US ARCTIC RESEARCH COMMISSION

REPORT ON THE Goals and Objectives for Arctic Research 2013–2014

FOR THE US ARCTIC RESEARCH PROGRAM PLAN

THE US ARCTIC RESEARCH COMMISSION

The US Arctic Research Commission is an independent federal agency created by the Arctic Research and Policy Act of 1984. It is a presidentially appointed advisory body supported by staff in Washington, DC, and in Anchorage, AK. In addition to establishing the goals in this report, the Commission recommends US Arctic research policy to the President and Congress and builds cooperative links in Arctic research within the federal government, with the State of Alaska, and with international partners. The law also requires the Commission to report to Congress on the progress of the Executive Branch in reaching goals set by the Commission and on their adoption by the Interagency Arctic Research Policy Committee.

The Commission plays an active role in the work of several interagency committees, is a statutory member of the North Pacific Research Board and the North Slope Science Initiative, and is a member, a participant, or an observer on various committees, such as the National Ocean Council, Extended Continental Shelf Task Force, Interagency Program Management Committee of the Study of Environmental Arctic Change, Department of the Interior's Arctic Landscape Conservation Cooperative, Civil Applications Committee, Scientific Ice Expeditions Interagency Committee (involving US Navy submarines), UNOLS Arctic Icebreaker Coordinating Committee, State Department's Arctic Policy Group, Alaska Ocean Observing System, Alaska Climate Change Executive Roundtable, International Permafrost Association, and Consortium for Ocean Leadership.

During the last two years, the Commission led special initiatives, gave testimony before Congress and the Alaska State Legislature, authored reports, and contributed articles in peer-reviewed publications, such as the special issue of *Oceanography* on "The Changing Arctic Ocean" and *Marine Policy*. The Commission also writes editorials and "white papers" on a variety of other subjects, which are posted on the Commission's website, http://www.arctic.gov.

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HOW THIS REPORT WAS COMPILED

Under the Arctic Research and Policy Act, the US Arctic Research Commission biennially recommends key goals and objectives ("goals report") for the US Arctic Research Program Plan. To prepare this report, the Commission, through public meetings and by other means, sought substantial input from scientific researchers, policy makers, the public in Alaska and throughout the United States, and in the growing number of nations with Arctic interests. To help define its research goals and objectives, the Commission also cosponsors a number of scientific meetings and workshops on oil spill response, impacts of an ice-diminishing Arctic on naval and maritime operations, on the provision of safe supplies of water and sanitary facilities in rural Alaska, on Arctic civil infrastructure, and on "Operating in the Arctic: Supporting US Coast Guard Challenges through Research."

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DUTIES OF THE COMMISSION

- Develop and recommend a national Arctic research policy and research goals and objectives
- Assist the Interagency Arctic Research Policy Committee in establishing a national Arctic research program plan to implement the policy
- Facilitate cooperation in Arctic research among federal, state, and local governments and with international partners
- Review federal Arctic research programs and recommend coordination improvements
- Recommend improvements in Arctic research logistics
- Recommend improved methods for data sharing among research entities

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A MESSAGE FROM USARC CHAIR FRAN ULMER

DEFINING OUR GOALS

As required by the Arctic Research and Policy Act, the US Arctic Research Commission (USARC) recommends goals for the nation's Arctic Research Program Plan. These goals are based on advice we receive from Arctic residents, government agencies, scientists, and citizens who are keenly interested in the Arctic's future.

Although significant progress on these research goals has been achieved by scientists in many organizations, including the Interagency Arctic Research Policy Committee (IARPC), much more investment is needed if we are to improve our understanding of this valuable and vulnerable region. The urgency for this work must be heightened, given the rapidly evolving conditions in the Arctic.

Dramatic changes in the environment and in resource development make it essential that important public and private decisions have the benefit of research, including timely and comprehensive information and a more thorough understanding of Arctic ecosystems, resources, and infrastructure challenges.

Additional research is needed to address national priorities related to energy and climate, ocean policy, health, conservation, national and homeland security, and keeping the United States competitive in the world economy. International investment in research and development has increased significantly in recent years, reflecting global interest in the Arctic. Oil and gas development, shipping, fishing, tourism, communication, and infrastructure construction are of intense interest to many countries, not just Arctic nations. Only with an active Arctic presence, which requires investment, as well as accession to the United Nations Convention on the Law of the Sea, can the United States help shape new patterns of activity in the Arctic that are consistent with our nation's best interests.

To meet national goals, USARC, IARPC agencies, the National Science Foundation, the White House Office of Science and Technology Policy, the Office of Management and Budget, and Congress must work together to encourage collaboration and the commitment of resources. With regard to Arctic transportation, we encourage prompt decisions, such as on how the nation will obtain the scientific research and maritime mission capabilities previously provided by the nation's polar-class icebreakers, commissioned over 35 years ago, which are currently out of service. With a rapidly changing Arctic Ocean, these capabilities are required for research, law enforcement, environmental protection, emergency response, search and rescue, maritime commerce, and national and homeland security.

Now more than ever, America's Arctic needs increased American attention and investment.

INTRODUCTION

The Arctic is front-page news. It's here and it's now. This previously inaccessible region, once viewed as cold and remote, is now closer and warmer. As the world shrinks, and our understanding of the North grows, we see the Arctic as a keystone in the global climate system, as a shortcut to the rest of the world, as a destination to, and perhaps the last untapped source of, natural resources to meet growing local and global demand.

And what about the 4 million inhabitants of this region? They are experiencing unprecedented rates of change in their environments, societies, and cultures. Whether it is offshore oil and gas exploration, shipping, fishing, sovereignty claims, record highs (temperatures) or lows (ice), food security, thawing permafrost, broadband access, or national security, the Arctic isn't what it was even 20 years ago. As an Arctic nation, one of only eight, the United States reaps great benefits from this region, but we also have obligations and responsibilities.

So what is the role of Arctic research? Simply put, to advance knowledge. Sometimes this knowledge is basic and has no specifically envisioned or immediately practical outcome. Other times it is applied to foster innovation and promote economic development. The distinction between basic and applied research is not always clear and, in fact, it should be viewed as a continuum. Importantly, new knowledge also informs policy development, planning, and decision making, and serves as a basis for education and training. Ideally, research is an investment in the future and the means by which we improve life in the Arctic and, indeed, on the planet.

USARC contributes to this effort by identifying research goals and objectives for the nation, and then working with a broad variety of entities in federal, state, local, and tribal governments, nongovernmental organizations, and industry, and in other countries to advance Arctic research. In so doing, USARC listens to and consults with communities of scientists, researchers, decision makers, and Arctic residents.

In the following pages, USARC identifies Arctic research goals and emerging issues, and provides suggestions on how to advance research through communication, coordination, and cooperation.

FIVE PRIORITY RESEARCH GOALS

The US Arctic Research Commission recommends research on five central and crosscutting goals, summarized below. In the following pages, we provide specific and illustrative examples of current and proposed research programs that address these goals.

GOAL 1 | OBSERVE, UNDERSTAND, AND RESPOND TO ENVIRONMENTAL CHANGE IN THE ARCTIC

Motivation

- As Arctic climate continues to warm at twice the global rate, climate system "wild cards" requiring greater attention include: (1) rapidly thawing permafrost and the possible release of staggering amounts of carbon into the atmosphere, (2) the sharp decline of Arctic glacial and sea ice (75% reduction from 20 years ago), and (3) the climatic impact of black carbon (soot).

Recommendations

- Intensify efforts to observe and understand climate change and its impacts on ecosystems, infrastructure, economies, and cultures.
- Synthesize research results and translate them into actionable information. Efforts by the Study of Environmental Arctic Change (SEARCH) program and through IARPC's five-year plan are steps in the right direction.
- Move from knowledge to action, as successfully demonstrated by the Canadian ArcticNet program.

