

Edwards also addressed the new ocean observing initiative systems and how scientists will be able to make measurements of an area to determine how it changes through time. However she questioned where the money to maintain these systems will come from surmising they might be coming out of science and logistics budgets for ships.

Potential *Report on Goals and Objectives for Arctic Research* Topics

- IPY Follow-on/Legacy (~ beyond the 2 years of IPY)
- No long-term ecosystems and ocean observations/studies
- Disappearance of Arctic Specific Programs – USARC questions for ONR, NOAA, NASA and other agencies
- Reduce/Eliminate 'Earmarks' for Arctic Research
- Magnusson-Stevens Act ~ Research Agenda
- Make IARPC Function
  - Interagency Funding and Coordination
- Sustainability of Programs
  - North Slope Science Initiative (NSSI)
  - Key Infrastructure Issues for Barrow Lab
- Integration of Major Programs:
  - Arctic Observing Network (AON)
  - Alaska Ocean Observing System (AOOS)
  - Ocean Research Interactive Observatory Network (ORION)
- Long Range Science Plan for ARRV
- More IARPC
  - NSF response to Senator Murkowski and Agency responses to NSF (several missing agencies!)
  - Culture/responsiveness to ARPA Act
- Agency Arctic Focus/Programs
  - How agencies respond to earmarks
  - USARC communications with agencies
- USARC work with other commissions: examples Marine Mammal Commission, Canadian Polar Commission
- Outreach/Education Components
  - Integrate Arctic & Bering Sea activities
- Integration
  - Observing Systems
  - Monitoring/Modeling
- Bering Sea Issues ~ holistic/integrated research
  - Ecosystems (Large Marine Ecosystem approach)
  - Integration
  - BEST/AFSC/NPRB

- NPRB – Example of Long-Range Integration of Bering Sea Studies (a start)
- NAS – Long Range Plan for Arctic Research beyond IPY
- AON Report from the Polar Research Board
  - Accepted by NSF
  - Must tie to GEOS/others ~ More Agencies Involved?
  - Marketing
  - Legacy of IPY
- Infrastructure – Sustainability (Especially IPY follow-on years)
- IPY – US Roles/Responsibilities
  - Agencies Beyond NSF ~ potential USARC Statement
  - USARC Kickoff/Roles & Opportunities
  - Website – Links to IPY
- Previous Goals – How did we do with past reports?
- Human Resources
  - Needs
  - Concerns
  - Health Issues
  - Security
  - Life-saving Issues
  - Communications Issues (Federal, State, Local)
- Energy Research
  - Alternative Energies
- Technology
  - Ice/Oil Spills
  - River/Ocean
- National Research Council (NAS) – Arctic Economic Potential Study
- Icebreakers – National Assets
- Support to US lead in Arctic Marine Shipping Assessment
  - Regional Bering Strait Studies: Sea ice, regional economics
- History of Arctic Research [Potential Illustration/Table]
- Arctic Policy Group (APG) - Broader than Arctic Council issues
  - Review US Arctic Research Policy
- Law of the Sea Issues
  - UNCLOS Article 76 ~ Mapping
  - UNCLOS Article 234 – US Response to regulatory regime for vessel traffic
- Capacity – Building in Arctic Research
  - Arctic Research Community & Rural Communities
  - Involvement of Secondary Schools, Universities, Education
- Language Preservation in the Arctic
- Communications throughout the Arctic
  - Improved Satellite Coverage and Sensors
- Continued Declassification of Arctic Submarine Data
- OPA – 90 Research
- Resource Assessment (how to emphasize)

US ARCTIC RESEARCH COMMISSION
80TH MEETING
27-29 June 2006
North Slope Borough (NSB), Barrow
North Pacific Research Board, Anchorage

In attendance:

Commissioners

Mr. George Newton, Chairman
Mrs. Michele Longo Eder
Mrs. Mary Jane Fate
Mr. Duane Laible
Dr. Thomas C. Royer
Dr. Susan Sugai
Mr. Mead Treadwell

Staff

Dr. John Farrell, Executive Director **Dr. Lawson Brigham, Deputy Executive Director**
Kathy Farrow, Publications

Attendees in Barrow

Harry Brower, North Slope Borough; **Lewis Brower**, BASC; **Bob Bulger**, BASC; **Bernard Coakley**, University of Alaska, Fairbanks (UAF); **Leslie Eaton**, Pfizer R&D (former position); **Kirsten Eaton**, UAF, Fairbanks; **Taqulik Hepa**, NSB; **Larry Hinzman**, UAF, Fairbanks; **Richard Lanctot**, US Fish and Wildlife Service (USFWS), Anchorage; **Emerald Laija**, BASC; **Doreen Lampe,** NSB; **Anna Lijedahl,** UAF, Fairbanks; **David Lin,** University of Texas at El Paso; **Tom Lohman,** NSB; **Bessie O'Rourke,** NSB; **George Olemaun,** NSB; **Brian Person,** NSB; **Cheryl Rosa,** NSB; **Glenn Sheehan,** BASC; **Heather Smith,** University of Washington; **Alfred Teerik,** NSB; **Blake Trask,** University of Washington

Attendees in Anchorage

Kristina Baiborodova, Institute of the North; **Rudy Brueggemann,** Canadian Consulate; **Douglas Causey,** UAA; **Phil Cutler,** Institute of the North; **Ben Ellis,** Institute of the North; **Laura Furgione,** NOAA/NWS; **Karen Gillis,** Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative; **Steven Heimel,** Alaska Public Radio Network; **Nancy Hemseth,** Institute of the North; **Brian Jackson,** Alaska Ocean Observing System (AOOS); **Rosa Meehan,** USFWS; **Hans Neidig,** DOI; **Walter Parker,** CITF/ ION/BSF; **Richard Reich,** BTS Professional Services; **Dennis Thurston,** Minerals Management Service; **Jeff Welker,** UAA; **Molly McCammon,** AOOS; **Ken Taylor**, North Slope Science Initiative; **Clarence Pautzke,** NPRB.

June 27, 2006, Barrow, Alaska

After **George Newton, Commission Chair**, called the meeting to order and the Commission approved the current agenda and minutes from the 79th meeting, George Olemaun, the borough's chief administrative officer, welcomed the Commission to Barrow on behalf of the town's mayor, Edward Itta.

Welcome

Olemaun discussed the long-term linkage of science and traditional knowledge throughout Barrow's history, especially since the 1940s when the Naval Arctic Research Lab was built. And while the Iñupiats have always relied on their own record of observations about the natural world—seasonal weather patterns, ice conditions, animal migration, habitat changes—science has played a key role in their survival because the culture is so deeply dependent on the Arctic environment. The borough, through its frequently emulated Science Advisory Committee, has conducted research on its own for over 30 years, mostly in the area of wildlife management. The research has identified and monitored threats to their subsistence way of life. The borough was also instrumental in founding and guiding the startup of the Barrow Arctic Science Consortium (BASC). In addition, the Barrow Village Corporation has started its own science division, the focal point of which is a program titled Schoolyard Saturday that brings together scientists and educators with local students and the community to understand the long tradition of cooperation between the Iñupiat people and visiting researchers. Olemaun requested that the Commission support efforts to secure Congressional funding for the construction of the Barrow Global Climate Change Research Facility (BGCCRF) until it is completed and operational.

Chairman's Report

Newton gave a report of his activities since the Commission's most recent meeting in April, 2006.
4/23-26—Traveled to St. Petersburg, Russia, to give an invited presentation at the Arctic Shipping Conference on the proposed expansion of the Worldwide Navigation and Warning Service (WWNWS) in the Arctic Ocean...
4/28—Met with National Science Foundation's (NSF's) Dr. Karl Erb to discuss a gathering of senior officials for an Interagency Arctic Research and Policy Committee (IARPC) meeting and Commission support for such an activity. Erb asked for IARPC agenda items. (The Commission's list of agenda items can be found at the conclusion of these minutes.)
5/3—Attended a farewell reception at the State Department for Ray Arnaudo
5/3—Met at the USARC offices with Vladimir Shelykov, Russian Economic Counselor, at the Russian Embassy. He was interested in learning about the Arctic Shipping Conference.
5/5—Interviewed by Steve Barnett, New York, for an internet radio broadcast on climate change in the Arctic.
5/10—Met with Bill Woolf and James Wemyss of Senator Murkowski's office to discuss research matters in Alaska.
5/12—Met with **Executive Director John Farrell** to discuss USARC activities.
5/24—Attended the Arctic Research Consortium of the United States (ARCUS) Annual Meeting.
5/30—Together with Dr. Bernie Coakley, Newton briefed Rear Admiral (RADM) Jerry Ellis (N973) at the Pentagon on the need for a nuclear submarine to conduct bathymetric surveys in the Arctic. Ellis asked that Bernard Coakley and Newton brief his boss, RADM Joseph Walsh. The next day, Coakley met separately with NSF's Simon Stevenson, and Wemyss, to deliver the same brief.
6/1-2—Traveled to Halifax, Nova Scotia, to be part of the US delegation, meeting with the Canadian representatives, to discuss WWNWS expansion. Gave a presentation on the rationale of protecting research equipment and ships from damage.

6/9—With Bill Woolf, and a staff member from the Senate Government Affairs Committee, met with staffers from the House Science Committee to discuss the need for additional authorized workdays for the USARC Chairman.
6/8—Attended the Polar Research Board's meeting with the Executive Director.
6/12——Met with RADM Dick West (retired), president of Consortium for Oceanographic Research and Education (CORE).
——Met with the Executive Director and Emma Duncan, Deputy Editor of *The Economist* magazine, to discuss Arctic climate change. The magazine will publish a 15,000-word special section in the September issue. **Deputy Executive Director Lawson Brigham** also met with her when she visited Anchorage.
6/13-14—Attended a "Northwest Passage" conference in Ottawa as an invited panelist. The conference attracted high level attendees and was sold out. Representatives from the US Embassy were present.

Commissioner Reports
Commissioner Susan Sugai had no direct Commission-related activities to report since the last meeting but discussed her participation in the selection of proposals to be supported for a second cruise to the Northern Bering and Chukchi seas as part of the Russian-American Long-term Census of the Arctic (RUSALCA) Program. RUSALCA is focused on gathering long-term observations to develop an understanding of the causes and consequences of the reduction in sea ice cover in the Northern Bering Sea and the Chukchi Sea in the Arctic Ocean. The proposals were submitted to conduct studies of primary productivity, higher trophic levels and related hydrographic measurements including dissolved oxygen, pigments and nutrients, or to conduct modeling work in the study area using RUSALCA data and to provide products that can be used in diagnostic studies and in the design of sampling strategies. The work would begin in 2007 or 2008 for a period of up to five years.

Commissioner Mead Treadwell asked whether the climate models in RUSALCA focused on the accuracy of global climate models. **Sugai** replied that the models were regional in scale.

Commissioner Duane Laible chaired a meeting of the USARC Task Force on research needs related to Arctic marine transportation. **Treadwell** and **Lawson** participated as well. The task force compiled an outline for a report covering this transportation issue. Future meetings will be held in Banff and Seattle. Laible also attended the spring meeting of the Marine Board, which was scheduled to appoint a study committee to assess the economic impact of increasing marine transportation in the Arctic. The Board is supportive and has requested that the Executive Committees of the Transportation Research Board and National Research Council approve that appointment. He also attended the National Academy of Sciences (NAS) Icebreaker meeting in Washington DC. He found little support for a Service Life Extension Program (SLEP) of the Polar Sea but strong support for the idea of a national icebreaker presence. The Committee on the Assessment of US Coast Guard Icebreaker Roles and Future Needs did not reach consensus on several important issues and will have to meet again for another drafting session.

Newton, **Laible** and **Brigham** exchanged several comments on Coast Guard's role in operating ice breakers. **Treadwell** asked if the NAS report would likely comment on whether the US icebreaker *Healy* should be refit or replaced. **Laible** said that if the Coast Guard regains control of their budget, he was confident that it would take the appropriate action. *Healy* will continue to be used as major ice-breaking vessel for the US as long as there is a demand for it, which he believes exists. **Newton** added that the Coast Guard Commandant said he will do what it takes to take care of the *Healy* over next few years.

Commissioner Michelle Eder met with the Oregon congressional delegation concerning important Arctic matters including icebreakers and the Alaska Regional Research Vessel (ARRV). She was also asked to submit an article for *National Fisherman* concerning the Law of the Sea Treaty.

Commissioner Tom Royer participated in a teleconference with *The Economist's* Emma Duncan. He remains active in the North Pacific Research Board (NPRB)-affiliated Gulf of Alaska Integrated Ecosystem Research Program (GOAIERP). Its objective is to develop a new NPRB Initiative for the Gulf of Alaska that will begin with a blend of existing data possibly with FY07 proposal solicitations. It is patterned much like the Bering Sea Integrated Research Program. He attended a meeting of the NPRB Ecosystem Modeling Committee where guidelines for model evaluations were developed and the upcoming Request for Proposals for modeling was discussed and further developed. As a representative of the Scientific and Technical Advisory Committee (STAC) of the Exxon Valdez Oil Spill Trustee Council (EVOSTC), he presented testimony advocating the continuation of the long-term ocean monitoring program in the spill area. The Trustees issued their FY07 Invitation for Proposals on June 1, 2006 that focused on damaged resources, in particular, herring and lingering oil. Long-term ocean monitoring was not included in the call for proposals. He also attended the Scientific and Technical Committee of Oil Spill Recovery Institute (OSRI) meeting to discuss the upcoming activities for 2006-7. A major ongoing activity is the fieldwork and modeling effort for Prince William Sound. This is in conjunction with the Alaska Ocean Observing System (AOOS). There were some current mooring failures within the sound last year but most of the equipment was recovered. A joint drift experiment will be conducted next summer with AOOS using the Coastal Ocean Dynamics Applications Radar (CODAR) installation in the sound to obtain the surface currents and satellite tracked drifters. The joint programs with the University of New Hampshire's (UNH) Coastal Response Research Center (CRRC) and Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) have not been successful and will be discontinued. The joint-funding program with NPRB will continue.