GOAL 2 | IMPROVE ARCTIC HUMAN HEALTH

Motivation

- Significant health disparities exist between Arctic and non-Arctic residents. Decreasing rates of infant mortality, fetal alcohol syndrome, chronic respiratory disease, and accidental injury are offset by increasing rates of substance abuse, domestic violence, obesity, diabetes, cancer, and suicide.
- Adequate infrastructure for water and sanitation is critical; there is a clear connection between health and access to clean water for hand washing.
- Subsistence foods and affiliated social systems are critically important to the health and well-being of indigenous peoples.

Recommendations

- Enhance biomedical and psychiatric research in mental and behavioral health, and, on a decadal basis, review and evaluate intervention efforts to update research priorities and guide the scaling of successful local efforts into broader clinical interventions and public health strategies.
- Expand the use of telemedicine to diagnose and treat diseases in remote Arctic regions.
- Make mandatory the collection of water service "status" data at all federally funded medical facilities.
- Address food security issues.

GOAL 3 | UNDERSTAND NATURAL RESOURCES

Motivation

- Arctic economies are based on natural resources. The region produces about one-tenth of the world's oil, and a quarter of its natural gas[1], and assessments suggest there are considerable undiscovered reserves of both. Abundant deposits of metals and minerals are also being discovered and developed. Renewable resources, such as fish, birds, and mammals (marine and terrestrial) and energy (wind, geothermal, hydro, and ocean) provide benefits and future opportunities.

Recommendations

- Support greater mapping of Arctic lands and charting of waters. The United States must quantitatively assess mineral, energy, and living resources and learn more about the environmental, societal, and economic impacts of developing them.
- Prepare thoroughly for responding to oil spills. Challenging response conditions and unique characteristics of Arctic environments require specialized research.
- Develop international standards for Arctic exploration and oil and gas development, and share innovative technology and best management practices for Arctic regions.

GOAL 4 | ADVANCE CIVIL INFRASTRUCTURE RESEARCH

Motivation

- Thawing permafrost, reduced sea ice extent, strengthening storms, and eroding coastlines resulting from Arctic climate change are affecting civil infrastructure, such as transportation, communication, and energy delivery. The number of ships moving goods through Arctic waterways is increasing in frequency and duration as global demand for resources rises.

Recommendations

- Maximize the design life of infrastructure—particularly of water and sanitation systems—as funding declines for construction and for operation and management.
- Develop Arctic-specific technology, design, and engineering for rapidly changing environments.
- Increase applied research to improve land, air, and sea infrastructure that supports community essentials (energy, utility, communication, and transportation). Immediate needs include collecting baseline data and mapping of coastal and nearshore environments, collecting terrestrial imagery and elevation data, and installing knowledge management systems to support engineering design and assessment (e.g., an engineering atlas).

GOAL 5 | ASSESS INDIGENOUS LANGUAGES, IDENTITIES, AND CULTURES

Motivation

- There are over 40 indigenous languages in the circumpolar Arctic. Language is one of the most important, but vulnerable, elements of Arctic cultural heritage.
- When speakers of endangered languages switch from their mother tongue to other languages for communication and education, vast amounts of cultural knowledge and tradition are lost.

Recommendation

- Develop an integrated Arctic indigenous languages research plan that: (1) conducts regular assessments to understand the extent and diversity of languages and their viability for future generations, (2) documents procedures to ensure that languages and place names used by Arctic people are recorded and preserved, (3) promotes interregional and international activities geared at enhancing language use and exchanges, and (4) defines policy options and processes for language monitoring and preservation.

[1] Lindholt, L. 2006. Arctic natural resources in a global perspective. Pp. 27–39 in *The Economy of the North*. S. Glomsrød and I. Aslaksen, eds, Oslo: Statistics Norway, http://www.ssb.no/english/subjects/00/00/30/sa_economy_north/sa84_en/kap3.pdf

IS THE LOSS OF ARCTIC SEA ICE LINKED TO SEVERE STORMS?

In 2012, the sea ice covering the Arctic Ocean reached the lowest level since the National Aeronautics and Space Administration (NASA) started making such observations in 1979. The cover was only about half of what it was a few decades ago. This stunning development caught the attention of *The Washington Post's* Editorial Board, which argued in the September 3, 2012, edition that "The melting Arctic shouldn't be on the back burner."

Sea ice retreat amplifies warming because the darker ocean absorbs sunlight that normally would be reflected back into space by the bright white ice, warming the water and further reducing the ability of sea ice to form. Similarly, snow cover atop Arctic lands is also declining at about 18% per decade[2], exposing the underlying darker soil and allowing it to warm and dry, leading to thawing of underlying permafrost.

In the fall, heat released from the ocean and the land returns to the atmosphere, affecting the weather locally and, perhaps, even on a larger scale. The warmer Arctic atmosphere weakens the west-to-east flow of the jet stream, resulting in steeper north-south waves, or "meandering." Based on this meandering, and other changes in the climate system, some scientists[3] predict a greater likelihood of extreme weather events across the lower 48 states of the United States, as well as in Europe and Asia. US examples include "Superstorm Sandy" and snowstorm "Nemo." Dr. Jane Lubchenco, former NOAA Administrator, said that in a typical year the United States might see three or four weather-related events resulting in damages of at least $1 billion, but in 2011 there were 14 such events "across every major category of extreme weather." In 2012 there were 11.

The hypothesis linking sea ice cover to storm severity is intriguing, and is somewhat controversial, in light of the large amount of natural variability in the climate system and the short observational record of how the atmosphere responds to extreme losses of sea ice.

USARC calls for greater focus on the climate implications and teleconnections between Arctic sea ice loss and extreme weather events at lower latitudes.

[2] Derksen, C., and Brown, R. 2012. Spring snow cover extent reductions in the 2008–2012 period exceeding climate model projections. *Geophysical Research Letters* 39, L19504, http://dx.doi.org/10.1029/2012GL053387.

[3] Francis, J.A., and S. J. Vavrus. 2012. Evidence linking Arctic amplification to extreme weather in mid-latitudes. *Geophysical Research Letters* 39, L06801, http://dx.doi.org/10.1029/2012GL051000.

THE IMPORTANCE OF LONG-TERM DATA SETS AND MONITORING

The Arctic environment is changing, as witnessed by:

- Shifts in the composition, distribution, density, and behavior of Arctic animals and plants
- Erosion of the coastline from storm surges and thawing permafrost, which washes out roads and other civil infrastructure, requiring costly repairs and resulting in difficult or environmentally harmful travel
- Early breakup and late freeze up of ice, making traditional winter transportation routes and subsistence hunting dangerous or impossible

Long-term monitoring of the environment enables scientists to detect trends and patterns that ultimately reveal the forces responsible for environmental change. The classic example is the "Keeling Curve" that shows increasing concentrations of carbon dioxide in the atmosphere since 1958. Such information is critical to policy makers. Unfortunately, typical federal funding paradigms are not structured to support long-term data collection. Budgets at mission agencies such as the National Oceanic and Atmospheric Administration (NOAA) and Department of Interior are stretched, often resulting in interruptions to, or termination of, such programs. At basic research agencies such as the National Science Foundation (NSF) and NASA, emphasis has traditionally been on hypothesis-driven research and shorter-term awards for making environmental observations. Currently, however, change is afoot as agencies recognize the value of collecting long time-series data.

To this end, USARC recommends innovative funding approaches and logistical support for long-term monitoring and observing, and incorporation of local/traditional knowledge, at locations and scales that are most useful for scientists, resource managers, and decision makers. The value of these data sets needs to be better communicated to all audiences, including the general public.

SOURING SEAS: ACIDIFICATION AND ITS POTENTIAL IMPACT ON FISHERIES

As increasing amounts of carbon dioxide are being released into the atmosphere by human activities, the ocean is absorbing more CO_2, and as a result, is becoming more acidic. A more acidic ocean is more corrosive to calcium carbonate, which some marine organisms use to make their shells. The North Pacific Ocean, the Bering Sea, and the high Arctic are naturally more acidic than other ocean regions because cold water holds more CO_2 and because these waters are "old" (i.e., not recently in contact with the atmosphere). Other factors in the Arctic, such as summer algae bloom die-offs, melting sea ice, and increased riverine flow to the ocean, also impact acidity.

Oysters, scallops, corals, and pea-sized "sea butterflies" called pteropods, which constitute up to 50% of the diet of juvenile pink salmon, are particularly sensitive to increasing acidification. Besides corroding skeletal material, or even preventing it from being formed, acidity may also impact their reproduction, physiology, and survivorship, as well as metabolic rates and immune responses.

Ocean acidification threatens the sustainability of fisheries, which are essential to Alaska, as it produces 50% of all US seafood. One study[4] cites a model result that predicts that a 10% drop in pteropod production could result in a 20% decrease in the mature body weight of pink salmon, which is the most abundant salmon species in the North Pacific and an economically important resource throughout Alaska, Washington, and Canada.

The issue of ocean acidification is receiving increased attention, but more research is needed. The Alaska State Legislature recently provided $2.7 million to the University of Alaska Fairbanks to set up a network of buoys along the coast to continuously measure seawater pH, temperature, and CO_2 levels, among other parameters. These data, sent to scientists in near-real time via satellite, will help determine how seawater pH changes over the seasons and years. The information can be used to forecast potential disruptions to the ecosystem resulting from increases in ocean acidification.

USARC calls for reauthorization of the Federal Ocean Acidification Research and Monitoring Act of 2009 to conduct research on acidification and its implications.

[4] Fabry, V.J., B.A. Seibel, R.A. Feely, and J.C. Orr. 2008. Impacts of ocean acidification on marine fauna and ecosystem processes. *ICES Journal of Marine Science* 65(3):414–432, http://dx.doi.org/10.1093/icesjms/fsn048.

ARCTIC SYNTHESIS PROJECTS

Several projects underway in the US and Canadian Arctic are synthesizing scientific and traditional knowledge on Arctic marine ecosystems. While the missions and objectives of these efforts vary, the coordination among them is an encouraging development. USARC applauds these cooperative efforts, described below, and encourages a similar focus on terrestrial ecosystems in an effort to better understand the region.

THE CANADIAN BEAUFORT REGIONAL ENVIRONMENTAL ASSESSMENT (BREA)

This $21.8M project, closely aligned with Canada's "Northern Strategy," is collecting basic and socioeconomic information to inform regulatory decisions, primarily related to oil and gas development in the Beaufort Sea. Toward this goal, BREA initiated 17 projects in 2012 to analyze existing data and to generate new information. The project, which concludes in 2015, has received wide support, including that of indigenous stakeholders. Canada's BREA scientists are engaging with US scientists to develop a synoptic view of the Beaufort Sea region.

SYNTHESIS OF ARCTIC RESEARCH (SOAR)

A multidisciplinary group of Arctic scientists is exploring and integrating marine scientific research results from the Pacific Arctic region in order to better understand the links between oceanographic conditions and the ecosystem. SOAR's mission is somewhat similar to BREA's in that their efforts will help the US Bureau of Ocean Energy Management evaluate the potential impacts of oil and gas exploration and development. SOAR is taking a cross-discipline hypothesis testing approach, and it seeks to: (1) increase knowledge of the biophysical environment, (2) improve the ability to predict future conditions, and (3) actively and effectively communicate their results to a broad array of stakeholders.

PACIFIC MARINE ARCTIC REGIONAL SYNTHESIS (PacMARS)

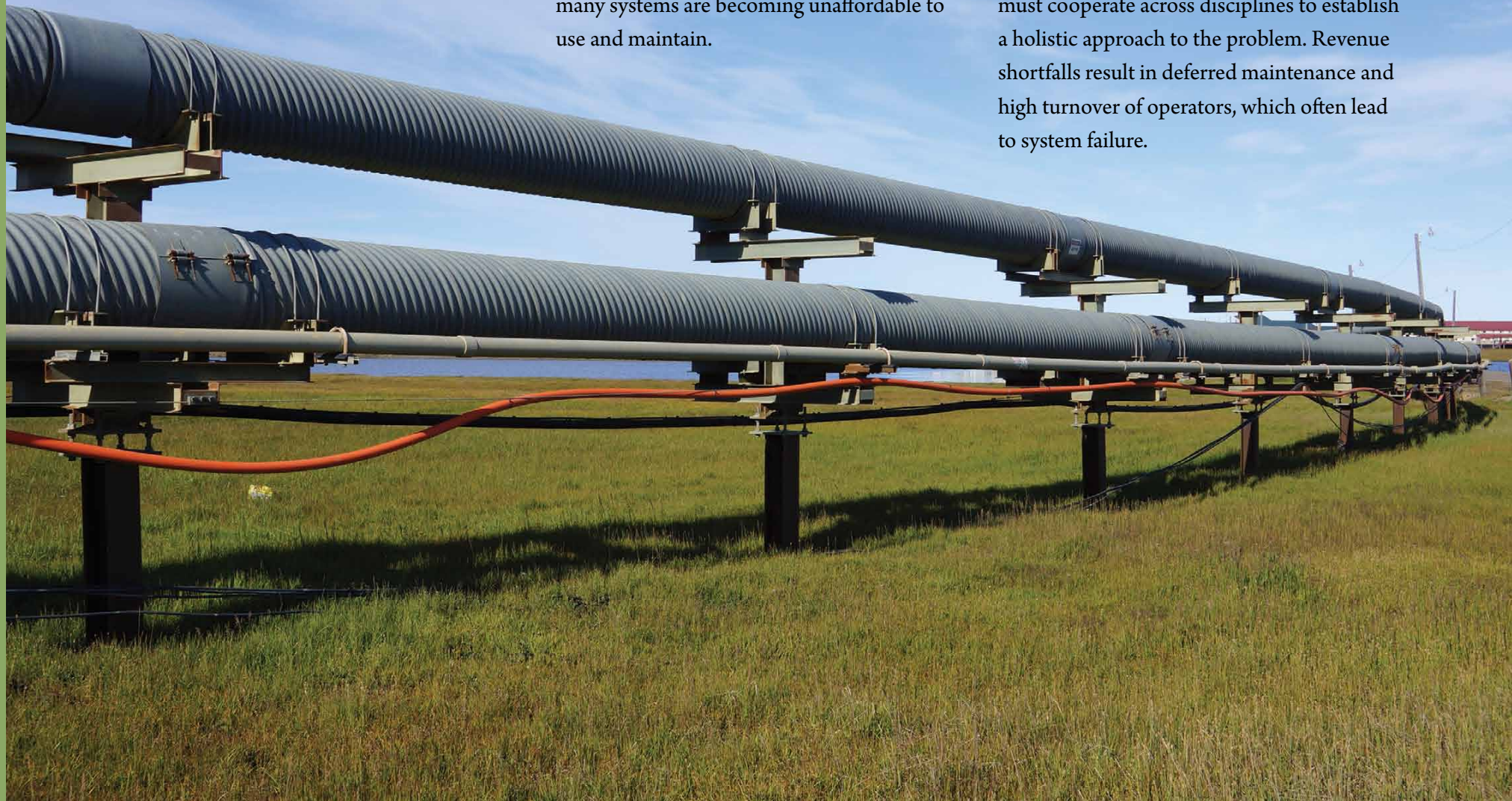
Motivated by climate change concerns, increased interest in offshore oil and gas exploration, and vessel traffic, PacMARS is a two-phase effort to better understand the marine ecosystem in the Pacific Arctic. In the first phase, university research scientists are using $1.45M provided by ConocoPhilips, and administered by the North Pacific Research Board, to synthesize existing scientific and traditional knowledge of the Bering, Chukchi, and Beaufort Seas. The scientists aim to better understand the Pacific-influenced Arctic Ocean coastal shelf ecosystem and to identify outstanding research needs. Planning for the second phase is underway, and will likely consist of a collaborative and integrative science program to further advance understanding of Arctic marine ecosystems.