Treadwell also attended the marine transportation task force described above. Treadwell met with Dan Colussy, Chairman and Chief Executive Officer of Iridium Satellite LLC, with whom he discussed communications challenges regularly faced on board *Healy*. Colussy said they were about to open a new ground station in Fairbanks, Alaska, which would improve and extend performance. **Newton** underlined the importance of Iridium communication and asked for Colussy's contact information so that he could encourage him to meet with appropriate counterparts in DC. Treadwell attended several meetings in Alaska with Senators Murkowski and Stevens. He gave input on Murkowski's speech to ARCUS. Murkowski is keen to see that IPY is funded and supported. Arctic environmental monitoring efforts are important to her. **Treadwell** has been in contact with Army, Air Force and the National Reconnaissance Office about holding a conference on the Cold War history of the Arctic. The purpose of meeting with these officials was to identify the facilities that were used in the Cold War and to establish the missions that were conducted to identify data sources for declassification efforts. Much information is cloistered away. He also gave various talks on behalf of the USARC to: KJDO radio, National Parks Foundation and Alaskan Conservation Center. He attended a retirement ceremony for Byron Mallott, head of First Alaskans Institute. He held discussions with Stu Nosett regarding potential use of Alaska as an analog for lunar or other planetary bases. **Treadwell** stated that airlines and ocean vessels should collect meteorological information in the Arctic.

Commissioner Mary Jane Fate suggested to Treadwell that Alaska Airlines collects reams of data. She discussed efforts to improve the economy of the Yukon River drainage basin, retention and promotion of jobs, the urgency of opening the Arctic National Wildlife Refuge (ANWR) to

drilling, and how the high cost of gas affects transportation issues and the social structure of high latitude native peoples.

Staff Reports
Farrell was introduced as new executive director of USARC. He explained his role and his initial attempts to understand the programmatic emphasis and priorities of the Commission as well as its budget and administration.

Brigham discussed the Arctic Monitoring and Assessment Program's (AMAP's) oil and gas assessment and the North Slope Science Initiative concerning remote sensing technology. He also met with Duncan of *The Economist*. He made two presentations to Minerals Management Service (MMS) and US Geological Survey (USGS) regarding the Arctic Marine Shipping Assessment.

Mayor's Greeting
Barrow's **Mayor Edward Itta** welcomed the Commission to Barrow and emphasized the Borough's interest in science. His administration is committed to working with BASC.

Barrow's Support for Science
After introducing members of the BASC team, including Harry Brower and Bob Bolger, **Glenn Sheehan**, BASC, provided the Commission with an overview of the BASC program and its cooperative arrangement with the Barrow community. Barrow's native people have donated 7,466 acres of their lands zoned as scientific research districts. In turn, BASC assists local scientists in accomplishing logistics, permitting, and other concerns. At the time of the Commission's visit, there were 200 active scientific studies underway in Barrow, 130 of which are affiliated with BASC. The native community's people, particularly its students, work alongside scientists on a variety of projects including erosion issues that are decimating the town's beaches, a few of which hold more than 100 endangered gravesites.

Sheehan also discussed the currently under-construction BGCCRF. Phase one of the facility is expected to open in March 2007, with $18 million of the required $61 million total thus far provided. Sheehan encouraged the Commission to seek Congressional support for the remainder of the funds.

Information Technology (IT) in the Arctic
Robert Bulger discussed the growth of IT in Barrow to its current status as a fully operational infrastructure. Despite this achievement, communications in Barrow remain a difficult issue. BASC has the only non-synchronous T-1 line in Barrow that operates at a cost of $12K per month. The same technology in Florida would run around $1,200 per month. At the same time, there is a research need for a T-3 line in Barrow which will cost approximately $15K a month. Bulger and the Commission then discussed a variety of related issues concerning communication latency and other IT-related matters, data management and data archiving and use of existing facilities for scientific research by non-US investigators.

ACTION: **Treadwell** moved that the USARC thank Congress for helping to develop the Barrow Global Climate Change Research Facility, and for helping to develop American Arctic science. In conjunction, the USARC expressed support for timely funding of the remaining construction phases of this 21st century science support facility. The motion was approved unanimously. Newton and Treadwell said they would discuss the formulation of an appropriate letter consistent with this motion.

Barrow Whaling Interests

Harry Brower, Alaska Eskimo Whaling Commission (AEWC), discussed a Bowhead whale population that is healthy and growing. He stated that during the 2005 bowhead whale subsistence hunt, 68 whales were struck and 55 were landed for an efficiency rate of 81 percent. This is slightly higher than the 10-year average efficiency rate of 79 percent. He also discussed the cooperation between the hunters and research scientists. Despite significant sacrifice, the hunting crews have given meat, muktuk, organs and other parts of the whales that they have caught for subsistence purposes to scientists seeking research materials as a sign of the indigenous population's commitment to research being conducted in their communities. Other cooperative efforts include an agreement by the AEWC to allow a whale-tagging project to go forward.

Managing Whalers' Interests

Tom Lohman, attorney for AEWC, discussed the environment in which whalers work, live and cooperate with science. He emphasized the native knowledge resource and its importance. He mentioned how whalers have worked collaboratively with organizations such as the US Minerals Management Service (MMS), oil companies, and other entities to protect whales, and to review research proposals submitted to MMS to explore for oil and gas deposits. The latter has proven to be difficult, particularly during the short, fall hunting season. The Whaling Commission is often overwhelmed by the proposal process that requires consideration of incomplete proposals while, at the same time, ensuring protection of the whale ecosystem. The USARC discussed whaling quotas, tagging, and the inclusion of whales in the WWNWS. **Laible** asked about the whale take, comparing the spring and fall hunts. Brower said that more are taken now in the fall, a change from prior years.

Cabled Seafloor Observatories

Bernard Coakley, University of Alaska Fairbanks (UAF), discussed telephone-cabled seafloor observatories that are being developed worldwide and how they can assist in data collection, environmental observing, and monitoring in ways unachievable by ship or other means. He said the Arctic is an ideal location for such an observatory given the challenges of conducting marine operations in this harsh environment. Barrow, in particular, presents an excellent opportunity for an observatory because of the heterogeneity of environmental conditions and Barrow's supply of instrumentation and infrastructure. He discussed the concepts of installing, operating and maintaining the observatories in the presence of sea ice which, as a prerequisite, requires the need for pre-installation mapping of the ocean floor and geophysical site surveys to properly design and site an observatory. An observatory program would have the potential for connections with the BGCCRF, to support Study of Environmental Arctic Change (SEARCH) monitoring, to capture Ocean Observing Initiative (OOI) funding for Arctic research, and to building on observatory technology developed elsewhere.

Newton asked about locations and the placement of cable beneath the seabed in light of ice gouging that could sever cables. Coakley indicated that depending on whom you talk to, gouging can be a problem offshore to as much as 4-5 km out and 60 m deep.

International Arctic Research Center and Permafrost Research

Larry Hinzman discussed International Arctic Research Center's (IARC) international coordination and integration activities in relationship to observing, modeling, process studies and data analysis. Modeling activities include establishing the rates of change in multi-year ice with the most dramatic warming occurring in the Arctic basin. IARC also hosts summer schools that bring together advanced modelers to look at various climate modeling, terrestrial system and sea ice data. The Center intends to become more of an international synthesis center—conducting and facilitating studies and coalescing research results, feedbacks and thresholds. It wants to improve quantitative predictions that require integration and synthesis across the board.

The Commission raised several funding questions including the amount of long-term support that the Japanese Marine Science & Technology Center (JAMSTEC) is providing to IARC. Currently, NSF and other federal sponsors provide approximately $5M per year and JAMSTEC provides $3M. Hinzman was confident that Japan's contribution would continue, long-term.

Drying of the Arctic Tundra

David Lin, graduate student at the University of Texas at El Paso, spoke about a biocomplexity project being conducted in conjunction with the Barrow Area Information Database—Internet Map Server (BID-IMS). The project measures the response of Arctic tundra carbon balance to warming and drying across multiple spatial and temporal scales. Lin and colleagues are trying to answer the question: "How does soil moisture control ecosystem structure and function?" They are attempting to understand biological and physical processes, ecosystem carbon balance and variation over space and time.

BAID-IMS is designed to help scientists, land managers, educators and the local community access spatially relevant information for northern Alaska. In addition to hosting information on current and historical research sites and infrastructure, BAID-IMS provides free access to satellite imagery and other remote sensing products, topographic maps, land ownership information and local infrastructure that facilitates research and science communication.

Measuring Atmospheric Radiation

Mark Ivey, Department of Energy (DOE), discussed the Atmospheric Radiation Measurement (ARM) Program's development of several highly instrumented ground stations for studying cloud formation processes, their influence on electromagnetic radiation transfer and for measuring other parameters that determine the radiative properties of the atmosphere. How much radiation comes in to Earth's system and how much goes back out as long-wave radiation? ARM wants to better understand clouds their impacts on climate models. This scientific infrastructure, and resultant data archive, is a national and international asset for advancing scientific knowledge of Earth systems. To provide more research capability for the global scientific community, ARM's field research sites are now being made available for use by scientists worldwide through the ARM Climate Research Facility (ACRF) in Barrow, the southern Great Plains, tropical western Pacific region, San Francisco and Niger. The ACRF will potentially contribute to a wide range of interdisciplinary science in areas such as hydrology, ecology and weather forecasting.

Treadwell asked about the Department of Energy's limited commitment in Alaska and the Arctic in general. Ivey said that this is a large program within DOE ($30M per year). Aerosols in the Arctic are becoming a hot research topic. Their original mission was 10 years, but they have extended beyond that. **Royer** said that long-term monitoring is of critical importance.

Shorebird Research

Richard Lanctot, USFWS, is the shorebird coordinator for the state of Alaska. He discussed the active breeding habitat for shorebirds in Alaska.

http://alaska.fws.gov/mbsp/mbm/shorebirds/images/Rock-Sandpiper.jpgUp to 71 species of shorebirds have been identified in Alaska, more than in any other state in the U.S. The density of shorebirds has increased two to three times this year as compared to prior years. However, only 16 of those species are increasing in number, likely due to predators/prey relationships, lemming cycles, other herbivores and climate change. Increasing oil and gas activity also impacts shorebird populations. USFWS is currently involved in comparing nests/territories and plotting them through time as well as banding adults and juveniles to determine survival rates and site fidelity. USFWS is also monitoring birds through radio telemetry and investigating the possibility and potential of avian influenza at three breeding sites and six post-breeding sites spread throughout the North Slope.

Monitoring Wildlife on the North Slope
Taqulik Hepa, North Slope Borough Department of Wildlife Management (NSBDWM), gave an overview of the NSBDWM and its personnel and funding assets. The department is now managing 30 grants. Currently they are studying several native species including bowhead and beluga whales, caribou and waterfowl. The department needs to gather considerable baseline data on these species in order to understand the impact of oil and gas production in the area.

Robert Suydam, NSBDWM, added that one of the major research priorities of the Borough is the bowhead whales and their reaction to oil and gas activities on the North Slope. A significant concern is that there is no Bureau of Land Management (BLM) office on the North Slope, despite the fact that much of the land is federal. He echoed Hepa's position that more research is needed as a baseline before further development is considered and that requires opening a federal office that includes representatives from the Department of the Interior.

Public Comment for Report on Goals and Objectives for Arctic Research—6/27/2006
Newton began this portion of the meeting by providing guidelines and background regarding why the Commission seeks public comment. Every two years, the USARC is required to submit to Congress and the President the *Report on Goals and Objectives for Arctic Research.* This next report is due January 31, 2007. The report forms the basis for review by IARPC for an update to the 5-year Arctic national plan and to encourage funding for the highest priority goals. The Commission interacts with the Arctic research community in a variety of settings, including public meetings, invitations to speak and public comment. Over the years USARC has selected five high-priority goals. The 2005 report featured:

- Arctic region and global environmental change
- Bering Sea
- Health of Arctic residents
- Natural resource assessment
- Improvements in civil infrastructure

This year, in an effort to be more inclusive, USARC is holding two public hearings, in Barrow and Anchorage, Alaska. Preparation of the *Goals* report is a consensus endeavor of the Commission.

The Commission heard from **Doreen Lampe** who spoke about two issues of concern to her and the Barrow community at-large.

The North Slope Borough was conveyed a parcel of federal land at Cape Simpson that had been a Defense Early Warning (DEW) line site. The land apparently contains soils that are chemically contaminated. Lampe alleges that the Federal government has not yet taken responsibility for cleaning up the site, leaving it to the Borough to manage. The clean-up costs are more than the Borough can assume.

Sheehan added that the land, contaminated or not, had some remaining buildings which the NSB would like to keep and use. However, the US Navy has planned to dispose of them. He asked the Commission to encourage Congress to transfer the buildings to the NSB.

Lampe also addressed advancing oil spill response in ice covered waters and challenged the Commission to muster responsible parties to manage these spills. She also encouraged financial support for travel needs in order to ensure participation by representatives from the general public in any future workshops on this matter.

June 29, 2006, Anchorage, Alaska

Data on Pacific Walrus

Rosa Meehan provided an overview of the recent Pacific Walrus Survey conducted by the US Fish and Wildlife Service (USFWS). The survey, set up to satellite tag walruses throughout the Arctic and collect scientific information about them, was carried out using two ships, including the Russian icebreaker Magadan, and three airplanes that worked in a coordinated fashion. An aerial survey measured thermal scanning, photography and group size assessment while the vessel-based operations estimated the proportion of the population in the water and unavailable for counting by thermal imagery. Despite the intended collaborative arrangement with Russia, the Russians would not allow her team to perform survey work in their national waters. Native peoples, on the other hand, were willing participants and did help significantly on the expedition. Since she has just returned from the field, little data have been collected. 46 tags, that are designed to work for 60 days or longer, provide position information. Dive depth and dive duration are the next aspects Meehan will study. Meehan also told the Commission that the next big focus of USFWS research will be on the management of polar bears at the Chukchi and Beaufort seas.

Fate asked whether Meehan has any arrangements with native hunters to share information. Meehan acknowledged that her team held meetings with the native communities to keep them aware of research activities. She also said that USFWS gathers information on harvests from native communities. She noted that the native people are very concerned about ship movements.

Newton encouraged Meehan to compare data from 2006 with that collected in 1990 in order to obtain a more complete picture.

Treadwell suggested that Meehan communicate to the Commission in the form of a letter about how it could best help the USFWS, explaining that the Commission has had the Bering Sea as a focal point for some time.

Royer recommended that Meehan consider using very high resolution and infrared weather satellite data since they could be helpful in conducting these surveys.