WATER AND SANITATION

Human health is directly linked to an adequate supply of clean water and the sanitary removal of sewage. Unlike conditions in the lower 48 states, over 5,000 rural Alaskan homes lack direct access to running water and sewer service. Much of Alaska's rural water and sewer infrastructure is failing or is noncompliant with regulations. The cost to meet existing needs is at least $900M, and many systems are becoming unaffordable to use and maintain.

As the need rises,
available funds are decreasing.

Threats to the water and sewer infrastructure in Alaska are rising sharply due to decreasing funding, increasing costs, inflation, and climate change. Federal and state agencies must cooperate across disciplines to establish a holistic approach to the problem. Revenue shortfalls result in deferred maintenance and high turnover of operators, which often lead to system failure.



COLLECT DATA ON WATER USE AND HEALTH

Similar to well-established practices of collecting data on tobacco and alcohol use, USARC strongly recommends mandatory collection of water service status (level of service) at all federally funded outpatient and inpatient medical facilities. This information will allow researchers to track the link between water use and health as it applies to American Indians and Alaska Natives.

FUND PREVENTATIVE MAINTENANCE

Many of the water and sanitation systems installed in rural Alaskan villages are failing prematurely, primarily as a result of insufficient, or even absent, preventative maintenance programs. An Alaska Rural Water and Sanitation Working Group, coordinated by USARC, is recommending actions to increase the lifetime of these systems. The group is calling for additional funding for preventive maintenance in villages that have demonstrated the capacity to maintain their systems as designed. The group also encourages the State of Alaska to consider funding small capital improvement/maintenance projects to incentivize basic operations and maintenance.

IMPROVE EFFICIENCY

USARC recommends new funding for the Environmental Protection Agency to begin an Alaskan Village Water-Use Efficiency Program to install low-flow fixtures and gray water recycling systems in homes. This effort would reduce water use and decrease energy and labor costs required to heat water and deliver/remove it from the home as sewage. USARC also recommends funding for a statewide cooperative, similar to the Alaska Village Electric Cooperative, which any village could join to improve the efficiency of its water and sanitation facility operations.


Brian Lefferts

PROVIDE TECHNICAL ASSISTANCE

USARC recommends funding for statewide water and sanitation technical support to villages with great need. This could be achieved via an expansion of the Tribal Utilities Support Group at Alaska Native Tribal Health Consortium (ANTHC) or the State of Alaska Remote Maintenance Worker Program.

SUPPORT INNOVATIVE APPROACHES

Technology applied in novel ways to Arctic conditions may help solve water and sanitation problems unique to the region and improve health in rural villages. The Alaska Department of Environmental Conservation's recent grant competition "New Approaches to Basic Water & Sewer Services for Rural Alaska" is an excellent example of this type of effort.

FOOD SECURITY IN ARCTIC COMMUNITIES

According to the World Health Organization and the Food and Agriculture Organization, "food security" has four facets:

- Availability (sufficient amounts of food on a consistent basis)
- Access (sufficient resources, both economic and physical, to obtain appropriate foods)
- Use (appropriate use based on knowledge of basic nutrition and care, as well as adequate water and sanitation)
- Stability (of availability, access, and use, over time)

USARC recommends research to determine:

- The extent of food security in the Arctic
- Shifting patterns of food consumption
- The extent of contamination of, and climate impacts on, fish and mammals
- The impact food insecurity is having on different age/socioeconomic groups
- How food-insecure families are attempting to adapt
- How to create pilot programs to ease food insecurity, including subsidies to provide healthy foods, food education programs, and "community freezer" projects

LOCAL CONCERNS

- New and more virulent wildlife diseases
- Contaminants in subsistence foods
- Changes or increases in the prevalence of zoonotic disease in subsistence species
- Invasive species (competing with typical subsistence species)
- Changes to hunting patterns and the distribution or abundance of subsistence species

ARCTIC SEAL UNEXPLAINED MORTALITY EVENT (UME)

In 2011, over 100 bearded and ringed seals were found stranded in northern Alaska, many of which were dead or near death. The majority had physical abnormalities, such as hair loss, weakness, abnormal mental activity, and/or skin sores. Some Pacific walruses also exhibited these signs, though they did not seem to be as widely affected. Autopsies have been performed on 28 seals, but as of early 2013, a causative agent/process has yet to be found. Considerable concern has been voiced by local communities, much of which relates to the potential for transmission of this unknown syndrome to humans. Currently, there is no scientific evidence to link the two. Far fewer cases were observed in 2012, and many of those are believed to be survivors of the previous year's outbreak.

Gay Sheffield

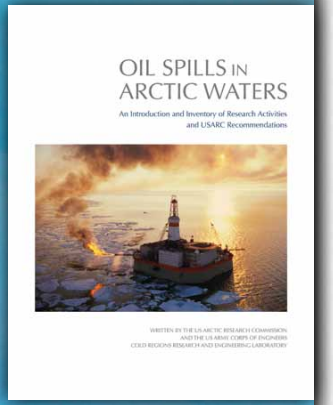
INDUSTRY SHARES ENVIRONMENTAL DATA

In 2011, Shell Exploration & Production, ConocoPhillips, and Statoil USA E&P Inc. signed an agreement with NOAA to enhance collaboration on Arctic ocean, coastal, and climate science. Industry agreed to share data on meteorology, coastal and ocean currents, circulation, and waves, sea ice, and biology; hydrographic services; and mapping. These data, with an estimated value in excess of $75M, will enable NOAA to monitor environmental conditions and provide useful products and services to inform responsible energy exploration activities. In turn, these products and services will provide a greater national capacity to effectively respond to and manage environmental disasters, such as oil spills. With just a few exceptions, spelled out in annexes to the agreement, the data will also be released to the broader scientific community.

This partnership is innovative because companies traditionally consider such data proprietary. Industry hopes to multiply the value of their data sets by releasing them. A broader group of scientists will combine the industry data, with other data, to develop a more comprehensive view of the Arctic environment, and to improve models for how it functions.

USARC encourages timely release of industry data and greater financial support to enable the development of websites and tools to improve access to and transmission of these data. The commission acknowledges the important initial steps taken by the Alaska Ocean Observing System to do so, and encourages additional support from NOAA.

USARC 2012 OIL SPILL WHITE PAPER



In 2012, USARC released its most recent white paper, *Oil Spills in Arctic Waters: An Introduction and Inventory of Research Activities and USARC Recommendations*.[5] The report addresses the question, "What research is being done on oil spills in ice-covered waters of the Arctic?" The report, coauthored with the US Army Cold Regions Research and Engineering Laboratory, is a compilation of recent research and contains recommendations for future work in areas such as oil spill response technologies for cleanup and recovery of oil, data management tools, and the fate of oil and its effects on the environment. This publication is third in a series of reports published by USARC to emphasize the importance of this topic.

[5] http://www.arctic.gov/publications/oil_spills_2012.html

OIL SPILLS IN ARCTIC WATERS

Given the growing likelihood of oil spills in the Arctic from both increased shipping and from oil and gas exploration and production, USARC calls for research to help prevent and respond to such events.

RESPONSE GAP ANALYSIS

A "response gap" is the period of time when oil spill response is not possible (or is rendered so inefficient as to be futile) because one or more limiting factors prevent an effective response (e.g., weather, sea ice, wave height, darkness, extreme cold, or technological limitations).

A response gap analysis should statistically consider the number of days that oil spill response is not possible or would be minimally effective.

An effective response to an oil spill on land or in the ocean requires (1) the ability to locate and track the oil, (2) access to the spilled oil (equipment capable of transporting people and equipment to the spill site and supporting the response operations), (3) environmental and oil spill conditions safe enough for people to operate response tools, and (4) response tools that are effective for the type of oil spilled and the environmental conditions encountered.

DAVIS STRAIT RESPONSE GAP ANALYSIS

As part of Canada's National Energy Board's Arctic Review initiative, SL Ross conducted a response gap analysis for the Canadian Beaufort Sea and Davis Strait. The objective was to "provide estimates about when and how long primary recovery and clean-up techniques of mechanical recovery, dispersants, and in-situ burning would be unavailable due to environmental factors such as adverse ice conditions, fog, darkness, higher sea states, etc." Many touted this work as a strong step in the right direction, while others felt it did not go far enough and urged greater inclusion of adverse conditions and further refinement of the study.

MICROBIAL GENETICS AND ARCTIC OIL SPILL RESPONSE

Naturally occurring "oil-eating" bacteria and other microbes have been found globally in the ocean. Well adapted to the environments in which they have evolved, these microbes use enzymes and oxygen in seawater to break down oil. The microbe communities, referred to as indigenous on a local or regional scale, often thrive and multiply wildly in response to increases in petroleum. Thus far, genetically engineered microbes have been no match for these natural specialists. The characterization of microbial communities before and after exploratory drilling offers unprecedented insight into how marine ecosystems respond to oil.

Researchers, such as those at Battelle, are using state-of-the-art metagenomics/metaproteomic strategies to understand how petroleum affects microbial population, diversity, and function. These techniques determine the genetics and protein profiles of entire microbial communities and may be applicable to yet-to-be-discovered microorganisms.

Results from these studies provide valuable information on microbial community responses to the presence of oil. In particular, metagenomic/metaproteomic approaches can be used to characterize locations prior to exploratory drilling and can subsequently be used to indicate a return to baseline levels of microbial diversity and function following drilling or after a release of oil into the environment.

SCENARIO PLANNING

"Scenario planning" has been described as a tool to identify constraints and opportunities that help people develop strategies to guide and respond to change. It is long range (>20 years out). Rather than being predictive, scenario planning encourages development of hypotheses about what could happen in the future given a set of conditions.

Five steps are nested within scenario planning:

1. Framing the issue, purpose, and scope
2. Assessing the available information (including drivers of change and uncertainties)
3. Developing and evaluating plausible scenarios
4. Planning and implementing an appropriate response
5. Monitoring the indicators and consequences of change

In Alaska, scenario planning has been applied to marine shipping, climate change, port site selection, and resource development issues. The National Park Service (NPS) is conducting a three-year Alaska climate change scenario project. To this end, NPS held five workshops to help park employees and others better understand climate trends, to anticipate future changes that may affect resources, assets, and operations in parklands, and to help identify a range of possible climate change response strategies that NPS might use to minimize negative impacts on park resources. USARC recommends the use of scenario planning to address additional challenges throughout the Arctic.

VESSEL TRAFFIC: BERING STRAIT

As interest in Arctic resources increases, so does vessel traffic. In the Pacific, and north of the Aleutian Islands, there is unlikely to be an area more heavily and densely transited than the Bering Strait. Greater vessel traffic poses a host of threats to local users and marine resources, including direct ship strikes, oil spills, noise, and hunting disturbances. USARC has helped develop possible solutions to these problems and has the following recommendations for short-term, achievable efforts:

SUBSISTENCE VESSEL SAFETY PILOT PROJECT

USARC supports placement of Digital Select Calling (DSC) receivers in boats operated by Alaska Natives, typically for subsistence purposes, in high vessel traffic areas of the Bering Strait (and potentially elsewhere). This equipment will allow the smaller vessels to see larger ships, and it may also allow them to see the smaller vessels (when data sharing is authorized by the hunters[6]). Strong search and rescue benefits are also conferred by DSC transmission of local vessel locations, which will be most useful to local communities. Finally, there is the possibility of gaining local, real-time information on the location of marine mammals with this system, which may be useful to transiting ships.

UNITED STATES COAST PILOT® IMPROVEMENTS

Improvement to US Coast Pilot® (an American navigation publication distributed yearly by NOAA's Office of Coast Survey) would increase vessel safety for mariners transiting the Bering Strait. Currently, the information in Coast Pilot® that is specific to this region is limited. Additional regional information (especially for the Bering Strait), gained through input from local residents, would greatly improve the data available to ships in the region and would decrease risk to mariners and vessels and, therefore, decrease risks of fuel/oil spills in the region.

[6] In the past, the proprietary nature of hunting areas and activities has been an issue with respect to subsistence vessel tracking. The option to turn the DSC on and off, at will, resolves this issue, though may at times result in a lack of signal from the hunter vessels.

USE THE NOAA/INDUSTRY AGREEMENT TO AUGMENT ARCTIC MARINE CHARTS

USARC is closely monitoring the NOAA-industry memorandum of agreement (see p. 11) to share data. USARC recommends using industry data where possible to improve marine charts in the Bering Strait and Arctic region, thereby increasing marine and human safety.

REVITALIZATION OF ARCTIC INDIGENOUS LANGUAGES

The majority of the world's indigenous languages are no longer used, and those in the Arctic region are no exception. A 2007 poll by the Alaska Native Language Center showed that over 20 indigenous languages are spoken in Alaska, but only 22% of indigenous Alaskans spoke their native language.

This erosion represents a tremendous loss of traditional knowledge, cultural diversity, and self-identity for indigenous peoples and for us all. In oral communities, language serves as the encyclopedia of knowledge, passed along the generations. It contains customary laws and practices that foster governance and survival. Addressing this issue in a 1998 article, Michael Krauss stressed the "urgent need … for realistic programs that include a commitment to intensive oral immersion."[7]

To protect and promote indigenous languages, action must be taken on several fronts. The Commission recommends research that explores effective educational mechanisms to preserve and develop indigenous languages, such as through revitalization and immersion programs for both children and adults.

While much work remains, USARC recognizes two recent successes. First, in May 2012, Alaska's Governor Sean Parnell signed into law a bill creating an Alaska Native Language Preservation and Advisory Council to assess the state of Alaska Native languages, reevaluate existing programs, and make recommendations on reorganizing them or creating new ones. Five experts were appointed in November, and the first formal meeting is scheduled for early 2013. The council, with an annual operating budget of about $600K, will work with state agencies and the University of Alaska to preserve and assess all languages, and it will also advise the governor on language issues.

Second, the Arctic Council's Sustainable Development Working Group has approved the Inuit Circumpolar Council's proposal to conduct a project titled, "Assessing, Monitoring and Promoting Arctic Indigenous Languages." The most recent effort in this project was a research development workshop, in Ottawa, Canada, in November 2012.

Herman Ahsoak

[7] Krauss, M. 1998. The condition of Native North American languages: The need for realistic assessment and action. *International Journal of the Sociology of Language* 132:9–21, http://dx.doi.org/10.1515/ijsl.1998.132.9.