Preserving Salmon for the Future

Karen Gillis discussed the Arctic Yukon Kuskokwim (AYK) Sustainable Salmon Initiative (AYKSSI) and its purpose to develop and implement a research plan to better understand the causes, declines and recoveries of AYK salmon. Since 2002, AYKSSI has been appropriated $21 million through a partnership that includes the Association of Village Council Presidents, the Tanana Chiefs Conference, Kawerak, Inc., Bering Sea Fishermen's Association, Alaska Department of Fish and Game, NOAA Fisheries, US Fish & Wildlife Service, plus additional native, governmental and NGO ex-officio partner institutions. AYKSSI has distributed $5 million in grant monies and expects to give out another $4.5 million in the coming year. By 2012, AYKSSI will have expanded knowledge to assure sustainable uses of wild salmon for future generations. They want to develop a self-sustained and coordinated effort that continues into the future, co-managing the effort with local communities.

Fate stated a concern that private industries are involved with this native people's issue. She thinks there is not enough monitoring of industrial participation, and what there is comes too little, too late.

Eder applauded Gillis for this effort, especially for getting the concept of co-management in writing in the actual research plan. She identified this as a landmark type of mandate. The fact that the government agencies have signed off on this initiative is unique.

Royer noted that Gillis was humble about the $4.5M AYKSSI is distributing in 2007 through the RFP since, by comparison, NSF is only putting $2 million into the Bering Ecosystem Study (BEST) program.

Institute of the North
Ben Ellis, Institute of the North, gave an overview of the Institute's publications and provided a briefing on its Arctic Aviation project that analyzes the safety of flight paths using weather cameras. The Institute is in discussion with Canadians and Russians about radar and satellite information/capabilities. He also spoke about the Arctic shuttle container link from Adak in Alaska to Europe, and possibly Iceland. He discussed two routes that could be used in shipping through the Northern Sea Route and the two different sizes of cargo ships that are being considered. He emphasized that ice breaker support is required. Costs of this project still need to be analyzed. The ultimate goal is a connected Arctic.

Newton noted that USARC is pushing in Washington for two ideas linked to the Institute's interests. One is a proposed economic feasibility study by the Transportation Board of the National Academies of Science. The second, pertaining to the WWNWS, is the consideration of the role that buoys ice and whales will play in the warning system, as well as the need to create five new navigational areas in the Arctic.

Oil and Gas Assessment
Dennis Thurston, MMS**,** discussed the AMAP Arctic Oil and Gas Assessment. In essence, his group is attempting to create an environmental impact statement for the entire Arctic. They hope to finish by October 2006 for the Ministerial meeting in Russia. Thurston discussed the impact of oil and gas exploration, drilling and seismic work on the Arctic and the fact that those activities peaked in the 1980s. Production may increase now as will infrastructure activities, but only the Norwegians are increasing marine exploration.

In preparing this report, Thurston has faced three major challenges:
- the size or the amount of information to be compiled
- cooperation with other countries to achieve a balance.
- locating volunteer authors to write chapters has been very difficult, especially working with Russian authors. The US State Department dispatched a demarche to put pressure on, but it hasn't helped.

Treadwell asked about the exploration activity level in the Arctic, considering a USGS report that indicates 25 percent of remaining oil and gas is in the Arctic basin, and the results from the Integrated Ocean Drilling Program's Arctic Coring Expedition (ACEX) that found organic-rich sediments in the Eocene section of deep-sea cores from the Lomonosov Ridge, possibly indicating petroleum source rocks that might be deposited around the Arctic Basin at that geological time interval. Thurston said that the assessment does incorporate some of the information from the USGS report. Regarding ACEX, Thurston said the Arctic would become source rock targets of opportunity depending on the sedimentary sections around the basin.

North Pacific Research Board
Clarence Pautske gave the Commission an update on NPRB activities. NPRB's research funding runs $6-7 million annually, and is primarily directed at the Bering Sea/Aleutian Islands, Gulf of Alaska and the Arctic Ocean. NOAA, Alaska Fisheries Science Center and the University of

Alaska receive over 50 percent of the funds. Research categories comprise ecosystem studies, fish and invertebrates, habitat, humans, marine mammals, salmon and seabirds.

NPRB's focus is on integrative ecosystem research. The Board's first Science Plan will guide its funding decisions over the next 5-7 years. A Bering Sea study will run between 2007 and 2011 and will address questions related to:
- climate variability and change
- regulation of the production, distribution and abundance of upper trophic level organisms
- quantifying these processes and separating variability from climate and human intervention
- tying together the lower and upper food webs.

NPRB is increasing collaboration with NSF allowing them to work together more diligently. The Commission endorsed that position.

Newton commented on NPRB's status as a funding source and believes that they have gone from being the new kid on the block to one of the gorillas.

The Commissioners discussed the financial resources of the BEST study and the need to promote the program to NSF and IARPC and support a more cooperative spirit between NSF and NPRB.

Alaska Ocean Observing System
Molly McCammon, Alaska Ocean Observing System, expressed concern regarding the small funding opportunities available in Alaska considering its size when compared to other states. AOOS needs the Commission's help to secure more funding. They have received earmark funding and other options are pending. NOAA has offered appropriations assistance but because support for NOAA in Congress is mixed, it's a tough battle.
McCammon said the crucial funding needs relate to sea ice research, particularly in coastal areas. She gave the Commission a laundry list of AOOS interests and concerns involving collaborative partners, the status of observations, Bering Sea and Gulf of Alaska priorities and coastal erosion.

Farrell asked whether the AOOS had any links to the NSF's Ocean Research Interactive Observatory Network (ORION). McCammon said there were no direct links.
AOOS is constituting a sea ice working group in which **Brigham** is involved. The goal is to look at existing sea ice products for coastal Alaska waters and consider whether or not they can do more with existing satellite coverage.

North Slope Science Initiative
Ken Taylor discussed the progress of the North Slope Science Initiative (NSSI) updating the Commission on its history, objectives and activities and its oversight group's priorities.
- Complete NPRB software database of current research, inventory and monitoring efforts
- Develop GIS data management system in Geographic Information Network of Alaska (GINA).
- Update NSSI web portal information
- Develop implementation plan
- Identify priorities for Science Technical Group
- Secure funding to proceed with priorities

Taylor discussed the possibility for future funding and met with Alaska Senator Ted Stevens who is interested in creating a funding stream like NPRB's Dinkum Sands funds. He said that with that type of funding, annual appropriations are not required. Taylor put together a draft bill similar to what created NPRB. Without a long-term funding source, the NSSI won't thrive. The Commission then discussed other funding options.

Royer asked whether they had considered having the National Research Council review a NSSI science plan. Taylor indicated that at some point they would like to do so.

Access to Meteorological Data
Laura Furgione (NOAA/NWS) gave a brief presentation on automated weather reports from aircraft and the ability to acquire meteorological data from aircraft. There are six regions in the country in terms of NWS and Alaska is one of them. They are keen to increase participation in this program and consider that likely since the programs budget is on the order of $0.5 million per year.

Public Comment for Report on Goals and Objectives for Arctic Research—6/29/2006

Douglas Causey, Associate Provost at University of Alaska Anchorage, noted that in an atmosphere of structural change at the University of Alaska, they have had to identify their strengths which are: Native Alaska Health—delivery of services, avian influenza, Arctic ecology vs. Arctic biology, the planning effort for the NSF National Ecological Observatory Network (NEON) program with particular emphasis on tundra and taiga (boreal forest), and Arctic engineering, with a special focus on erosion.
Jeff Welker (UAA) spoke to the USARC about ecosystem research being conducted at UAA and asked for the Commission's support for the NEON program at NSF, the Tundra and Taiga NEON regions and the International Polar Year.

Wrap-Up
The Commissioners discussed a variety of issues and action items that resulted from this three-day meeting.

• Arctic Research is broken—the way it is funded does not work. There is a change in funding climate—too many earmarks. NSF funded one-third of the research proposals it received three years ago, now it has dropped to funding one out of 10. The problem is that there are an increased number of people looking for fewer dollars.

• The Commission wants to draft a meeting schedule for the next six to nine months.

• The Commission has to respond to the Budget Letter provided by NSF's Michael van Woert at the April meeting of the Commissioners.

• The Commission must draft a letter to Pacific Marine Environmental Lab's Doug deMaster regarding Sue Moore.

Commission Research Concerns
In light of this discussion, Newton recommended that the Commissioners make a list of concerns to be presented at the next IARPC seniors meeting.

Newton
Permafrost research
BEST (Bering Sea is under funded)
NEON
Stove piping of all the various monitoring programs
Russian access

Brigham
Polar ship issue (*Aurora Borealis*. Will the US buy into it?)

Eder
Integrating the role of homeland security in Arctic Research (Coast Guard, and beyond?)
transpolar flights

Treadwell
Research infrastructure beyond ships
Research sustainability, Office of Naval Research program
IARPC effectiveness. Calendar of meetings, agenda
IARPC staffer should exist
Data declassification
Mapping

Sugai
Commitment to long-term funding of programs
Bering Strait mooring

Fate
Economy research
Oil and gas, spill and resource assessment
Avian flu
Access to the Arctic. Sea lane.

Royer
Mechanisms for coordinating research among NGO, state, and federal agencies/organizations
Science support for the ARRV
Identification of Arctic monitoring efforts
Data management is getting out of control
Clean up efforts. Oil spill research program. OPA90

Final Announcement
The meeting adjourned with George Newton announcing his retirement as Chair, having conducted or participated in 61 straight meetings of the US Arctic Research Commission.

Appendix B: Meetings and Other Activities During FY 2006

In addition to those meetings and other activities reported in the minutes, the Commission is represented, when possible, at the monthly meetings of the

- State Department's Arctic Policy Group
- Interagency Arctic Research Policy Committee's staff meetings
- *Ad hoc* Alaska Arctic Council Working Group.

The Commission's staff attends all meetings of the National Research Council's Polar Research Board and Ocean Studies Board. The Commission continues to attend the annual (spring) Arctic Summit Week, an international gathering of Arctic scientists coordinated by the International Arctic Science Committee.

Various commissioners and staff have participated, as the Commission's representative(s), at all meetings of the North Pacific Research Board. They have also participated in workshops for the development of a National Climate Change Program.

Several Commissioners and staff have attended meetings of the Arctic Council and meetings of the various working bodies under the Council:

- Emergency Prevention, Preparedness and Response working group (EPPR)
- Arctic Climate Impact Assessment (ACIA)
- Arctic Monitoring and Assessment Program (AMAP)
- Protection of the Arctic Marine Environment (PAME)
- Circumpolar Infrastructure Task Force (CITF) under the Sustainable Development Working Group.

In addition, Commissioners continue to attend meetings of the American Geophysical Union, and other science gatherings such as the

- Arctic Institute of North America
- The Oceanography Society
- US Permafrost Association
- Alaska Marine Science Symposium
- International Bering Sea Conference
- Biennial Meetings of the Advisory Board of the Law of the Sea.

Commissioners and staff also attended and presented at a number of individually sponsored meetings around the world including

- International Circumpolar Conference General Assembly, Barrow, Alaska
- 8th World Wilderness Conference in Anchorage, Alaska
- *State of the Arctic Workshop* at Woods Hole Oceanographic Institution, Woods Hole, MA (Staff contributed to the report issued by NOAA/PMEL)
- International Ice Charting Working Group (IICWG), Helsinki, Finland
- International Workshop on Arctic Sea Ice Thickness: Past and Present, Copenhagen, Denmark
- Alaska Forum on the Environment, Anchorage, Alaska

- Arctic Science Summit Week, Potsdam, Germany
- Institute of the North, Anchorage
- Regional Coordinators Meeting of the Northern Forum in Girdwood, Alaska
- World Wildlife Fund (WWF), Anchorage
- European Union's ARCOP (Arctic Operational Platform), Helsinki, Finland

Appendix C: The Arctic Research and Policy Act, As Amended

PUBLIC LAW 98-373 – July 31, 1984
Amended as
PUBLIC LAW 101-609 – November 16, 1990

An Act

To provide for a comprehensive national Policy dealing with national research needs and objectives in the Arctic. Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

TITLE 1-ARCTIC RESEARCH AND POLICY

SHORT TITLE

SEC. 101. This title may be cited as the "Arctic Research and Policy Act of 1984, as amended."

FINDING AND PURPOSES

SEC. 102(a) The Congress finds and declares that:

1) the Arctic, onshore and offshore, contains vital energy resources that can reduce the Nation's dependence on foreign oil and improve the national balance of payment;
2) as the Nation's only common border with the Soviet Union, the Arctic is critical to national defense:
3) the renewable resources of the Arctic, specifically fish and other seafood, represent one of the Nation's greatest commercial assets;
4) Arctic conditions directly affect global weather patterns and must be understood in order to promote better agricultural management throughout the United States;
5) industrial pollution not originating in the Arctic region collects in the polar air mass, has the potential to disrupt global weather patterns, and must be

controlled through international cooperation;
6) the Arctic is a natural laboratory for research into human health and adaptation, physical and psychological, to climates of extreme cold and isolation and may provide information crucial for future defense needs;
7) atmospheric conditions peculiar to the Arctic make the Arctic a unique testing ground for research into high latitude communications, which is likely to be crucial for future defense needs;
8) Arctic marine technology is critical to cost-effective recovery, and transportation of energy resources and to the national defense;
9) the United States has important security, economic, and environmental interests in developing and maintaining a fleet of icebreaking vessels capable of operating effectively in the heavy ice regions of the Arctic;
10) most Arctic-rim countries, particularly the Soviet Union, possess Arctic technologies far more advanced than those currently available in the United States;
11) Federal Arctic research is fragmented and uncoordinated a the present time, leading to the neglect of certain areas of research and to unnecessary duplication of effort in other areas of research;
12) improved logistical coordination and support for Arctic research and better dissemination of research data and information is necessary to increase

the efficiency and utility of national Arctic research efforts;
13) a comprehensive national policy and program plan to organize and fund currently neglected scientific research with respect to the Arctic is necessary to fulfill national objectives in Arctic research;
14) the Federal Government, in cooperation with State and local governments, should focus its efforts on collection and characterization of basic data related to biological, materials, geophysical, social, and behavioral phenomena in the Arctic;
15) research into the long-range health, environmental, and social effects of development in the Arctic is necessary to mitigate the adverse consequences of that development to the land and its residents;
16) Arctic research expands knowledge of the Arctic, which can enhance the lives of Arctic residents, increase opportunities for international cooperation among Arctic-rim countries, and facilitate the formulation of national policy for the Arctic; and
17) the Alaskan Arctic provides an essential habitat for marine mammals migratory waterfowl, and other forms of wildlife which are important to the Nation and which are essential to Arctic residents.
b) The purposes of this title are

1) to establish national policy, priorities, and goals and to provide a Federal program plan for basic and applied scientific research with respect to the Arctic, including natural resources and materials, physical, biological and health sciences, and social and behavioral sciences;
2) to establish and Arctic Research Commission to promote Arctic research and to recommend Arctic research policy;
3) to designate the National Science Foundation as the lead agency responsible for implementing Arctic research policy; and
4) to establish an Interagency Arctic Research Policy Committee to develop a national Arctic research policy and a five-year plan to implement that policy.