UNITED NATIONS CONVENTION ON THE LAW OF THE SEA

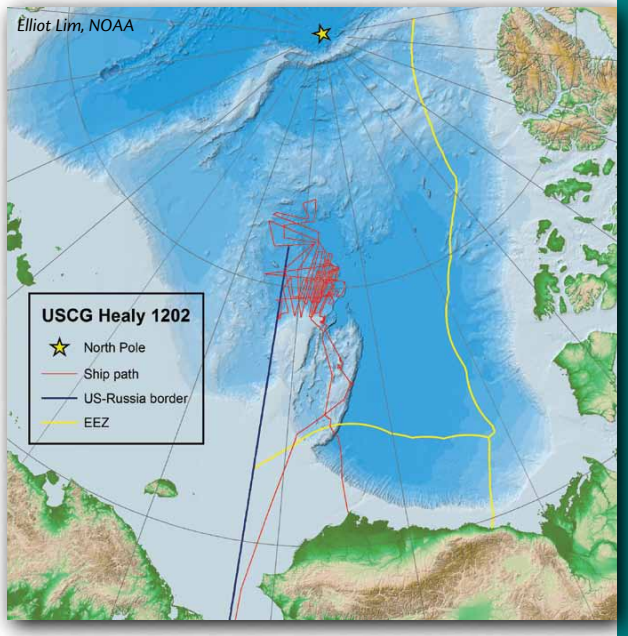
This treaty, largely drafted by Americans over 40 years ago, and supported by every US President since, promotes international cooperation and provides rules-based governance to resolve disputes and territorial limits. The European Union and 164 countries, including all seven other Arctic nations, have acceded to this treaty.

Although not yet party to the United Nations Convention on the Law of the Sea (UNCLOS), the United States has undertaken activities consistent with accession, and one of them has been a concerted effort to map offshore lands. In the Arctic, the United States recently completed its eighth mapping expedition since 2003 aboard the icebreaking US Coast Guard Cutter *Healy*. Besides the inherent value of knowing more about these undersea regions, the maps could also be used by the United States, were it party to UNCLOS, to formally delimit our nation's sovereign rights to an extended continental shelf that would stretch seaward beyond our 200-nautical-mile Exclusive Economic Zone (EEZ). US ownership of the resources on and beneath this shelf's seabed would be internationally recognized.

Accession is supported by a broad coalition, including US military leaders, most US Senators (including both from Alaska), energy, rare earth mineral and shipping industries, and nongovernmental organizations. We need to join the other nations that have committed to international cooperation and good governance.

USARC Recommendation: Ratify UNCLOS

The Commission continues to strongly advocate for Senate ratification of UNCLOS. While sovereignty is the primary focus of marine mapping efforts conducted by national programs to delimit the extended continental shelf, fundamental scientific advances are also made by simply exploring the Arctic seafloor. As only 10% of this area has been mapped to modern standards (multibeam sonar), basic discoveries are still being made, such as a huge submarine channel recently identified in Nautilus Basin, north of Alaska.



INTERNATIONAL ARCTIC RESEARCH

The importance of international cooperation is central to the USARC's mission to advance research efforts around the globe.

EUROPEAN UNION'S ARCTIC RESEARCH PROGRAMS

The European Union (EU) wants to develop stronger ties with the United States on Arctic research infrastructure. A bilateral workshop that is being discussed would focus on physical infrastructure, such as icebreakers and research stations, data sharing and standards, and "best practices" for logistical and operational support. EU programs, such as SIOS (Svalbard Integrated Arctic Earth Observing System), INTERACT (International Network for Terrestrial Research and Monitoring in the Arctic), and EISCAT (European Incoherent Scatter Scientific Association), have counterparts in the United States and in other Arctic nations that provide the potential for multilateral research opportunities and investment.

CANADA'S ARCTICNET AND THE CANADIAN POLAR COMMISSION

Canada's ArcticNet program studies the impacts of climate change and modernization on the coastal Canadian Arctic. The program, which has benefitted significantly from sustained funding from the Canadian government and the Canadian Foundation for Innovation, is successful because it effectively translates knowledge into action by bringing together many scientists, managers, and northern residents from a wide range of entities and by focusing efforts on integrated regional impact studies. It includes a robust interactive process of involving local people in science planning to ensure that useful research results that relate to real-world challenges are produced.

USARC has begun to more closely coordinate with the Canadian Polar Commission on planning and convening US-Canada meetings on Arctic oil and gas research, water and sanitation efforts, and promoting social and economic development across the North.

SWEDEN'S MISTRA ARCTIC FUTURES PROGRAM

The Swedish Foundation for Strategic Environmental Research (Mistra) spends over $30M per year on environmental issues and on means to enhance Sweden's competitiveness. A related outcome was the 2012 inauguration of Sweden's first Arctic Research Center at Umeå University. Mistra recently decided to support a second phase of their Mistra Arctic Futures program. The purpose of this four-year effort, which starts in 2014, is to expand knowledge of the Arctic's distinctive prospects for long-term sustainable development and to apply research results to policy. Because this program shares several traits with the NSF's recently developed Arctic Science, Engineering, and Education for Sustainability program, USARC encourages closer coordination between the United States and Sweden on Arctic sustainability research.

THE INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE'S FIVE YEAR PLAN

USARC applauds recent developments in the revitalization of IARPC. Release of IARPC's *Arctic Research Plan: FY2013-2017*[8] is a major accomplishment. This five-year plan, called for in the Arctic Research and Policy Act of 1984 (Public Law 98-373), is firmly rooted in the goals and objectives put forward by USARC.

The plan is the first one to be released by President Obama's Science Advisor Dr. John Holdren in light of President Obama's July 22, 2010, memorandum that made IARPC a subcommittee of the National Science and Technology Council Committee on Environment, Natural Resources, and Sustainability.

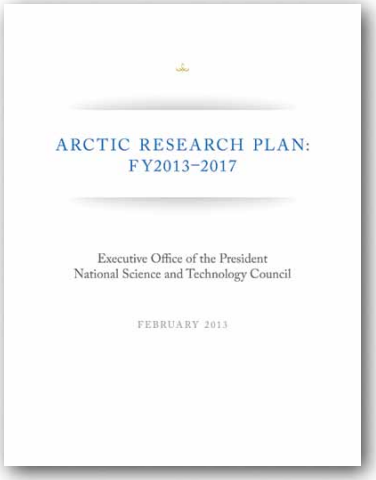
Dr. Subra Suresh, an ex officio USARC commissioner and the chair of IARPC, transmitted the plan to Dr. Holdren on behalf of 13 federal agencies, departments, and offices in IARPC. In so doing, Dr. Suresh stressed the importance that the United States "serve as a global leader in Arctic research."

The plan includes recommendations for nationally coordinated Arctic research objectives. The seven overlapping research areas that form the basis of a national policy for Arctic research are:

1. Sea ice and marine ecosystems
2. Terrestrial ice and ecosystems
3. Atmospheric studies of surface heat, energy, and mass balances
4. Observing systems
5. Regional climate models
6. Adaptation tools for sustaining communities
7. Human health

Interdisciplinary work and interagency collaboration will be central to achieving the goals identified for these research areas, which also underpin the objective of local sustainability and the welfare of Arctic communities. Twelve implementation teams involving 14 federal agencies, and nonfederal partners, constituting 240 participants, have already begun to work on the activities associated with the plan's research themes.


Matthew Ayre



[8] http://www.nsf.gov/od/opp/arctic/iarpc/arc_res_plan_index.jsp

THE ARCTIC UPDATE AND ARCTIC SCIENCE PORTAL

ARCTIC UPDATE

To increase communication on Arctic research issues, the Commission publishes a daily "Arctic Update" electronic newsletter. USARC distributes this newsletter through a listserv that is freely accessible to all through self-subscription. The update is published on all federal workdays, and past issues, back to November 2010, are archived on the USARC's website (http//www.arctic.gov). Each edition consists of four sections: Today's Events, Media, Legislative Action, and Future Events. The update currently has over 1,000 subscribers, and USARC seeks feedback on ways to improve this product.


ARCTIC UPDATE

THE US ARCTIC RESEARCH COMMISSION DAILY EMAIL NEWSLETTER

February 15, 2013

Today's Events

The House is expected to complete consideration federal pay legislation and consider a resolution condemning North Korea for testing a nuclear device. The Senate is not in session.