ARCTIC RESEARCH COMMISISON

SEC. 103(a) The President shall establish an Arctic Research Commission (hereinafter referred to as the "Commission").
b)(1) The Commission shall be composed of seven members appointed by the President, with the Director of the National Science Foundation serving as a nonvoting, ex-officio member. The members appointed shall include:
(A) four members appointed from among individuals from academic or other research institutions with expertise in areas of research relating to the Arctic, including the physical, biological, health, environmental, social and behavioral sciences;
(B) one member appointed from among indigenous residents of the Arctic who are representative of the needs and interests of Arctic residents and who live in areas directly affected by Arctic resource development; and
(C) two members appointed from among individuals familiar with the Arctic and representative of the needs and interests of private industry undertaking resource development in the Arctic.
(2) The President shall designate one of the appointed members of the Commission to be chairperson of the Commission.
(C)(1) Except as provided in paragraph

(2) of this subsection, the term of office of each member of the Commission appointed under subsection
(b)(1) shall be four years.
(2) of the members of the Commission originally appointed under subsection
(b)(1)
(A) one shall be appointed for a term of two years;
(B) two shall be appointed for a term of three years; and
(C) two shall be appointed for a term of four years.
(3) Any vacancy occurring in the membership of the Commission shall be filled, after notice of the vacancy is published in the Federal Register, in the manner provided by the preceding provisions of this section, for the remainder of the unexpired term.
(4) A member may serve after the expiration of the member 's term of office until the President appoints a successor.
(5) A member may serve consecutive terms beyond the member's original appointment.
(d)(1) Members of the Commission may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code. A member of the Commission not presently employed for compensation shall be compensated at a rate equal to the daily equivalent of the rate for GS-18 of the General Schedule under section 5332 of title 5, United States Code, for each day the member is engaged in the actual performance of his duties as a member of the Commission, not to exceed 90 days of service each year. Except for the purposes of chapter 81 of title 5
(relating to compensation for work injuries) and chapter 171 of title 28 (relating to tort claims), a member of the Commission shall not be considered an employee of the United States for any purpose.
2) The Commission shall meet at the call of its Chairman or a majority of its members.
3) Each Federal agency referred to in section 107(b) may designate a representative to participate as an observer with the Commission. These representatives shall report to and advise the Commission on the activities relating to Arctic research of their agencies.
4) The Commission shall conduct at least one public meeting in the State of Alaska annually.

DUTIES OF THE COMMISSION

SEC. 104(a) The Commission shall

1) develop and recommend an integrated national Arctic research policy;
2) in cooperation with the Interagency Arctic Research Policy Committee established under section 107, assist in establishing a national Arctic research program plan to implement the Arctic research policy;
3) facilitate cooperation between the Federal Government and State and local governments with respect to Arctic research;
4) review Federal research programs in the Arctic and recommend improvements in coordination among programs;
5) recommend methods to improve logistical planning and support for Arctic research as may be appropriate and in accordance with the findings and purposes of this title;
6) recommend methods for improving efficient sharing and dissemination of data and information on the Arctic

among interested public and private institutions;
7) offer other recommendations and advice to the Inter-agency Committee established under section 107 as it may find appropriate;
8) cooperate with the Governor of the State of Alaska and with agencies and organizations of that State which the Governor may designate with respect to the formulation of Arctic research policy;
9) recommend to the Interagency Committee the means for developing international scientific cooperation in the Arctic; and 1 0) not later than January 31, 1991, and every 2 years thereafter, publish a statement of goals and objectives with respect to Arctic research to guide the Interagency committee established under section 107 in the performance of its duties. b) Not later than January 31 of each year, the Commission shall submit to the President and to the Congress a report describing the activities and accomplishments of the Commission during the immediately preceding fiscal year.

COOPERATION WITH THE COMMISSION

Sec. 105(A) (1) The Commission may acquire from the head of any Federal agency unclassified data, reports, and other nonproprietary information with respect to Arctic research in the possession of the agency which the Commission considers useful in the discharge of its duties.
2) Each agency shall cooperate with the Commission and furnish all data, reports, and other information requested by the Commission to the extent permitted by law; except that no agency need furnish any information that it is permitted to withhold under section 522 of title 5, United States Code.
b) With the consent of the appropriate agency head, the Commission may utilize the facilities and services of any Federal agency to the extent that the facilities and services are needed for the establishment and development of an Arctic research policy, upon reimbursement to be agreed upon by the Commission and the agency head and taking every feasible step to avoid duplication of effort. c) All Federal agencies shall consult with the Commission before undertaking major Federal actions relating to Arctic research.
ADMINISTRATION OF THE COMMISSION

Sec. 106. The Commission may –
1) in accordance with the civil service laws and subchapter III of chapter 53 of title 5, United States Code, appoint and fix the compensation of an Executive Director and necessary additional staff personnel, but not to exceed a total of seven compensated personnel;
2) procure temporary and intermittent services as authorized by section 3109 of title 5, United States Code;
3) enter into contracts and procure supplies, services and personal property;
4) enter into agreements with the General Services Administration for the procurement of necessary financial and administrative services, for which payment shall be made by reimbursement from funds of the Commission in amounts to be agreed upon by the Commission and the Administrator of the General Services Administration; and
5) appoint, and accept without compensation the services of, scientists and engineering specialists to be

advisors to the Commission. Each advisor may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code. Except for the purposes of chapter 81 of title 5 (relating to compensation for work injuries) and chapter 171 of title 28 (relating to tort claims) of the United States Code, and advisor appointed under this paragraph shall not be considered an employee of the United States for any purpose.

LEAD AGENCY AND INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE

SEC.107(a) The National Science Foundation is designated as the lead agency responsible for implementing Arctic research policy, and the Director of the National Science Foundation shall insure that the requirements of section 108 are fulfilled.

(b)(1) The President shall establish an Interagency Arctic Research Policy Committee (hereinafter referred to as the "Interagency Committee").

(2) The Interagency Committee shall be composed of representatives of the following Federal agencies or offices:

(A) the Nations Science Foundation;
(B) the Department of Commerce;
(C) the Department of Defense;
(D) the Department of Energy;
(E) the Department of the Interior;
(F) the Department of State;
(G) the Department of Transportation;
(H) the Department of Health and Human Services;
(I) the National Aeronautics and Space Administration;
(J) the Environmental Protection Agency; and
(K) any other agency of office deemed appropriate.

(3) the representative of the National Science Foundation shall serve as the Chairperson of the Interagency Committee.

DUTIES FO THE INTERAGENCY COMMITTEE

SEC. 108 (a) The Interagency Committee shall

(1) survey Arctic research conducted by Federal State, and local agencies, universities, and other public and private institutions to help determine priorities for future Arctic research, including natural resources and materials, physical and biological sciences, and social and behavioral sciences;

(2) work with the Commission to develop and establish an integrated national Arctic research policy that will guide Federal agencies in developing and implementing their research programs in the Arctic;

(3) consult with the Commission on-

(A) the development of the national Arctic research policy and the 5-year plan implementing the policy;

(B) Arctic research programs of Federal agencies;

(C) recommendations of the Commission on future Arctic research grants;

(4) develop a 5-year plan to implement the national policy, as provided in section 109;

(5) provide the necessary coordination, data and assistance for the preparation of a single integrated, coherent and multi agency budget request for Arctic research as provided for in section 110;

(6) facilitate cooperation between the Federal Government and State and local governments in Arctic research, and recommend the undertaking of neglected areas of research in accordance with the findings and purposes of this title;
(7) coordinate and promote cooperative Arctic scientific research programs with other nations, subject to the foreign policy guidance of the Secretary of State;
(8) cooperate with the Governor of the State of Alaska in fulfilling its responsibilities under this title;
(9) promote Federal interagency coordination of all Arctic research activities, including–
(A) logistical planning and coordination; and
(B) the sharing of data and information associated with Arctic research, subject to section 552 of title 5, United States Code; and
(10) provide public notice of its meetings and an opportunity for the public to participate in the development and implementation of national Arctic research policy.
(b) Not later than January 31, 1986, and biennially thereafter, the Interagency Committee shall submit to the Congress through the President, a brief, concise report containing

(1) a statement of the activities and accomplishments of the Interagency Committee since its last report; and
(2) a statement detailing with particularity the recommendations of the Commission with respect to Federal interagency activities in Arctic research and the disposition and responses to those recommendations.

5-YEAR ARCTIC RESEARCH PLAN

SEC.109(a) The Interagency Committee, in consultation with the Commission, the Governor of the State of Alaska, the residents of the Arctic, the private sector, and public interest groups, shall prepare a comprehensive 5-year program plan (hereinafter referred to as the "Plan") for the overall Federal effort in Arctic research. The Plan shall be prepared and submitted to the President for transmittal to the Congress within one year after the enactment of this Act and shall be revised biennially thereafter.
(b) The Plan shall contain by need not be limited to the following elements:
(1) an assessment of national needs and problems regarding the Arctic and the research necessary to address those needs or problems;
(2) a statement of the goals and objectives of the Interagency Committee for national Arctic research;
(3) a detailed listing of all existing Federal programs relating to Arctic research, including the existing goals, funding levels for each of the 5 following fiscal years, and the funds currently being expended to conduct the programs;
(4) recommendations for necessary program changes and other proposals to meet the requirement of the policy and goals as set forth by the Commission and in the Plan as currently in effect; and
(5) a description of the actions taken by the Interagency Committee to coordinate the budget review process in order to ensure interagency coordination and cooperation in (A) carrying out Federal Arctic research programs, and
(B) eliminating unnecessary duplication of effort among these programs.
COORDINATION AND REVIEW OF BUDGET REQUESTS.

SEC. 110(A) The Office of Science and Technology Policy shall
(1) review all agency and department budget requests related to the Arctic transmitted pursuant to section 108(a)(5), in accordance with the national Arctic research policy and the 5-year program under section 108(a)(2) and section 109, respectively; and
(2) consult closely with the Interagency Committee and the Commission to guide the Office of Technology Policy's efforts.
(b)(1) The Office of Management and Budget shall consider al Federal agency request for research related to the Arctic as one integrated, coherent, and multi agency request, which shall be reviewed by the Office of Management and Budget prior to submission of the President's annual budget request for its adherence to the Plan. The Commission shall, after submission of the President's annual budget request, review the request and report to Congress on adherence to the Plan.
(2) The Office of Management and Budget shall seek to facilitate planning for the design, procurement, maintenance, deployment and operations of icebreakers needed to provide a platform for Arctic research by allocating all funds necessary to support icebreaking operations, except for recurring incremental costs associated with specific projects, to the Coast Guard.

AUTHORIZATION OF APPROPRIATATIONS; NEW SPENDING AUTHORITY

SEC.111(a) There are authorized to be appropriated such sums as may be necessary for carrying out his title.

(b) Any new spending authority (within the meaning of section 401 of the Congressional Budget Act of 197 4) which is provided under this title shall be effective for any fiscal year only to such extent or in such amounts as may be provided in appropriation Acts.
DEFINITION

SEC 112. As used in this title, the term "Arctic" means all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi seas, and the Aleutian chain.

Table 1
PUBLICATIONS OF THE US ARCTIC RESEARCH COMMISSION

Annual Reports to the President and the Congress *US on the Arctic Rim.* 1986

- *The United States: An Arctic Nation.* 1987
- *Entering the Age of the Arctic*. 1988.
- *Arctic Research for an Arctic Nation.* 1989
- *Arctic Research: A Focus for International Cooperation.* 1990
- *Arctic Research in a Changing World*. 1991
- *An Arctic Obligation.* 1992
- *Arctic Research Priorities.* 1993
- *Annual Report, Fiscal Years 1994 and 1995.*
- *Annual Report, Fiscal Year 1996.*
- *Annual Report, Fiscal Year 1997.*
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- *Annual Report, Fiscal Year 2000.*
- *Annual Report, Fiscal Year 2001.*
- *Annual Report, Fiscal Year 2002.*
- *Annual Report, Fiscal Year 2003.*
- *Annual Report, Fiscal Year 2004.*
- *Annual Report, Fiscal Year 2005.*
- *Annual Report, Fiscal Year 2006.*

Special Reports

- *National Needs and Arctic Research, a Framework for Action.* May, 1986
- *Logistics Recommendations for an Improved U.S. Arctic Research Capability.* June 1997
- *The Arctic Ocean and Climate Change: A Scenario for the U.S. Navy.* January, 2002
- Climate Change, Permafrost, and Impacts on Civil Infrastructure, 2003
- Advancing Oil Spill Response in Ice Covered Waters 2004

Findings and Recommendations

- *Logistic Support of Arctic Research.* July, 1988.
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- *Arctic Data and Information: Issues and Goals.* June, 1989.
- *Improvements to the Scientific Content of the Environmental Impact Statement Process*. December, 1989.
- *Arctic Engineering Research: Initial Findings and Recommendations.* April, 1990.
- *Logistic Support of United States Research in Greenland: Current Situation and Prospects.* December, 1990.
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- *Goals and Priorities to Guide United States Arctic Research.* January, 1993.
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- *Goals and Priorities to Guide United States Arctic Research.* January, 1997.
- *Goals and Priorities to Guide United States Arctic Research.* January, 1999.
- *Report on Goals and Objectives for Arctic Research.* January, 2000.
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- *Report on Goals and Objectives for Arctic Research.* January, 2003.
- *Report on Goals and Objectives for Arctic Research.* January, 2005.

Background Reports

- *International Agreements for Research, Logistics, and Access concerning the Arctic. J.A. Lopocaro.* April, 1990.
- *Corrosion of the Trans Alaska Pipeline Systems & Research Needs. L.D. Perrigo.* May, 1990.
- *Effects of Glasnost and perestroika on the Soviet Establishment: Relevance to Arctic Research. J.G. Roederer.* March, 1991.

- *The Increasing Importance of Arctic Research to the United States. J.G. Roederer.* May, 1991.

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