Media

Murkowski Urges Secretary of State Kerry to Maintain American Leadership, Momentum in Arctic. Senator Lisa Murkowski reached out to new Secretary of State John Kerry, asking him to prioritize America's Arctic engagement as his predecessor did, with Murkowski becoming the first U.S. Senator to participate in the Arctic Parliamentarians' conference in 2011 with former Secretary of State Clinton - making a high-profile national commitment to Arctic issues. In a letter to the Department of State, Senator Murkowski call upon expanded U.S. leadership in a region currently at a crossroads - with Arctic waters opening and international policies being created. Alaska Business Monthly

Aberdeen Scientists Trawl Arctic Seabed for Antibiotics as World Faces 'Apocalypse.' The desperate search for new life-saving antibiotics has reached new lows, as scientists dredge the Arctic and Antarctic seabed to try to find new medications. Dame Sally Davies, England's chief medical officer, recently warned that the world is facing an "apocalyptic scenario" as we are fast running out of antibiotics.The over-use and reliance on antibiotics has meant that many diseases are now resistant to them. International Business Times

Arctic Ice Loss Causing Big Changes. Last year's record loss of Arctic sea ice is already causing big changes for plants and animals that scientists are just starting to understand, according to

ARCTIC SCIENCE PORTAL

In an attempt to better connect researchers, decisions makers, and the general public with Arctic information, USARC has created a website portal that can be thought of as a library of links (URLs) to websites where Arctic data are made publicly available. This nascent portal directs users to appropriate websites based on topic and short description (e.g., Arctic weather, sea ice conditions, fisheries information, Arctic oceanography, oil spill response research). The portal is neither an interactive website where data from one or more sources can be combined, integrated, or analyzed, nor is it a site where data are archived. Instead, it is a tool that directs users to available information on the Arctic sorted into five main categories: Society, Environment, Economics, Reference, and Organizations. With additional effort and based on feedback from the community of users, the Commission will continue to expand and improve the portal. USARC's goal is to facilitate access to the broad array of information available on the Arctic.


About | Site Index | Search | Feedback | Home | USARC

ARCTIC SCIENCE PORTAL

Connecting researchers, decision makers, and the general public with Arctic information.

Society | Environment | Economics | Reference | Organizations | Glossary | Org Chart

Welcome to the Arctic Science Portal

At a time when the world is increasingly interested in the Arctic, and when many decisions are being made by public agencies, private industry, and individuals that will impact the development of this region, it is essential that relevant research and information be easy to find and access.

To facilitate access to the broad array of data available on the Arctic, this portal can be thought of as a library of links (URLs) to websites where Arctic data are made publicly available. The portal directs users to appropriate websites based on topic and short description (e.g., Arctic weather, sea ice conditions, fisheries information, Arctic oceanography, oil spill response research). The portal is neither an interactive website where data from one or more sources can be combined, integrated, or analyzed, nor is it a site where data are archived. Instead, it is a tool that directs users to available information on the Arctic sorted in the main categories of Society, Environment, Economics, Reference, and Organizations.

Please send your feedback on the Arctic Science Portal to info@arctic.gov.

Society | Environment | Economics | Reference | Organizations | Glossary | Org Chart
About | Site Index | Search | Feedback | Home | USARC

EMERGING TOPICS IN THE ARCTIC

Recognizing the rapid rate of Arctic change, the eight Arctic nations are striving to better understand and more accurately forecast future conditions and to anticipate the challenges that lie ahead. Most of these nations have adopted comprehensive national policy statements to guide their strategic investments and manage their resources. In order to do so, they are investing in scientific research, which provides information to decision makers. While not attempting to be fully comprehensive, USARC highlights several emerging topics of interest.

MARINE DEBRIS

Recent research has found that plastic litter in the deep Arctic Ocean doubled between 2002 and 2011. Sea organisms colonized nearly 70% of the plastic waste.[9] Another study found that human litter more than doubles the rafting opportunities for invasive species.[10] The Japanese government estimates that the recent tsunami swept roughly 5 million tons of debris into the Pacific Ocean, leaving 1.6–1.7 million tons floating off the coast of Japan. NOAA anticipates that throughout the winter of 2012–2013, seasonal changes in North Pacific winds and currents will cause marine debris of mixed types to wash ashore on western coastlines of North America, possibly carrying nonnative species that may disrupt local ecosystems. A small amount of funding has been made available to address the situation, but greater resources will be needed to adequately respond.

METHANE

New research from the University of Alaska Fairbanks supports the theory that as climate change progresses and greenhouse gases warm the atmosphere, permafrost thaws, methane is released, and the planet warms.[11] This research also reveals that an underappreciated source of methane—ice-capped, organic-rich geologic deposits—is thawing as well. Additional research will reveal specifically how this large carbon reservoir may become an active source of greenhouse gas, adding to the direct contributions from human activity.

[9] Bergmann, M., and M. Klages. 2012. Increase of litter at the Arctic deep-sea observatory HAUSGARTEN. *Marine Pollution Bulletin* 64:2,734–2,741, http://dx.doi.org/10.1016/j.marpolbul.2012.09.018.

[10] Barnes, D. 2002. Biodiversity: Invasions by marine life on plastic debris. *Nature* 416:808–809, http://dx.doi.org/10.1038/416808a.

[11] Walter Anthony, K.M., P. Anthony, G. Grosse, and J. Chanton. 2012. Geologic methane seeps along boundaries of Arctic permafrost thaw and melting glaciers. *Nature Geoscience* http://dx.doi.org/10.1038/ngeo1480.


Heather Crawford

CHILDHOOD OBESITY

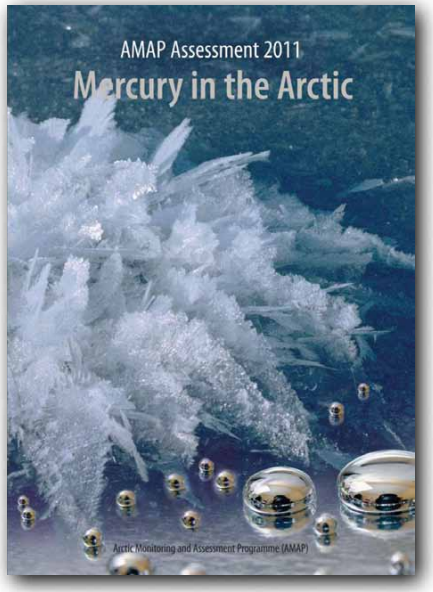
A recently published study shows that obesity now tops hunger as the world's biggest food problem.[12] Alaskans, however, have reason to be hopeful. Research shows that obesity in Anchorage schools showed a slight, but statistically significant, decrease between 2002 and 2003 and 2010 and 2011.[13] This is positive news, as obesity is considered a major public health threat in greater Alaska, with obese children more likely than children of healthy weight to experience problems such as diabetes and asthma. During the intervening time between the assessments, the Anchorage School District banned the sale of junk food and soda in schools, adopted a wellness policy, and increased the amount of elementary physical education.

[12] The Global Burden of Disease Study 2010 (GBD 2010).

[13] http://dhss.alaska.gov/dph/Chronic/Documents/Publications/assets/ChroniclesV4-2.pdf

[14] http://amap.no/documents/index.cfm?action=getfile&dirsub=&filename=86253_mercury_LO_FINAL-SEC.pdf

[15] Fisher, J., D. Jacob, A. Soerensen, H. Amos, H. Steffen, and E. Sunderland. 2012. Riverine source of Arctic Ocean mercury inferred from atmospheric observations. *Nature Geoscience* 5:499–504, http://dx.doi.org/10.1038/ngeo1478.



MERCURY IN THE OCEAN

The Arctic Council's Arctic Monitoring and Assessment Program recently published a detailed scientific assessment on mercury in the Arctic, updating previous assessments in 1998 and 2004.[14] The report showed a rise in the mercury concentrations in the tissues of certain Arctic marine species, in certain regions. A ten-fold increase in mercury levels in top predators has been observed over the past 150 years. A recent study form Harvard University points to five circumpolar rivers that carry toxic mercury north as a major source.[15] Mercury is considered a persistent bioaccumulative toxin because it remains in the environment without breaking down, and it concentrates as it travels up the food chain. The authors point out the potential implications of increasing mercury to local subsistence consumers and recommend a greater understanding of the sources of mercury to the Arctic Ocean and how these levels are expected to change in the future.

ARCTIC IN THE NEWS

LAW OF THE SEA AND EXTENDED CONTINENTAL SHELF CLAIMS

Migration of fish stocks and the US Geological Survey's estimate that the Arctic holds up to 13% of the world's undiscovered oil and 30% of its gas[15] have been noticed by the media in Arctic nations involved in Extended Continental Shelf (ECS) delimitation. As the United States has yet to ratify UNCLOS, we are excluded from legal processes in which other Arctic states, all parties to the treaty, are engaged. UNCLOS prescribes a seazone (EEZ) for every maritime state that extends 200 nautical miles from its coast. If the continental shelf extends beyond the EEZ, based on criteria in UNCLOS Article 76, then a coastal state may expand its ECS to 350 nautical miles offshore. The state has sovereign rights relating to natural resources on the seabed and in the subseafloor of the ECS. USARC, among many others, continues to urge Senate ratification of UNCLOS.

[15] http://pubs.usgs.gov/fs/2008/3049/fs2008-3049.pdf

CHINA'S ARCTIC INTERESTS

While not an Arctic nation, China is strengthening international relationships to further its interests in research, resources, commerce, and Arctic shipping. China's *Xuelong*, the world's largest nonnuclear icebreaker, recently returned from its fifth Arctic mission for the Polar Research Institute of China, and a new icebreaker is under construction. Though recent reports would suggest a less aggressive approach by China to Arctic resources, the country remains keenly interested in obtaining Permanent Observer status on the Arctic Council, the principal international forum for Arctic governments and indigenous peoples to address Arctic issues. China's request, submitted in 2009, has yet to be granted, and the next opportunity to do so would be at the May 2013 meeting of the Arctic Council ministerial.

Ian Boardman; Copyright: Commonwealth of Australia

THE LAUNCH OF R/V *SIKULIAQ*

On October 13, 2012, the 261-foot R/V *Sikuliaq* (pronounced "see-KOO-lee-ack," which means "young sea ice" in Inupiat) was launched in Wisconsin. The American Recovery and Reinvestment Act of 2009 provided $200M for the vessel, which is being built by the Marinette Marine Corporation, and will be owned by NSF and operated by the University of Alaska Fairbanks School of Fisheries and Ocean Sciences. In January 2014, the ship, the first built for NSF in over 30 years, will arrive at its home port, the Seward Marine Center in Seward, Alaska. This double-hull vessel is rated for year-round operations in ice, can accommodate up to 26 scientists, and can break ice up to 2.5 feet thick. It is outfitted with the latest technology that will allow advanced vessel control and broadband satellite communications. The vessel will enable complex multidisciplinary research activities, such as the study of polar ecosystems, high latitude fisheries, and ocean acidification.

Todd Paris

STAY INFORMED

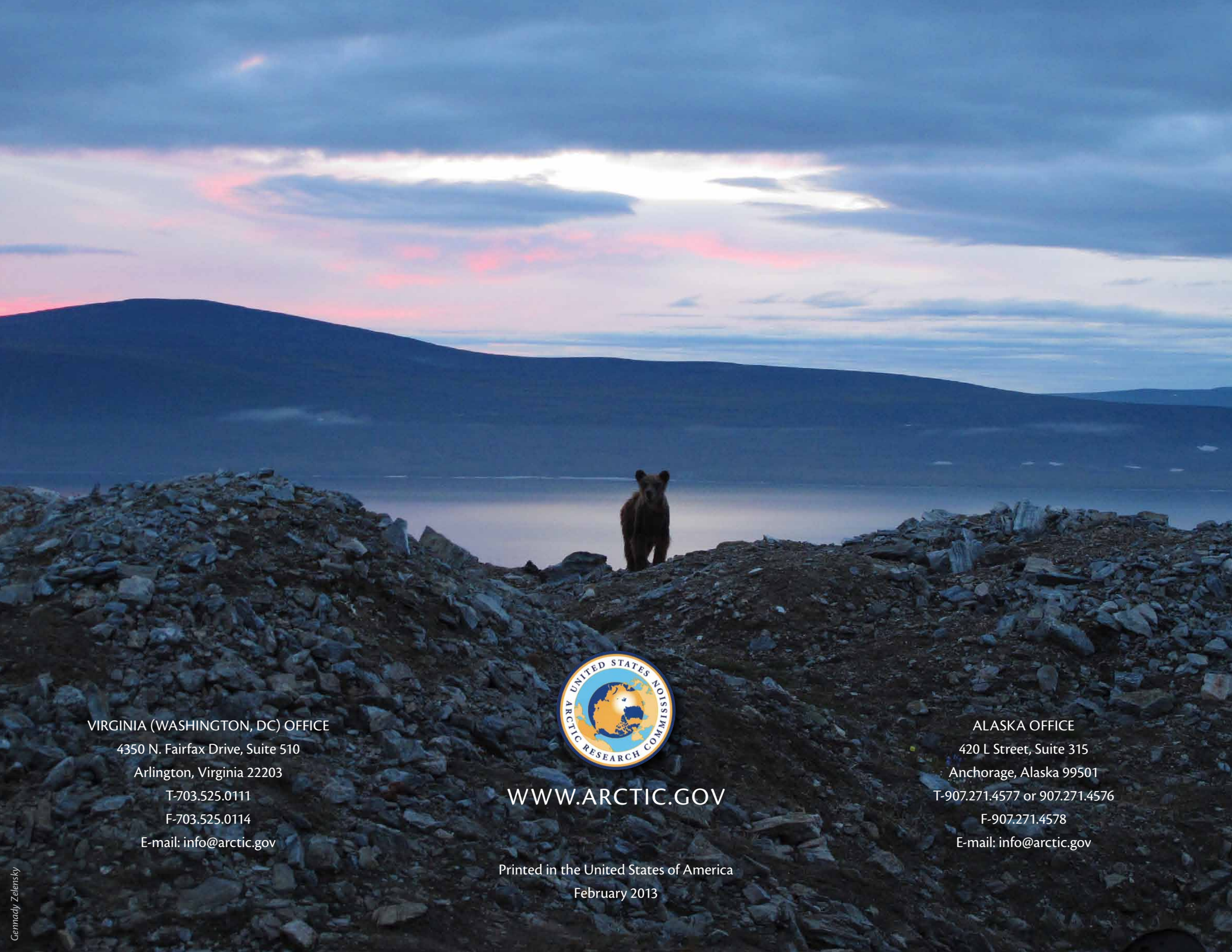
Stay informed about the Arctic through USARC's:

- Arctic Science Portal: http://www.arctic.gov/portal
- Facebook: http://www.facebook.com/arcticresearch
- Twitter: USARC@US_ARC
- Daily Arctic Update: http://www.arctic.gov/arctic_update_archive/index_general.html

THE LOCAL ENVIRONMENTAL OBSERVER NETWORK


Herman Ahsoak

As Alaska's climate changes, locals are reporting greater incidents of unusual weather and environmental phenomena. The Alaska Native Tribal Health Consortium's mapping system, the Local Environmental Observer (LEO) network, allows local experts to share their knowledge and environmental observations. Monthly maps on LEO track air quality, erosion, food and water security, animal sightings, insects, and more. The site serves as a repository for locally generated environmental reports and provides answers to people in rural Alaskan communities with questions about their changing environment. LEO connects traditional knowledge, science, technology, and current events, and the maps share this information. More information can be found at http://www.anthc.org/chs/ces/climate/leo.



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